Reports to the President

For the year ended
June 30, 1998

MIT
Massachusetts
Institute
of Technology

Reports to the President

The *MIT Reports to the President 1997-98*
was published by the
MIT Communications Office
Public Relations Services, Room E28-100
77 Massachusetts Avenue
Cambridge, Massachusetts, 02139-4307.

Copies of the reports are available
in print and electronic formats.
For information on ordering a print copy,
call the Communications Office
at (617) 253-2635.

The publication is also available
via the Internet at the following
World Wide Web address:
http://web.mit.edu/communications/pres98/

For the year ended
June 30, 1998

MIT Massachusetts
Institute
of Technology

THE CORPORATION 1997-98

Chairman: Alexander V. d'Arbeloff
President: Charles M. Vest
Treasurer: Glenn P. Strehle
Secretary: Kathryn A. Willmore

Life Members

Paul M. Cook, Breene M. Kerr, Kenneth H. Olsen, W. Gerald Austen, Edward E. David, Jr., John S. Reed, Mary Frances Wagley, Emily V. Wade, Charles H. Spaulding, Shirley A. Jackson (on leave), Frank Press, Angus N. MacDonald, Raymond S. Stata, Samuel W. Bodman, James A. Levitan, Alexander W. Dreyfoos, Jr., Morris Tanenbaum, Paul E. Gray, George N. Hatsopoulos

Members

Denis A. Bovin, John M. Hennessy, Michael M. Koerner, Claudine B. Malone, William S. Edgerly, Lawrence A. Hough, Brian G. R. Hughes, David H. Koch, Ronald A. Kurtz, John A. Morefield, Jr., Robert A. Muh, Kenichi Ohmae, Darcy D. Prather, James A. Champy, Edie N. Goldenberg, Richard A. Jacobs, Judy C. Lewent, Patrick J. McGovern, A. Neil Pappalardo, Peter M. Saint Germain, Richard P. Simmons, Mark Y. D. Wang, John K. Castle, Arthur Gelb, Barbara A. Gilchrest, Mark E. Lundstrom, Antonia D. Schuman, R. Gary Schweikhardt, George N. Butzow, Josephine S. Jiménez, L. Robert Johnson, Dana G. Mead, Paul Rudovsky, Theresa M. Stone, R. Robert Wickham, Elliot K. Wolk, Gregory K. Arenson, Osie V. Combs, Jr., Norman E. Gaut, Lissa A. Martinez, DuWayne J. Peterson, Jr., Gerhard H. Schulmeyer, Elisabeth A. Stock, Susan E. Whitehead, Robert E. Wilhelm

President of the Association of Alumni and Alumnae

Robert M. Metcalfe

Representatives of the Commonwealth

Acting Governor: The Honorable, Argeo Paul Cellucci
Chief Justice of the Supreme Judicial Court: The Honorable Herbert P. Wilkins

Life Members Emeriti

Cecil H. Green, George P. Gardner, Robert C. Gunness, Laurance S. Rockefeller, Luis A. Ferré, Semon E. Knudsen, Irénée du Pont, Jr., J. Kenneth Jamieson, John C. Haas, George W. Thorn, Ralph Landau, Carl M. Mueller, Richard L. Terrell, D. Reid Weedon, Jr., Ellmore C. Patterson, Frank T. Cary, Norman B. Leventhal, Harold J. Muckley, David S. Saxon, Colby H. Chandler, Mitchell W. Spellman, Joseph G. Gavin, Jr., Edward O. Vetter, T. A. Wilson, Louis W. Cabot, Christian J. Matthew, Howard W. Johnson

TABLE OF CONTENTS

PRESIDENT

At this time during each year of my tenure as president, I have written an essay of relevance to MIT, but speaking as well to a larger audience beyond our campus This year my report is directly addressed to the MIT community alone, because I believe that we have reached a watershed and must craft a more explicit vision of our future and an intellectual and financial plan for realizing it. What follows is a personal statement and framework, yet one that is informed and influenced by many others. The work of many of my Faculty, Administration, and Corporation colleagues is embedded within it. I hope it is useful.

FOREWORD

MIT is the quintessential American research university, and the world's preeminent institution focused primarily, though not exclusively, on science and engineering. We are dedicated to serving our nation and world by discovering fundamental knowledge of the natural, social, economic, and aesthetic realms; by working in concert with others to bring this knowledge to bear on the world's great challenges; and by preparing a highly talented and diverse group of students to deeply understand science and engineering and developing their ability, values, and passion to apply this knowledge wisely and creatively to the betterment of humankind.

We can take great pride in our accomplishments, and we do. Yet this is precisely the moment when we must reach for our promise. The times and the needs of the world are changing rapidly, and in the years ahead MIT must redefine itself and the very nature of the research university if we are to best serve our students, our nation, and the global society of which we are a part.

The Cold War era has receded into history, and we find ourselves in a new, fast-paced, globally-interconnected, knowledge-driven age. This age presents its own instabilities and dangers, but also is rich in promise and opportunity driven by an unprecedented acceleration of knowledge, understanding, and technology. In the coming century, as the information and genetic revolutions gather momentum, and great environmental challenges loom ever larger, society will, as always, look to MIT graduates, faculty, and staff for fundamental research, and for creative understanding and application of science and engineering. But society also will expect MIT and its people to play an increasingly important leadership role in many dimensions of world affairs. We have begun to prepare for this by increasing our understanding of, and partnership with, business, industry, and governments in new endeavors of learning, research, and problem solving. This will be an important element of the research university of the future. It is an exciting moment for us.

LOOKING TO THE FUTURE

MIT is uniquely poised to be the preeminent university in shaping and serving an emerging new age. We are blessed with an intellectual environment of remarkable creativity – generated by the synergy among world-class programs in science, engineering, and management together with extraordinary programs in the arts, humanities, architecture, and the social sciences. This provides an ideal educational setting at the dawn of the 21st century. Our faculty, students, staff, and graduates will make breakthrough discoveries and redraw the intellectual map in areas that will define the quality of our future. We will bring our talents to bear on the toughest challenges and most exciting opportunities before us. We will reinvent ourselves and our institutions along the way.

Our plans rest on several assumptions about the future – of science, society, and universities themselves. What are some of these assumptions?

- First, the end of science is nowhere in sight. Indeed, we stand at the brink of many new scientific adventures. Understanding the brain and the mind, for instance, will be one of the most profound and productive scientific ventures in the next century – one that will have great implications for maximizing human potential and for living long and living well.

- The strength of economies, regions, and nations will be determined in large measure by technological and organizational innovation. This innovation must be built upon a foundation of new research in science, engineering, and management.

- Humankind's advances will depend increasingly on new integrative approaches to complex systems, problems, and structures. Design, synthesis, and synergy across traditional disciplinary boundaries will be essential elements of both education and research. Engineering, for example, will provide instruments and techniques to facilitate the rapid advancement of the biological and physical sciences. Biology and physics, in turn, will create revolutionary new approaches to engineering and production, as well as to health care.

- Research universities will grow in importance as the primary source of fundamental research and scholarship in the United States.

- The need for leaders to solve the complex problems of the modern world requires a new paradigm for the research university itself – one in which industry, academia, and governments work together in effective partnership. For example, the quality of our environment, the sustainability of economies, and the efficient use of our material and energy resources, will depend upon sound scientific and engineering knowledge leading to action by all three partners.

- The flow of information will be instantaneous and ubiquitous, as the technology, applications, and benefits of computer, information, and intelligence sciences evolve, expand, and become more central still to human activities.

- Information technology will dramatically alter learning and working. Many faculty will change their teaching role from one of lecturing to one of shaping and guiding the use of electronically-available information. They will lead team efforts in both campus-based and electronic communities.

- Still, the residential campus experience will remain the best and most important form of education of our most talented youth.

- Our security and quality of life will require that all people work together to form a coherent, productive society, built on common values as well as rich diversity. This will not occur unless it is fostered within our schools and universities.

- Finally, the future will demand new leaders – leaders with a deep understanding of science and engineering who possess the ability, values, and desire to apply their knowledge wisely and creatively to the betterment of humankind.

A VISION FOR MIT

Upon the strong foundation of our institutional heritage, but informed by these assumptions about the future, we can build a vision – a set of defining goals – for MIT. MIT can and must:

- attract the best and brightest students and faculty and support them with a stimulating and effective living and learning environment;

- be committed to excellence, yet thrive on change;

- be steeped in fundamental scientific inquiry, yet lead the new, integrative modes of scholarship, learning, and action;

- be dedicated to scholarship, inquiry, and criticism, yet adept at bringing together industry, government, and academe to explore and solve major problems facing the world;

- recognize that its educational, scholarly, and leadership goals, as well as the quality and effectiveness of its intellectual dialogue, require the continued presence and engagement of strong programs in the arts, humanities, and social sciences;

- be dedicated to expanding technological and organizational capabilities, yet be concerned with exploration of attendant moral and ethical issues; and

- serve our nation first and foremost, yet recognize that to do so now requires substantial global engagement and cooperation as well as competition.

These, I believe, are the essential goals that will enable MIT to be the quintessential research university of the next century, as it has been in the past.

MIT IN THE '80s AND '90s – STRENGTHS TO BUILD UPON

The 1980s were a decade of remarkable accomplishments at MIT: We developed an exceptionally diverse student body; maintained and strengthened the excellence of our programs across all five Schools; continued a deep, though often insufficiently recognized, commitment to undergraduate education; led American academia in internationalization, through such activities as the MIT Japan Program; established a new paradigm of education, research, and industrial interaction through the Leaders for Manufacturing Program; launched Project Athena, the first really large-scale academic computing environment; embarked on an unusual and highly successful venture with a newly created, affiliated research organization – the Whitehead Institute; entered a new level of private fund raising through the successful *Campaign for the future*; and realized one of the very best investment performances among university endowments.

Our path through the 1990s has been marked by exciting progress in numerous aspects of education, research, and campus development, despite the pressures of shifts in federal research funding policy, the world economy, and public support of higher education and research.

The following highlights offer a picture of an energetic, dynamic institution oriented toward and investing in the future.

SCIENCE

MIT's excellence in mathematics and the basic sciences is a defining strength of our institution. In the 1990s, the life sciences have continued and expanded their world-class excellence, and now play a major role in the education of all MIT students. The emergence of neuroscience and the study of the mind and brain as major new intellectual arenas is reflected in the establishment of the Center for Learning and Memory and the reorganization of Brain and Cognitive Science as a department in the School of Science. The development last year of the "atom laser" is yet another example of how faculty at MIT are inventing the future.

ENGINEERING

At the same time, we have initiated a second revolution in engineering education, characterized by increased emphasis on integrative aspects of engineering and real-world considerations involving production, process and design. We continue to be at the heart of the information technology revolution through many endeavors such as the leadership and management of the World Wide Web. Of particular note is the establishment of the new Division of Bioengineering and Environmental Health, which organizes faculty, research, and education outside of traditional disciplines in recognition of the future role of cell and molecular biology in engineering.

MANAGEMENT

The MIT Sloan School of Management now is clearly recognized as being in the first rank of business schools. It has astutely built synergy with many other schools at MIT, totally redesigned and expanded its MBA program, emphasized entrepreneurship in new ways, and established coherent new international initiatives, such as the World Business Curriculum project with Tsinghua and Fudan Universities in China. Its eminence in quantitative and international matters and its strong interfaces to technology are excellent comparative advantages today.

HUMANITIES, ARTS AND SOCIAL SCIENCES

The role of the humanities, arts, and social sciences has expanded in recognition that these are essential intellectual and cultural components of the creative spirit and ethos of education and scholarship at MIT. The humanities and social science faculty have played leadership roles in extending the global reach of many of our programs and in broadening the perspectives and expertise needed to engineer, manage, and set policy. MIT's world-renowned strengths in economics and linguistics continued to build and evolve. Writing and the performing arts have continually expanded their importance and, in addition, have played a notable role in developing an appreciation of

the role of diversity in living and learning. The visual arts have evolved in new directions and have expanded their strength and centrality in our institution.

ARCHITECTURE AND PLANNING

The School of Architecture and Planning has undergone a renaissance, as it has begun to define the new technology-based modes of practice and education. There is a rededicated emphasis on design in Architecture; Urban Studies and Planning is at the forefront of using technology to inform the planning, management, and delivery of services in urban settings; the Media Laboratory is better integrated into the activities of the School; and the School has established new and increasingly important links to other elements of MIT.

INTERDISCIPLINARY PROGRAMS

A number of large, highly interdisciplinary programs have been formed across the Institute, many of which focus on the environment. The Joint Program on the Science and Policy of Global Change, the Alliance for Global Sustainability, and other activities have set new standards of effectiveness in bringing sound scientific understanding and more effective policy contributions to important discourse among industry, government, and academia on a national and international basis. Educational and research programs requiring effective partnership between the School of Engineering and the Sloan School of Management emerged as a nearly unique comparative advantage of MIT. We have made progress toward more efficiently and effectively realizing our full potential in bringing new scientific and engineering techniques to the practice of human medicine, but more remains to be done in this regard.

STUDENT SUPPORT

The office and role of the Dean of Students and Undergraduate Education was dramatically changed by combining all elements of service for our students: Academic support, admissions, athletics, bursar, career planning, counseling, dining, financial aid, housing, and student records were combined into a single, more integrated organization. Through this change and through substantial process reengineering, we are establishing an organization to support the improvements in the quality of student experience that will be important to accomplish in the years immediately ahead.

CAMPUS DEVELOPMENT

Over the years, MIT's physical plant has evolved through a combination of new construction, periodic major renovations, and rework of existing buildings. During the 1990s, we constructed the Biology Building, widely regarded as the best facility for biological research and education in the world; completely renovated Buildings 16 and 56; rebuilt the interior of our oldest residence hall, Senior House; constructed the Tang Center for Management Education; and carried out a prudent schedule of maintenance and reuse. There is much to be proud of on our campus, but much remains to be done if our campus *in toto* is to inspire, reflect and support the excellence and creativity of MIT and function better as a means for enhancing the student experience and building a sense of community and pride of place.

CHALLENGES

Our greatest challenge is to bring to MIT the best students, the best faculty, and the people and infrastructure to support them. And we must provide the physical facilities and information infrastructure that enable them to live, learn, and work within an effective and inspirational environment. Increasingly, we must compete with other, often more heavily endowed, institutions for these students and faculty. We must make continued investments in people and facilities in order to remain great, yet our financial underpinnings and opportunities are changing rapidly.

MIT, more than any other university in America, built its financial structure on the foundation of federal support. In the early 1990s, federal support for our universities in general, and MIT in particular, began to erode. Despite this, the MIT faculty succeeded in maintaining strong research support. However, a series of changes in federal cost reimbursement policy, including the reduction of financial support of graduate students, and other mechanisms for shifting costs of research from the federal government to universities, seriously reduced our operating revenues. Financing MIT's future requires a rebalancing of public and private support.

There were other sea changes during the decade as well. The pressures of world economic competition shortened both vision and time horizons in research and development. The public became deeply concerned about rising costs of education, both real and perceived. The arts and humanities were devalued. Continuing racial and economic

schisms in our society, together with failures in many elements of American primary and secondary education, reduced educational opportunity for many and thereby deprived society of their full talents. The costs of continuing our deeply-held commitment to need-blind admissions and need-based financial aid grew.

The support, authority, and convening power of MIT must be continuously earned, and this requires that we recognize and address these realities as we strike out on the path to our future.

THE PATH TO THE FUTURE

Our path to the future will be guided by our vision and assumptions. We will chart a course to meet the priorities established by our academic leadership and will address the challenges and obstacles before us. In so doing, we also will be informed by various task forces and councils which have worked throughout the past two years to chart our course and to outline the principles and directions that will lead to an enhanced campus environment for learning, working, and living.

ACADEMIC PRIORITIES

As always, the new intellectual directions of the Institute will be determined by the faculty. Our institutional goal is to create the infrastructure of services, facilities, and support to enable them to pursue their ideas and activities in as vigorous a manner as possible.

Even though evolving faculty pursuits will drive our intellectual future, there is a clear sense of several overarching themes that characterize much of the Institute's emerging research and educational agendas. It is clear, for example, that our faculty have every intention of leading the continuing revolutions in information technology and the intelligence sciences; in the study of neuroscience, the brain, and the mind; in basic biology and its application to engineering and medicine; in the environment and sustainable development; in 21st century business practice and entrepreneurship; in understanding the nature and social impact of new digital media; in visual and performing arts; in the understanding, design, and operation of large-scale, complex systems; in blending technology, management, economics, and policy; and in the development of new modes of teaching and new uses of technology to enhance learning.

Our faculty's commitment to deep, fundamental research and scholarship is matched by a desire to transfer new knowledge, insights, and technologies into the world in important and positive ways. We will pursue a number of strategic educational and research initiatives that will create a new paradigm for the research university – one dedicated to bettering the human condition through partnerships among industry, government, and academia. These partnerships will have the goals of improving our environment, advancing health, creating new products and services, and enhancing productivity. Many of these initiatives will be global in scope and will increase the exposure of our students to different modes of thought and activity throughout the world.

We must clearly define our place in the changing galaxy of educational institutions, activities, and alliances. There can be no doubt that emerging information technologies with enormous storage, bandwidth, and display capabilities will profoundly affect the way we all work, live, and learn. Institutions and groups of institutions will provide various educational services, from specific training and the updating of skills to high-quality degree programs. MIT will define an appropriate balance between using these new capabilities to help educate those beyond our campus and bringing a wealth of information and interaction to those on our campus. We will do both, but likely will emphasize the latter. We must be certain that we define the most advanced concepts and operate at the cutting edge of new learning modalities.

Above all, MIT wants to make it possible for its remarkable students to achieve their full potential as scholars, innovators, and leaders. The residential campus will remain the best environment for the education of the most talented young men and women, and it is they we must continue to attract.

THE LEARNING ENVIRONMENT

We will take a number of steps to enhance the quality of life for students, faculty, and staff, recognizing the Task Force on Student Life and Learning's formulation of an MIT education built on a triad of academics, research, and community. The learning environment will be enhanced by specific commitments of resources to improving the freshman year, expanding and improving housing for undergraduate and graduate students, enhancing our athletic

facilities, and establishing a cutting-edge computing and digital media environment as well as state-of-the-art library/information facilities. The arts will further strengthen their place in MIT culture and experience. We will raise a major endowment for enhancing undergraduate education and student life, create new alternative pathways through the MIT undergraduate curriculum, and increase opportunities for leadership training and experiences.

RESIDENTIAL CAMPUS LIFE

The magic and synergy established by bringing together bright, motivated, interesting, and dedicated young men and women in a residential campus is the essence of the best in American higher education. To do so within an intense research university that additionally enables them to be part of many electronically-extended learning communities, both within the campus and throughout the world, creates the potential for an unparalleled social and educational experience. Yet student years remain times of intense personal development, value formation, and individual exploration and growth.

We will draw on the many strengths of our diverse housing opportunities in campus residence halls, fraternities, sororities, and independent living groups to create a diverse yet enhanced and better-integrated residence system. The living experience must simultaneously nurture and support individual needs and build an extra-ordinary common experience that defines MIT and bonds all to it. Students, faculty, alumni/ae, and administrators will work intensely to forge this system and its detailed objectives as we move toward Fall 2001. From that year forward, greater coherence of purpose and community for our students' years here will be manifest, with all MIT undergraduates sharing the experience of residing on campus during their first year.

The distance between living and learning at MIT has become too great. For many, the components of education have become too compartmentalized. Building on the foundation of the report of the Task Force on Student Life and Learning, we must assure every student of personal engagement with scholars and advisors, and with more inherent avenues for serious dialogue and mutual learning. Residential and dining experiences must contribute to this.

BUILDING THE INFRASTRUCTURE

Even as we forge these exciting new pathways, we must overcome serious practical obstacles. We must improve our ability to adequately fund the education of graduate students, particularly in our doctoral programs. We must be able to maintain the levels of compensation, start-up expenses, and flexibility to explore new areas and seed new programs that are required to attract and retain the very best faculty. We must keep an MIT education affordable by moderating the growth of tuition, strengthening financial aid, and attenuating self-help levels. And while some might not think of this as infrastructure, we must continue to build a diverse student body, faculty, and staff in order to educate our students effectively and prepare them for leadership in our increasingly diverse society – a society that must function more cohesively and productively in the future.

Finally, we must place emphasis on improvement of our physical campus. We propose major enhancements of our facilities and infrastructure that will be efficient and functional, yet will generate a greater sense of community and pride in MIT and what it stands for. These developments will be guided by our desire to enhance the quality of student life and learning, but they also are congruent with our vision of the key areas of research and education in the coming decades.

THE STRATEGY

Meeting our challenges and advancing along the path to our future requires a three-element strategy of building public understanding and support, managing our assets well, and developing new financial resources. Our strategy has been consistent for the last several years, and will continue to be so.

ADVOCACY

In order to keep the nation on a course toward a vibrant future, and to create an environment in which MIT can flourish, we have worked vigorously to increase public, federal, and business understanding and support of science, technology, research, and advanced education. We have delivered a consistent message centered on the importance of investing in the future through support of research and education. To do so, we have built national coalitions, worked with all branches of the federal government, worked with the traditional scientific and educational organizations, and have engaged the business communities, state governors, and the media. Critical to our

effectiveness has been our practice of bringing MIT faculty expertise to bear on the problems and challenges faced by leaders in government and business, and of convening serious interactions across these sectors.

Our advocacy efforts are helping to create new understanding and support in industry for university research and education, and they have had a significant influence on the federal government's stance as well. There is a growing recognition, stimulated in part by MIT-based efforts, that the future strength of America's economy and quality of life depend on our ability to innovate, and that innovation in large measure depends on investment in research and education. After six years of essentially level funding, both the Administration and Congress, in an increasingly bipartisan manner, now are supporting stronger research budgets. The issue of federal entitlements, however, still threatens these budgets in the ensuing years.

FISCAL DISCIPLINE AND MANAGEMENT IMPROVEMENTS

The quality and dedication of our administrative and support staff are vital elements in our ability to realize our vision of excellence and effectiveness in education, research, and service to society. In the last several years, staff throughout the Institute have worked to rein in costs and provide more effective services. We have reengineered several of our administrative services, outsourced many functions, cut back some administrative paper flow, and reconfigured many of our operations. Fiscal discipline and our efforts to gain administrative efficiency have had positive results, involving and affecting the entire institution. This has been difficult and controversial. Much has been accomplished, but more remains to be done, and it is a tribute to MIT's staff that they continue to develop better ways to support our education and research programs.

Management improvements are but one of the ways in which we have made major adjustments to new financial realities. Others include absorbing very large costs associated with sponsored research that used to be paid for by the federal government; using Institute funds to support the full academic year salaries of almost all faculty; and reducing the size of the staff as employees leave or retire. (The retirement incentive program also enabled us to open many positions for new faculty, primarily in the junior ranks, allowing us to renew the Institute's most critical resource – its intellectual capital.) We are nearing completion of the installation of a modern financial and management information system, thereby increasing our potential for efficiency, and avoiding the costs of solving the "Year 2000 problem" in our primary systems.

We also have been moderate in tuition increases, have reduced operating budgets, have reduced our energy costs (through conservation and the construction of a modern cogeneration plant), and have extended the life of our physical plant through major renovation of existing buildings.

INCREASING PRIVATE SUPPORT

Increased private support is a dominant and absolutely critical component of our strategy. Simply put, the financial structure of MIT must change substantially. This requires that our support from traditional constituencies such as alumni and alumnae, other individual donors, and foundations must grow substantially. Happily, our intellectual agenda in many areas of research and education requires deeper partnership with industry and greater global interaction, both of which also open new avenues of financial support. We have made a good start in gaining increased financial commitment by donors to MIT, and by forging innovative new partnerships with business and industry, but this is just the beginning of the road.

The outlook is good. We have set three consecutive record years for private fund raising at MIT, with cash received reaching $137 million in Fiscal Year 1998. With the addition of generous contributions and the skillful investment in strong financial markets, MIT's endowment has more than doubled in recent years, growing from $1.40 billion in 1990 to $3.68 billion in June 1998. Industrial support of research at MIT has grown from 15 percent of our research volume in 1990 to almost 20 percent of our research volume in 1998. This growth is the result in part of newly conceived strategic partnerships with industry.

FUNDING OUR FUTURE: MIT'S FINANCIAL PLAN

Realizing our vision of the future also requires a new financial plan. During the last nine months, we have worked with the Executive and Investment Committees of the MIT Corporation to develop a new vision and plan for deployment of our financial resources. This plan is evolving, but its broad aspects, assumptions, and goals are clear.

The costs of our operations, facilities, and infrastructure are funded by three sources of revenue: tuition, externally-sponsored research, and gifts and endowment income.

We have projected the expenses of realizing our goals and vision. They include funding for core needs, programmatic initiatives and improvements, and extensions of physical plant and infrastructure. They commit us to certain specific strategic directions, yet allow for some increase in the freedom, flexibility, and intellectual entrepreneurism that must characterize a great university.

The financial structure of MIT must evolve rapidly to meet the new realities of changing federal support, increased competition from our peers, and deterioration of our physical facilities. Simply put, we will become more dependent upon private resources. This raises profound policy issues about our operating budget, our capital budget, and, particularly, the long-term development and deployment of our asset base, especially our endowment.

MIT must increase its expenditures from earnings on its endowment and other invested assets, as well as from newly raised funds for both non-recurring and recurring purposes. We are confident that MIT faculty will conceive and find support for the great new ventures of the future if we continue to provide a conducive environment and infrastructure to support them.

The key factors in our financial planning fall into two categories: essential baseline parameters, and the incremental expenditures needed to maintain and expand our areas of excellence.

BACKGROUND FACTS

Before presenting these factors, it is useful to review a few background facts.

- Approximately 85 percent of what MIT does is engineering and science, requiring highly-compensated faculty and staff, and necessitating a continually changing physical and informational infrastructure. Unlike most of our peer institutions, we have no large academic programs with low intrinsic and infrastructure costs.

- MIT has been highly dependent on federal research support through almost four decades in which federal policy favored us both implicitly and explicitly. Faculty salaries, graduate student support, and funding of research-related construction and renewal all have been funded (appropriately) in very substantial measure by sponsors as direct and indirect costs of research. In 1980 federally sponsored research revenues paid for 56 percent of our campus operating budget; by 1995 that figure had dropped to 44 percent. Further changes in federal policy have now made even this level untenable in the absence of increased private support.

- MIT is unique in its practices of charging full tuition to most graduate students during their research and study for 12 months per year, rather than the 9 months per year that is the practice at our peer institutions.

- During the last six years we have made a number of major transitions in our funding sources. MIT resources, rather than sponsored research, now fund 96 percent of faculty salaries during the academic year. MIT now expends $56 million annually from private resources to meet costs that the federal government used to fund as legitimate, audited costs of research. We have made substantial, though not sufficient, progress toward the government-mandated shift of tuition support for graduate research- and teaching assistants from the employee benefit pool to a combination of direct charges to grants and to Institute funds.

ESSENTIAL BASELINE PARAMETERS

Student tuition accounts for about a quarter of our campus revenue. The largest component of our operating expenses is salaries and wages. Our commitment to strong undergraduate student aid programs is fundamental. In addition, MIT's finances and our faculty's ability to compete for grants and contracts are very sensitive to the indirect cost rate charged to our sponsors. The plan must begin with assumptions about these four parameters.

- **Tuition:** For the last five years, we have held the annual increases in the cost of education (tuition, room, and board) to approximately 1.5 percent above the Consumer Price Index. Our tuition alone has grown at about 5 percent per year. We are now in a time of very low inflation, and of strong competitive, social, and political

pressures to restrain the cost of education to students and their families. It is appropriate and prudent that we continue to hold tuition growth to modest levels.

- **Salaries and Wages:** Competitive pressures on compensation are strong. This reflects pent-up demand, increased resources for faculty compensation at peer institutions, and the tight labor market in technical and administrative positions. Compensation must continue to rise at reasonable real rates.

- **Undergraduate Financial Aid:** MIT is deeply committed to its excellent, diverse, and often financially needy undergraduates. We must continue our commitment to the important principle of need-blind admission, and therefore must maintain strong programs of need-based financial aid. We intend to meet the cost of remaining competitive in undergraduate financial aid.

- **Indirect Cost (F&A) Rate:** The indirect cost rate charged to research sponsors, under new federal guidelines, is known as the Facilities and Administration (F&A) Rate. The magnitude of this rate and the details of its accounting have been contentious issues between universities and the federal government. F&A costs are increasingly a competitive factor in attracting and retaining faculty at MIT. Our goal is to restrain the growth of F&A rates through prudent management and increased private support for facilities and infrastructure.

NEW EXPENDITURES TO ACHIEVE EXCELLENCE

Recruiting and retaining the very best faculty remains one of our greatest challenges. To do so, we must be able to offer competitive salaries, state-of-the-art research and teaching facilities, and opportunities to work with the very best students. Faculty salaries are included in the baseline budget parameters discussed above. In addition to these parameters, there are three major incremental expenditures that we believe will position MIT for greatness in the coming decades.

- **Graduate Student Support:** We must take bold action to substantially reduce the price of graduate education, or, equivalently, the cost felt by programs and research projects. This will substantially enhance our ability to attract the most promising graduate students to MIT, make our research proposals more competitive, and assist those programs which have limited access to sponsored research. To accomplish this, we intend to eliminate summer tuition for research-based graduate students, and to create a large number of graduate fellowships to support recruitment of the very best graduate students to MIT.

- **Facility Maintenance and Renewal:** MIT has a strong record of maintaining and renewing its facilities, and of adapting them to changing purposes over time. Nonetheless, we have identified very substantial deferred maintenance across our physical plant. We will undertake a broad program to upgrade existing facilities and infrastructure, especially where it will support innovation in teaching and research and enhance the quality of campus life.

- **New Construction:** A great university requires sound, attractive, and efficient buildings and spaces for world-class teaching, research, and student life. We are establishing priorities, schedules, and private funding goals for new construction during the next ten years. Our plan also clearly recognizes the increase of the operating costs which new construction brings. Fund raising for new facilities is off to a strong start, but we are just starting down the road.

FUNDING THE PLAN

Meeting MIT's goals will require new revenues, new approaches to use of our resources, and revised processes and procedures in our operations. Increased dependence on gifts and investment earnings requires a dynamic adjustment to economic conditions and greater control over some aspects of budgeting and expenditures.

- **Capital Campaign:** MIT must embark on a new capital campaign with a fund-raising goal in excess of $1 billion during a seven-year period. We have every reason to believe that this goal is attainable. Indeed, during the last year MIT has received several gifts of $15 million and above. Substantial planning and preparation for the campaign has already been accomplished, and in the months ahead we will be working with the community to refine and articulate its goals and priorities.

- **Return on Invested Assets:** MIT can support operating and capital budgets that achieve our vision, but only if policies regarding allocation of investment returns are modified. Our endowment and other invested assets have been managed extremely well, and have benefited from the extraordinary performance of the stock market during recent years. This provides optimism regarding distributions from the endowment during the next few years. Going forward, we plan to provide at least the normal rate of growth of distributions to Pool A funds; however, a portion of the earnings above that, together with some earnings on unrestricted funds, will be allocated to Institute-wide improvements – primarily to the support of graduate education, to our program of renewal of facilities and infrastructure, and to our program of new construction.

- **Control of Budgeting and Expenditure:** MIT will establish and adhere to a dynamic ten-year financial plan covering operating and capital expenses. It will achieve our essential goals of modest real tuition growth, real growth of compensation, restrained growth of F&A (indirect cost) rates of research, and maintained commitment to need-based financial aid and need-blind admissions.

Our ability to achieve our goals for graduate education, facility maintenance and renewal, and major construction will depend to some extent on the performance of the economy and the financial markets. Increased expenditures require improved control. We will fulfill legal and moral obligations to maintain the purchasing power of our endowment. Projects and expenditures will be prioritized and paced throughout the next decade. Our spending plans at all times will be keyed in part to investment performance during the preceding three years and to the growth of other resources. We will be prepared to suspend some of these expenditures in a pre-planned manner if our financial performance decreases dramatically.

Finally, our ability to realize our vision necessitates internal budgetary simplification and continued commitment to the quality and efficiency of services. We will improve and simplify our system of funds, budgets, and plans. We will make budgeting a clearer and more direct process for meeting our academic goals. We also will remain dedicated to improvement of our financial and management systems and processes.

A FINAL, OR BEGINNING, WORD

Together, we have the opportunity to lead the most intense period of change and redefinition of MIT since the post-war years. Now is the time. I hope that this document will provide a useful framework and agenda for this task. It is about ideas, buildings, finances, opportunities, and responsibilities. But it really is about something even more important – it is about people.

MIT – its past, present and future – is defined by people. It is the dedication, ability, and effort of our faculty, staff, students, trustees, and alumni and alumnae that have brought us to our current extraordinary position on the world stage. It will be your vision, creativity, abilities, values, sense of mission, and will to excel that will create the MIT of the 21st Century. It will be a grand adventure. I am grateful for your service, support, and accomplishments, and I look forward to working with each and every one of you to make this vision of the future a reality.

Charles M. Vest
September 1998

IN SPECIAL RECOGNITION

The 1997-98 academic year brought several significant changes to MIT's senior academic and administrative leadership.

In May, Joel Moses announced his decision to step down as Provost effective August 1, 1998. Professor Moses had indicated his strong desire to focus more directly on teaching and research after nearly two decades of administrative service to the Department of Electrical Engineering and Computer Science, the School of Engineering, and, since 1995, as Provost. As Provost, he was particularly effective in forging new institutional partnerships, both in the industrial and international arenas. An intellectual as well as an administrative leader of MIT, his pioneering work in complex software systems has been recognized by his election as a member of the National Academy of Engineering, and Fellow of both the Institute of Electrical and Electronic Engineers and of the American Association for the Advancement of Science. An abiding devotion to the interests of the Institute has informed his many accomplishments.

In June, it was announced that Dean of Engineering Robert A. Brown would be the next Provost. The Warren K. Lewis Professor of Chemical Engineering and former Head of his department, he has specialized in the fields of fluid mechanics, transport processes and numerical methods. As Dean of Engineering, Professor Brown has been a leader in establishing the Division of Bioengineering and Environmental Health and has played a major role in developing the Ray and Maria Stata Center for the computer, information, and intelligence sciences to be built on the site currently occupied by Building 20.

At the same time, Lawrence S. Bacow, Lee and Geraldine Martin Professor of Environmental Studies in the Department of Urban Studies and Planning, was named to the new position of Chancellor, effective August 1, 1998. Professor Bacow's research and teaching span several fields, including environmental economics and policy, regulation of the development process, negotiation, and risk assessment. He served as Chair of the Faculty from 1995 to 1997 and possesses a broad-based appreciation for all aspects of the MIT community.

The decision to appoint two senior officers with responsibility for academic administration was made in recognition of the increasing complexity and volume of issues faced by research universities. The Provost will have overall management responsibilities for MIT's five schools and will work with the academic deans to direct programs and oversee budgets. Lincoln Laboratory and several other interdisciplinary centers will continue to report to the Provost's office. The Chancellor will play a leading role in the Institute's long-term strategic planning, and in developing and supervising educational policy at both the undergraduate and graduate levels. He will also be responsible for the overall management and development of MIT's large-scale institutional partnerships, both industrial and international.

This was also the year in which William R. Dickson retired after a career that spanned four decades of intense campus development. Beginning as a construction project manager in the late 1950's, Mr. Dickson rose through the Institute's administrative ranks to become Senior Vice President in 1981. Under his skillful management, the Institute's physical size has more than tripled, and a host of valuable management structures and systems have been successfully implemented. He has long been one of MIT's most valuable assets, and will continue to be a source of advice and guidance. Mr. Dickson's retirement was marked by tributes that testified to the extraordinary affection and esteem with which he is regarded across the Institute. Prominent among these was the naming of the William R. Dickson Cogeneration Plant.

Walter E. Morrow, Jr., stepped down as Director of MIT's Lincoln Laboratory effective June 30, 1998. Mr. Morrow was on the staff of the Laboratory when it opened in 1951 and was named its ninth Director in 1977. Much of the outstanding reputation of the Laboratory is due to his leadership of its exceptional staff, while in Washington he has been valued in the defense policy community as an advisor of great integrity, analytical capability, and wisdom. During the year it was announced that he would be succeeded as Director by David L. Briggs, Assistant Director of the Laboratory, and that Herbert Kottler, currently Assistant Director, would assume the position of Associate Director.

Glen L. Urban stepped down as Dean of the Sloan School of Management effective June 30, 1998. Under his leadership, Sloan developed innovative educational and research programs that enhanced its strong relationships with industry in the United States and abroad. Its standing among its peers has continued to rise, and applications have increased dramatically. After a sabbatical year, Dean Urban expects to return to teaching and research at Sloan. Richard Schmalensee, Gordon Y Billard Professor of Economics and Management, agreed to serve as Interim Dean of the Sloan School.

The year also saw the "retirement" of the venerable Building 20. Few buildings at any university have achieved such legendary status. It was never intended to be a permanent structure, but it leaves a rich legacy in the scientific and technological innovation that took place within its walls: A "magical incubator," it has been home to the Radiation Laboratory; the early years of the Research Laboratory of Electronics, Lincoln Laboratory, and the Laboratory of Nuclear Science; and more than fifty years of pioneering research in a host of fields. As the year came to a close, plans were in progress for the site to house the next generations of intellectual advance in the computer, intelligence, and information sciences.

As in every year, appointments to positions of leadership in the administration offered talented members of the faculty and staff the opportunity to shape the future of the Institute.

Daniel Roos, Japan Steel Industry Professor in the Department of Civil and Environmental Engineering, was named to the new position of Associate Dean for Engineering Systems in the School of Engineering, as part of the School's increased focus on interdisciplinary systems.

New academic department or program leaders whose service began during the year were Rohan Abeyaratne, Associate Head, Department of Mechanical Engineering; Rodney A. Brooks, Director, Artificial Intelligence Laboratory; Joel Clark, Director, Center for Technology, Policy, and Industrial Development ; Joshua Cohen, Head, Department of Political Science; Rick L. Danheiser, Acting Head, Department of Chemistry; Jeffrey P. Friedberg, Head, Department of Nuclear Engineering; Martha L. Gray, MIT Co-Director, Harvard-MIT Division of Health Sciences and Technology; Thomas J. Greytak, Associate Head, Department of Physics; Robert L. Jaffe, Director, Center for Theoretical Physics; Marc Kastner, Head, Department of Physics; David H. Marks, Director, Center for Environmental Initiatives; James G. Paradis, Head of the Program in Writing and Humanistic Studies; Paola Rizzoli, MIT Director of the MIT-Woods Hole Oceanographic Institution Joint Program in Oceanography and Applied Ocean Science and Engineering; Robert J. Silbey, Director, Center for Materials Science and Engineering; Robert Stalnaker, Head, Department of Linguistics and Philosophy; and Mriganka Sur, Head, Department of Brain and Cognitive Sciences.

Among notable changes in the administration during the past year were the appointments of Marilee Jones, Dean of Admissions; Patrick K. Marx, Special Assistant to the President for Communications; and Christopher G. L. Pratt, Director of Career Services and Preprofessional Advising.

***

The awards, recognition, and professional distinction achieved by MIT's faculty and staff reflect the excellence of our programs of instruction and research. This year, as always, that excellence was confirmed by the numerous prizes and other honors earned by members of the MIT community. The following summary touches on only a few of these professional achievements:

Four MIT professors were elected to membership in the National Academy of Sciences (NAS), one of the highest distinctions accorded within the scientific community. This year's new members from MIT were Roman W. Jackiw, Jerrold Zaccharias Professor of Physics; Thomas H. Jordan, Robert R. Shrock Professor and Head of the Department of Earth, Atmospheric, and Planetary Sciences; Carl O. Pabo, Professor of Biophysics and Structural Biology in the Department of Biology and a Howard Hughes Medical Institute Investigator; and Kenneth N. Stevens, Clarence Joseph LeBel Professor of Electrical Engineering. The election of these exceptional scholars and researchers brings the number of NAS members on the MIT faculty to 111.

The National Academy of Engineering elected five new members from the MIT faculty: Edward F. Crawley, Professor and Head of the Department of Aeronautics and Astronautics; John B. Heywood, Sun Jae Professor of Mechanical Engineering and Director of the Sloan Automotive Laboratory; James A. Fay, Professor Emeritus and Senior Lecturer in the Department of Mechanical Engineering; Jerome H. Saltzer, Professor Emeritus and Senior Lecturer in the Department of Electrical Engineering and Computer Science; and D. Bruce Montgomery, former Associate Director of the Plasma Fusion Center. This year's elections bring to 95 the total number of NAE members from the Institute. Corporation Member Richard P. Simmons, Chairman, President, and CEO of Allegheny Teledyne, also was elected to membership in the Academy.

Six MIT faculty members from a broad spectrum of academic fields were inducted into the American Academy of Arts and Sciences: Robert W. Field, Professor of Chemistry; Ellen T. Harris, Class of 1949 Professor of Music; Nancy H. Hopkins, Professor of Biology; Pauline R. Maier, William R. Kenan, Jr., Professor of History; Steven Pinker, Professor of Psychology and Director of the McDonnell-Pew Center for Cognitive Neuroscience; and Rainer Weiss, Professor of Physics.

The Institute of Medicine, whose 558 members include 24 members of the MIT faculty, elected to membership David E. Housman, Novartis Professor of Biology.

Timothy J. Berners-Lee, Principal Research Scientist in the Laboratory for Computer Science (LCS), was named a 1998 MacArthur Fellow by the John D. and Catherine T. MacArthur Foundation. Mr. Berners-Lee was awarded what is colloquially known as the "genius grant" for his development of the World Wide Web in 1989-90, when he was at CERN. As Director of the World Wide Web Consortium, a nonprofit, member-sponsored organization based at LCS, he has encouraged the development of open communications systems and works to enhance the capacity of the Web as a locus of free expression and global collaboration.

Professor Christopher C. Cummins of the Department of Chemistry was awarded the Alan T. Waterman Prize by the National Science Foundation for his achievements in the field of synthetic or exploratory chemistry. He was recognized in particular for his discovery of new methods for breaking down nitrogen molecules, thereby freeing nitrogen atoms for inclusion in different molecular combinations. This work has tremendous implications for industrial chemistry. The Waterman Prize was the second major award Professor Cummins received during the year: He also received the 1998 Award in Pure Chemistry from the American Chemical Society. Professor Cummins is the first member of the MIT faculty to win the Waterman Prize for work conducted at MIT, although Gang Tian, Simons Professor of Mathematics, was awarded the prize in 1994 while affiliated with the Courant Institute of Mathematical Sciences at New York University.

Elfatih A. B. Eltahir, Gilbert Winslow Career Development Assistant Professor of Civil and Environmental Engineering, received a Presidential Early Career Award for Science and Engineering. Professor Eltahir was nominated by the National Aeronautics and Space Administration for this Federal award, which recognizes scientists and engineers who demonstrate the highest levels of achievement and promise at the outset of their independent research careers. Professor Eltahir's work on the links between the biosphere and the atmosphere offers new understanding of how global climate change and human activity affect the sustainability of global water resources, especially in the tropics.

H. Robert Horvitz, Professor of Biology and a Howard Hughes Medical Institute Investigator, received the Alfred P. Sloan Award from the General Motors Cancer Research Foundation for the most outstanding recent contributions to basic science research related to cancer. Professor Horvitz was cited for his work in demonstrating that programmed cell death is a genetically determined biological process. This important discovery has contributed significantly to new knowledge about how benign cells can become malignant.

Robert S. Langer, Germeshausen Professor of Chemical and Biomedical Engineering in the Department of Chemical Engineering, was awarded the Lemelson-MIT Prize, which celebrates invention and innovation in all fields of science and technology. The prize is administered by MIT, but the Institute plays no role in selecting any of the nominees or the eventual winners. Professor Langer's innovations have led to over three hundred patents, provided a framework for the emerging technology of tissue engineering, and have been used in such areas as drug delivery systems, vaccines, tissue repair, diagnostics, innovative waste disposal technologies, and novel therapeutics.

Sheila E. Widnall, Professor of Aeronautics and Astronautics, returned to MIT after more than four years as Secretary of the Air Force. Professor Widnall was the first woman to head a branch of the armed forces. Two MIT faculty members with long records of service to the Federal government were recalled to duty this year. Institute Professor John M. Deutch, whose prior government experience includes service as Deputy Secretary of Defense and Director of the Central Intelligence Agency, was named to the President's Committee of Advisors on Science and Technology, whose 16 other members include President Charles M. Vest and Institute Professor Mario Molina. Ernest J. Moniz, Head of the Department of Physics and former Associate Director for Science of the President's Office of Science and Technology Policy, was appointed Undersecretary of the US Department of Energy.

Two members of the faculty were recognized for their commitment to teaching excellence with appointments as MacVicar Faculty Fellows: Sylvia T. Ceyer, John G. Sheehan Professor of Chemistry, and Robert L. Jaffe, Professor of Physics and Director of the Center for Theoretical Physics.

Pauline R. Maier, William R. Kenan, Jr., Professor of History, was the recipient of the twenty-seventh annual James R. Killian, Jr., Faculty Achievement Award. The selection committee cited Professor Maier's record as an outstanding teacher and scholar whose highly-praised books – including her recent study *American Scripture: Making the Declaration of Independence* – have broadened public awareness of MIT's great achievements in the humanities and social sciences.

Steven B. Leeb, Associate Professor of Electrical Engineering, received this year's Harold E. Edgerton Faculty Achievement award, which recognizes junior faculty for achievements in teaching, research, and service to the MIT community. A successful teacher and dedicated freshman adviser, Professor Leeb has worked on a multiprocessor-based monitor to track patterns of electrical energy consumption in buildings and on the medical use of polymer gels as controlled releasers of medicines and hormones.

The Gordon Y Billard Award, recognizing individuals who have performed special services of outstanding merit to MIT, was given this year to Cheryl N. deJong Vossmer of the MIT Campus Police and Ronald E. Parker of Information Systems. Sergeant deJong Vossmer was cited for her leadership in promoting security and community at MIT, and for her extensive community service work in Cambridge and Boston. Mr. Parker, Senior Database Analyst, was recognized for his effective mentoring of junior staff, his professional versatility, and his readiness to respond to data management crises at all hours of day and night.

***

The passage of another year has, as always, meant the passing away of beloved and honored former colleagues. The Institute cherishes the memories of their lives and their many accomplishments.

Albert G. H. Dietz, Professor Emeritus of Architecture, who died on April 28, 1998, at the age of 91, was a builder by family background and by inclination. He had earned three degrees from MIT before joining the faculty in 1946. At MIT, he held appointments in the Departments of Civil and Environmental Engineering and of Architecture. His work in construction techniques, materials and the use of solar energy earned him prizes and awards at the regional, national and international levels. An avid traveler, he had visited every continent except Antarctica, often bringing a special 3-D camera to take photographs which he could use as teaching aids in his coursework.

Carl F. Floe, Professor Emeritus of Metallurgy, died at his home in Boston on May 18, 1998, at the age of ninety. Recipient of an ScD from MIT in 1935, he joined the Institute faculty four years later. During World War II, he served as a consultant to the US Army Quartermaster Corps and to several defense industries. Named full professor in 1950, he was subsequently named Assistant Provost and then Assistant Chancellor. As Vice President for Research Administration, he oversaw the activities of the Lincoln and Draper Laboratories and represented MIT on numerous national boards, including those of the Brookhaven National Laboratory and the National Center for Atmospheric Research. He chaired the Harvard-MIT Joint Center for Urban Studies. He retired in 1973, but remained active in consulting to industries in the United States and overseas.

Martin Diskin, Professor of Anthropology, died in Cambridge on August 3, 1997, at age 62, after a lengthy struggle with leukemia. He joined the Department of Humanities in 1967, helping to establish both the Latin American Studies Program and the anthropology/archeology exchange program with Wellesley College. His work in rural Latin America had transformed him into a passionate advocate for social reform. A dedicated activist on behalf of the poor and oppressed, Professor Diskin was equally at home in political demonstrations and in congressional hearings.

Harold A. Freeman, Professor Emeritus of Statistics, died at his home in Andover on October 20, 1997, at the age of 88. Professor Freeman was affiliated with MIT for almost all of an academic career which spanned over six decades. An economist and statistician, much of his most important work grew out of his experiences with the Statistical Research Group assembled at Columbia University during World War II to devise methods of sampling inspection and quality control for use in wartime industry. Later in life, he turned to broader social criticism. While he retired from his professorship at the Institute in 1976, he continued to teach until 1990 as a senior lecturer.

David N. Hume, Professor Emeritus of Chemistry, died on March 2, 1998, at the age of 80. Professor Hume received his PhD in chemistry from the University of Minnesota in 1943 and went to work on the Manhattan Project at the University of Chicago and at the Clinton National Laboratories in Oak Ridge, Tennessee. By the end of World War II, he was head of analytical research at the Oak Ridge plutonium plant. He joined the MIT faculty in 1947, becoming a full Professor in 1959. Professor Hume won numerous honors, including the 1964 Fisher Award in analytical chemistry, in a career which lasted until 1980.

Professor Emeritus of Chemistry John Withers Irvine, Jr., died at the age of 84 on February 23, 1998, at his home in Tucson, Arizona. Like many MIT faculty of his generation, he performed vital scientific work during World War II. After earning his PhD from MIT in 1939, he served as a research associate in the Department of Physics until 1943, when he became Assistant Professor of Chemistry and joined the MIT Radioactivity Center. He was promoted to Associate Professor in 1947 and to full Professor in 1958. His contributions to the Institute community included service from 1966 to 1973 as the faculty resident in Ashdown House. At the time of his retirement in 1979, Professor Irvine was executive officer of the Department of Chemistry.

Padmakar P. Lele, Professor Emeritus of Experimental Medicine, died at age 71 on June 11, 1998, in San Diego. He had been a member of the faculty of the MIT-Harvard Health Science and Technology Program and the Department of Mechanical Engineering. A native of India and a graduate of the Universities of Bombay and Oxford, he was a pioneer in the medical and industrial uses of ultrasound and was affiliated with Massachusetts General Hospital before coming to MIT in 1969. A longtime resident of Winchester, he moved to La Jolla, California upon his retirement from MIT.

Donald A. Schön, Ford Professor Emeritus of Urban Studies and Education and Senior Lecturer in the School of Architecture and Planning, died on September 13, 1997, at the age of 66. A native Bostonian trained as a philosopher at Yale and Harvard, he was for several years Director of the Institute for Applied Technology in the Bureau of National Standards of the US Department of Commerce. He arrived at MIT in 1968 as a Visiting Professor, and was named Ford Professor in 1972. From 1990 to 1992, he served as chair of his department. A specialist in the ways that practitioners could continue to develop their professional skills and personal capabilities throughout their careers, Professor Schön was also a highly accomplished clarinetist who performed with local jazz and chamber music ensembles.

William J. Weisz, Life Member of the MIT Corporation, died December 17, 1997, at his home in Scottsdale, Arizona. A native of Chicago, he served in the US Navy before entering MIT, where he majored in electrical engineering and received the SB degree in 1948. He joined Motorola the same year and spent almost fifty years with the company. As President, Vice Chairman, and Chairman, he was a key member of the leadership team that transformed a relatively small consumer electronics company into the world's largest supplier of equipment for cellular telephones, paging, and two-way radios. His achievements at Motorola and his contributions to the electronics industry were widely recognized, and he was admired for his insights and expertise in the philosophy of corporate management. His ties to MIT grew with the passage of time, and he will be remembered as one of the Institute's most dedicated trustees.

STATISTICS FOR THE YEAR

REGISTRATION

In 1997-98 student enrollment was 9,880, compared with 9,947 in 1996-97. There were 4,381 undergraduates (4,429 the previous year) and 5,499 graduate students (5,518 the previous year). The international student population was 2,176, representing eight percent of the undergraduate and 33 percent of the graduate populations. These students were citizens of 108 countries. (Students with permanent residence status are included with US citizens.)

In 1997-98, there were 3,101 women students (1,747 undergraduate and 1,354 graduate) at the Institute, compared with 3,085 (1,749 undergraduate and 1,336 graduate) in 1996-97. In September 1997, 406 first-year women entered MIT, representing 38 percent of the freshman class of 1,066 students.

In 1997-98, there were, as reported by the students themselves, 2,691 minority students (1,997 undergraduate and 694 graduate) at the Institute, compared with 2,753 (1,997 undergraduate and 756 graduate) in 1996-97. Minority students included 401 African Americans (non-Hispanic), 63 Native Americans, 555 Hispanic Americans, and 1,672 Asian Americans. The first-year class entering in September 1997 included 509 minority students, representing 48 percent of the class.

DEGREES AWARDED

Degrees awarded by the Institute in 1997-98 included 1,184 bachelor's degrees, 1,492 master's degrees, 16 engineer's degrees, and 521 doctoral degrees, for a total of 3,213 (compared with 3,109 in 1996-97).

STUDENT FINANCIAL AID

During the academic year 1997-98 the continuing healthy economy and a reduction in the number of needy students reduced the need for grant funds. At the same time, endowment income for scholarships increased by 10 percent. A total of 2,505 students who demonstrated need for assistance (58 percent of enrollment) received $34,372,000 in grant aid and $15,072,000 in student loans from all sources. The total, $49,444,000, represents a decrease of approximately one percent from the amount spent the previous year.

Grant assistance to undergraduates was provided by $14,063,000 in income from the scholarship endowment, by $894,000 in current gifts, by $3,665,000 in federal grants (including ROTC scholarships), and by $2,995,000 in direct grants from non-federal outside sources to needy students. In addition, $12,755,000 in scholarships from MIT's unrestricted funds were provided to undergraduates, inclusive of the special program of scholarship aid to needy minority group students that represented $386,000 and the MIT Opportunity Awards that accounted for $391,000. An additional 425 students received grants irrespective of need from outside agencies, totaling $2,383,000. The undergraduate scholarship endowment was increased by the addition of $13,055,000 in new funds. These new contributions increased the endowment for scholarships to $143,666,000.

Loans totaling $15,072,000 were made to undergraduates, a decrease of 5 percent from the previous year. Of the total loans made, $1,922,000 came from the Technology Loan Fund, $4,009,000 came from the Federal Perkins Loan Program, and $9,020,000 came from the federal Direct Loan Program. An additional $121,000 was provided to undergraduates from other outside sources.

Graduate students obtained $4,986,000 from the Technology Loan Fund, an increase of 8 percent from the previous year's level. Graduate students obtained $8,739,000 from the Federal Stafford Program, $4,000 from Perkins Loan funds. The total, $13,729,000, represents a decrease of 3 percent from the previous year.

The total of loans made to undergraduate and graduate students was $28,801,000, a decrease of 4 percent from the previous year.

The number of needy undergraduate students decreased by 4 percent to 2,505. The average need for this population increased by 2 percent to $21,103. In the aggregate, the financial aid program required $28,069,000 from needy students' family resources and provided $52,862,000 in aid dollars including work programs. As in past years, the aid program provided more than two-thirds of needy students' total costs.

CAREER SERVICES AND PREPROFESSIONAL ADVISING

In 1997-98, the market for new MIT graduates soared in every area of industry, and a record-breaking number of employers visited campus. The number of individual employers (not including individual divisions of larger corporations) who came to interview was 740, compared to 715 the previous year. As the year came to a close, interview schedules for 1998-99 suggested that the upward trend would continue in the year ahead.

Software skills continued to be the most sought-after single area of student expertise, with particular emphasis on new multimedia and Internet technologies. Employers have learned that students from a wide variety of MIT courses have substantial experience with information technology. The telecommunications, pharmaceutical, finance, and semiconductor industries have contributed noticeably to this demand. Starting salaries have increased, as have the percentage and range of firms offering signing bonuses. Salaries for doctoral graduates in engineering range on the average from $65,000 to $80,000. Salary offers to master's candidates range from $50,000 to $60,000, and to bachelor's candidates from $45,000 to $48,000.

Applications to medical school have continued at a strong pace. 110 under-graduates applied to medical school, of whom 76 percent were admitted; 11 graduate students applied to medical school, of whom 36 percent were admitted. 77 MIT alumni/ae applied to medical school, of whom 49 percent were admitted. Altogether, 198 undergraduates, graduate students, and alumni/ae applied to medical school. Including re-applicants, their acceptance rates were 66 percent for the 98 men, and 60 percent for the 100 women.

PRIVATE SUPPORT

Private financial support received in Fiscal Year 1998 totaled $143,900,000, including $137,100,000 in gifts, grants, and bequests, and $6,800,000 in support through membership in the Industrial Liaison Program. The total compares with $133,600,000 in 1997, $130,900,000 in 1996, $108,900,000 in 1995, and $94,500,000 in 1994. Gifts-in-kind for the past year (principally gifts of equipment) were valued at $8,300,000.

The sources of gifts for Fiscal Year 1998 included alumni, $42,000,000; non-alumni friends, $38,000,000; corporations, corporate foundations, and trade associations, $30,000,000; foundations and charitable trusts, $25,900,000; and others, $1,200,000.

FINANCES

As reported by the Vice President for Finance and Treasurer, the overall financial results of the Institute's operations were favorable during Fiscal Year 1998. Revenues and funds of $1,219,300,000 were used for operations. Total operating expenses in Fiscal Year 1998 were $1,223,500,000. The operating results produced an additional need for general funds of $4,200,000, a decline from the $4,900,000 needed in the prior year. In addition, net assets increased $781,800,000, reaching almost $4,700,000,000 at year end. The MIT endowment reached a market value of $3,700,000,000, up 21.9 percent, and benefited from very favorable investment returns and a record level of gifts.

The research revenues of departmental and interdepartmental laboratories, primarily on campus, totaled $384,200,000 in Fiscal Year 1998, a small decrease of 0.9 percent from the prior year. Industry continued to be the leading sponsor of MIT research on campus, at $74,200,000. Lincoln Laboratory reported revenues of $364,800,000, an increase of 3.5 percent.

PHYSICAL PLANT AND CAMPUS ENVIRONMENT

During the year, progress on changes in administrative processes continued. The Copy Technology Centers successfully completed their first full year of operation as an independent department, as did the Publishing Services Bureau. Within Physical Plant, the Repair and Maintenance group successfully completed their first year following redesign into five local zones and twelve central teams. As a result of the redesign and cost-saving efforts implemented by the Mail Services group, the Institute saved over $850,000. Based on the success of the previous year's pilot program, the Visa Procurement Card (VIP Card) was introduced to the community and is available for Institute personnel to make small dollar purchases.

In addition to these process changes, the campus is poised on the verge of major building projects. The new complex for the computer, information, and intelligence sciences, which will house five laboratories and departments, will be built on the site of Building 20. During the year, internationally recognized architect Frank Gehry was selected to

design the new complex of buildings, to be named the Ray and Maria Stata Center, in recognition of their extraordinary generosity in supporting this project.

A number of other construction and renovation projects moved forward in 1997-98. The Student Services Center on the first floor of Building 11 opened; ten all-purpose classrooms in Building 2 were completely renovated; Room 9-150 was transformed from a traditional lecture hall into a state-of-the-art distance learning facility; and the extensive renovation of Building 16 was completed. In addition, the newly renovated Music Library in Building 14E received the "Building of the Year" award in the category of Spatial Planning and Interior Furnishings at the Facilities Management Expo.

Due to the increased demand the Institute faces for housing on and near campus, the Planning Office engaged in preparations for new undergraduate and graduate residences.

Ensuring that Institute policies and procedures remain in compliance with city, state, and Federal regulations continued to be a priority during the year. Staff from the Safety Office coordinated preparations for a site inspection of the campus by the Environmental Protection Agency, and worked with the inspection teams during their visits.

PERSONNEL CHANGES

CORPORATION

DEATHS
William J. Weisz
Member

CHANGES OF APPOINTMENT

Howard W. Johnson
Life Member Emeritus

ELECTIONS

Norman R. Augustine
Member

Gerald J. Burnett
Member

Glen V. Dorflinger
Member

William S. Edgerly
Life Member

John W. Jarve
Member

David H. Koch
Life Member

Ronald A. Kurtz
Member

Patrick J. McGovern
Life Member

Robert M. Metcalfe
Member

Robert A. Muh
Life Member

LeslieTang Schiling
Member

Richard P. Simmons
Life Member

Anthony Sun
Member

Matthew J. Turner
Member

MEMBER EX-OFFICIO

John A. Morefield
President of the Associate of Alumni and Alumnae

TERM EXPIRED

Lawrence A. Hough
Member

Brian G. R. Hughes
Member

John A. Morefield
Member

Kenichi Ohmae
Member

Darcy D. Prather
Member

FACULTY

DEATHS

Edwin Diamond
Visiting Associate Professor
Department of Political Science

Albert G. Dietz
Professor
Department of Architecture

Martin Diskin
Professor
Anthropology Program

Carl F. Floe
Department Head and Professor
Department of Materials Science and Engineering

Harold A. Freeman
Professor
Department of Economics

David N. Hume
Professor
Department of Chemistry

John W. Irvine, Jr.
Professor
Department of Chemistry

Donald A. Schon
Professor
Department of Urban Studies and Planning

RETIREMENTS

Michael Athans
Professor
Department of Electrical Engineering and Computer Science

Stephan L. Chorover
Professor
Department of Brain and Cognitive Sciences

Charles C. Counselman, Iii
Professor
Department of Earth, Atmospheric, and Planetary Sciences

Lee Grodzins
Professor
Department of Physics

Samuel J. Keyser
Professor
Department of Linguistics and Philosphy

John E. Meyer
Professor
Department of Nuclear Engineering

Walter E. Morrow, Jr.
Professor
Department of Electrical Engineering and Computer Science

William T. Peake
Professor
Department of Electrical Engineering and Computer Science

Irwin A. Pless
Professor
Department of Physics

William F. Pounds
Professor
Sloan School of Management

Paul R. Schimmel
Professor
Department of Biology

RESIGNATIONS

Professor

William J. Dally
Professor
Department of Electrical Engineering and Computer Science

Marcia K. Mc Nutt
Professor
Department of Earth, Atmospheric, and Planetary Sciences

Andreas Mortensen
Professor
Department of Materials Science and Engineering

John L. Tonry
Professor
Department of Physics

Associate Professor

Jushan Bai
Associate Professor
Department of Economics

David Genesove
Associate Professor Department of Economics

Uday Bhanu Pal
Associate Professor Department of Materials Science and Engineering

James Propp
Associate Professor Department of Mathematics

William J. Qualls
Associate Professor Sloan School of Management

Lones A. Smith
Associate Professor Department of Economics

James R. Williamson Associate Professor Department of Chemistry

Assistant Professor

Peter Dayan
Assistant Professor
Department of Brain and Cognitive Sciences

Thomas De Frantz Assistant Professor
Music and Theater Arts Section

Sheena S. Iyengar
Assistant Professor
Sloan School of Management

Helen Elaine Lee
Assistant Professor Program in Writing and Humanistic Studies

Don O. May
Assistant Professor
Sloan School of Management

Kevin S. Mc Farland-Porter
Assistant Professor Department of Physics

Youngme Moon
Assistant Professor
Program in Writing and Humanistic Studies

Omar M. Razzaz
Assistant Professor
Department of Urban Studies AND Planning

Macdaniel D. Singleton
Assistant Professor
Athletic Department

Paul Slovenski
Assistant Professor
Athletic Department

Fabian Waleffe
Assistant Professor
Department of Mathematics

Kevin W. Wenzel
Assistant Professor
Department of Nuclear Engineering

PROMOTIONS

To Professor

Edward H. Adelson
Professor
Department of Brain and Cognitive Sciences

Daniel Blankschtein Professor
Department of Chemical Engineering

Jesus A. Del Alamo Professor
Department of Electrical Engineering and Computer Science

Glenn David Ellison Professor
Department of Economics

Charles H. Fine
Professor
Sloan School of Management

Elizabeth J. Garrels
Professor
Foreign Languages and Literatures Section

Jonathan Gruber
Professor
Department of Economics

Irene R. Heim
Professor
Department of Linguistics and Philosophy

Thomas A. Herring
Professor
Department of Earth, Atmospheric, and Planetary Sciences

Henry Jenkins
Professor
Literature Section

Michael I. Jordan
Professor
Department of Brain and Cognitive Sciences

Wolfgang Ketterle
Professor
Department of Physics

Noel M. McKinnell
Professor of the Practice
Department of Architecture

David C. Page
Professor
Department of Biology

Alex Paul Pentland
Department Head/Professor
Program in Media Arts and Sciences

Jean-Jacques E. Slotine
Professor
Department of Mechanical Engineering

James M. Snyder, Jr.
Professor
Department of Political Science

Jacob K. White
Professor
Department of Electrical Engineering and Computer Science

Krzysztof Wodiczko
Professor
Department of Architecture

To Associate Professor

K. Daron Acemoglu
Associate Professor
Department of Economics

Tania Baker
Associate Professor
Department of Biology

Bonnie A. Berger
Associate Professor
Department of Mathematics

Duane S. Boning
Associate Professor
Department of Electrical Engineering and Computer Science

Dora L. Costa
Associate Professor
Department of Economics

Julie Dorsey
Associate Professor
Department of Architecture

Edward Albert Fletcher Gibson
Associate Professor
Department of Brain and Cognitive Sciences

Evelynn Maxine Hammonds
Associate Professor
Program in Science, Technology, and Society

Tyler E. Jacks
Associate Professor
Department of Biology

Susanne Klingenstein
Associate Professor
Program in Writing and Humanistic Studies

Terry W. Knight
Associate Professor
Department of Architecture

Steven B. Leeb
Associate Professor
Department of Electrical Engineering and Computer Science

Chris J. Marone
Associate Professor
Department of Earth, Atmospheric, and Planetary Sciences

Jochem Marotzke
Associate Professor
Department of Earth, Atmospheric, and Planetary Sciences

Samir D. Mathur
Associate Professor
Department of Physics

Anne M. Mayes
Associate Professor
Department of Materials Science and Engineering

Hugh L. Mc Manus
Associate Professor
Department of Aeronautics and Astronautics

Maureen E. Raymo
Associate Professor
Department of Earth, Atmospheric, and Planetary Sciences

Janet Sonenberg
Associate Professor
Music and Theater Arts Section

Mitchell D. Trott
Associate Professor
Department of Electrical Engineering and Computer Science

Ian A. Waitz
Associate Professor
Department of Aeronautics and Astronautics

Boleslaw Wyslouch
Associate Professor
Department of Physics

CHANGES OF APPOINTMENT

Rohan Abeyarantne
Associate Department Head and Professor
Department of Mechanical Engineering

K. Daron Acemoglu
Pentti Kouri Associate Professor
Department of Economics

Akintunde I. Akinwande
Itt Career Development Associate Professor of Electrical Engineering
Department of Electrical Engineering and Computer Science

Susan Athey
Castle Krob Career Development Assistant Professor
Department of Economics

Lawrence S. Bacow
Lee And Geradine Martin Professor
Department of Urban Studies and Planning

Emilio Bizzi
Professor
Department of Brain and Cognitive Sciences

Duane S. Boning
Robert N. Noyce Career Development Associate Professor of Electrical Engineering
Department of Electrical Engineering and Computer Science

Rodney A. Brooks
Director And Professor
Artificial Intelligence Laboratory

Sandra L. Burkett
John Chipman Assistant Professor of Materials Chemistry
Department of Materials Science and Engineering

Michael J. Cima
Sumitomo Electric Industries Professor of Engineering
Department of Materials Science And Engineering

Joel P. Clark
Interim Director and Professor
Center for Technology, Policy and Industrial Development

John-Paul Barrington Clarke
Charles Stark Draper Assistant Professor
Department Aeronautics and Astronautics

Joshua Cohen
Department Head and Arthur and Ruth Sloan Professor
Department of Political Science

Dora L. Costa
Ford Career Development Associate Professor of Economics
Department of Economics

Rick L. Danheiser
Acting Department Head and Professor
Department of Chemistry

Dennis M. Freeman
W. M. Keck Career Development Assistant Professor in Biomedical Engineering
Department of Electrical Engineering and Computer Science

Jeffrey P. Freidberg
Department Head and Professor
Department of Nuclear Engineering

Martha L. Gray
Co-Director and Professor
Harvard-MIT Division of Health Sciences and Technology

Paul E. Gray
Professor
Department of Electrical Engineering and Computer Science

Thomas J. Greytak
Associate Department Head for Education and Professor
Department of Physics

W. Eric L. Grimson
Bernard Gordon Professor of Medical Engineering
Department of Electrical Engineering and Computer Science

John B. Heywood
Sun Jae Professor
Department of Mechanical Engineering

Bengt Holmstrom
Paul A. Samuelson Professor
Department of Economics

Thomas P. Hughes
Distinguished Visiting Professor of the History of Technology
Program in Science, Technology, And Society

Thomas H. Jordan
Professor
Department of Earth, Atmospheric, and Planetary Sciences

M. Frans Kaashoek
Jamieson Career Development Associate Professor of Computer Science and Engineering
Department of Electrical Engineering and Computer Science

Marc A. Kastner
Department Head And Donner Professor
Department of Physics

Stanley Kowalski
Professor
Department of Physics

Amos Lapidoth
KDD Career Devleopment Assistant Professor Of Electrical Engineering
Department Of Electrical Engineering And Computer Science

Steven G. Leeb
Carl Richard Soderberg Associate Professor in Power Engineering
Department of Electrical Engineering and Computer Science

John J. Leonard
Henry L. and Grace Doherty Professor
Department of Ocean Engineering

Christopher K. Y Leung
Visiting Associate Professor
Department of Civil and Environmental Engineering

Alan P. Lightman
Professor
Program in Writing and Humanistic Studies

Dennis P. Mohoney
Professor of Naval Construction and Engineering
Department of Ocean Engineering

David H. Marks
Professor and Director
Center for Environmental Initiatives

Gareth H. Mckinley
Lord Associate Professor
Department of Mechanical Engineering

David W. Miller
Boeing Assistant Professor
Department of Aeronautics AND Astronautics

James Paradis
Department Head and Professor
Program in Writing and Humanistic Studies

Alex Paul Pentland
Toshiba Professor and Department Head
Program In Media Arts And Sciences

Daniel Roos
Associate Dean of Systems Engineering
School of Engineering

Nancy L. Rose
Professor
Department of Economics

Caroline A. Ross
Lord Foundation Career Development Assistant Professor of Materials Science
Department of Materials Science and Engineering

Stephen A. Ross
Fischer Black Visiting Professor of Finance and Economics
Sloan School of Management

Richard J. Samuels
Ford International Professor
Department of Political Science

Robert J. Silbey
Director and Professor
Center for Materials Science and Engineering

Susan Slyomovics
Genevieve Mcmillan-Reba Stewart Professor Study of Women in the Developing World
Anthropology Program

Robert Stalnaker
Department Head and Laurence S. Rockefeller Professor
Department of Linguistics and Philosophy

George Stephanopoulos
Arthur Dehon Little Professor
Department of Chemical Engineering

Lawrence J. Stern
Pfizer Inc.-Gerald D Laubach Career Developement Assistant Professor
Department of Chemistry

Mriganka Sur
Department Head and Professor
Department of Brain and Cognitive Sciences

Anna Thornton
Class of 1943 Assistant Professor
Department of Mechanical Engineering

Neil E. Todreas
KEPCO Professor OF Nuclear Engineering
Department of Nuclear Engineering

Partick H. Winston
Ford Professor oF Engineering
Department of Electrical Engineering and Computer Science

NEW APPOINTMENTS

Professor

Robert S. Gibbons
Professor
Sloan School of Management

Dennis P. Mahoney
Professor
Department of Ocean Engineering

Daniel G. Nocera
Professor
Department of Chemistry

Susan Slyomovics
Professor
Anthropology Program

Associate Professor

David Cliff
Associate Professor
Department of Electrical Engineering and Computer Science

Daniel Jackson
Associate Professor
Department of Electrical Engineering and Computer Science

Nancy Kanwisher
Associate Professor
Department of Brain and Cognitive Sciences

Gareth H. Mckinley
Associate Professor
Department of Mechanical Engineering

Wellington Reiter
Associate Professor of the Practice
Department of Architecture

Duncan Simester
Associate Professor
Sloan School of Management

Madhu Sudan
Associate Professor
Department of Electrical Engineering and Computer Science

Assistant Professor

Kevin Amaratunga
Assistant Professor
Department of Civil and Environmental Engineering

Jennifer L. Babcock
Assistant Professor of Management
Sloan School of Management

John W. M. Bush
Assistant Professor
Department of Mathematics

Lucia Caporaso
Assistant Professor
Department of Mathematics

Paul R. Carlile
Assistant Professor of Management
Sloan School of Management

Donald P. Cram
Assistant Professor of Management
Sloan School of Management

John M. P. De Figueiredo
Assistant Professor of Management
Sloan School of Management

Thomas DeFramtz
Assistant Professor
Music and Theater Arts Section

Judith Donath
Assistant Professor
Program in Media Arts and Sciences

Bevin Engelward
Assistant Professor
Division of Toxicology

Ambrogio F. Fasoli
Assistant Professor
Department of Physics

Haiyan Gao
Assistant Professor
Department of Physics

Frank Gertler
Assistant Professor
Department of Biology

Michael Glanzberg
Assistant Professor
Department of Lingusistics and Philosophy

William H. Green, Jr.
Assistant Professor
Department of Chemical Engineering

Charles F. Harvey
Assistant Professor
Department of Civil and Environmental Engineering

Lars Hesselholt
Assistant Professor
Department of Mathematics

Sheena S. Iyengar
Assistant Professor of Management
Sloan School of Management

Simon Johnson
Assistant Professor of Management
Sloan School of Management

Victoria Kaspi
Assistant Professor
Department of Physics

Christina Klein
Assistant Professor
Literature Section

Guido M. Kuersteiner
Assistant Professor
Department of Economics

Nicholas C. Makris
Assistant Professor
Department of Ocean Engineering

Mary Ellen Mclaughlin
Assistant Professor
Athletic Department

Michael B. Mikhail
Assistant Professor of Management
Sloan School of Management

Youngme Moon
Assistant Professor
Program in Writing and Humanistic Studies

George A. Plesko
Assistant Professor of Management
Sloan School of Management

Martin F. Polz
Assistant Professor
Department of Civil and Environmental Engineering

Krishna Rajagopal
Assistant Professor
Department of Physics

Jeffrey S. Ravel
Assistant Professor
History Section

Ilaria Rebay
Assistant Professor
Department of Biology

Roberto Rigobon
Assistant Professor of Management
Sloan School of Management

Martin C. Rinard
Assistant Professor
Department of Electrical Engineering and Computer Science

Jowell Sabino
Assistant Professor of Management
Sloan School of Management

Peter H. Seeberger
Assistant Professor
Department of Chemistry

Brain Smith
Assistant Professor
Program in Media Arts and Sciences

Bernhardt L TROUT
Assistant Professor
Department of Chemical Engineering

Dimitrios Vayanos
Assistant Professor of Management
Sloan School of Management

Yashan Wang
Assistant Professor of Management
Sloan School of Management

Gregory A. Willard
Assistant Professor of Management
Sloan School of Management

Visiting Professor

Ravindra K. Ahuja
Visiting Professor
Sloan School of Management

David Baltimore
Visiting Professor
Department of Biology

John S. Baras
Visiting Professor
Department of Electrical Engineering and Computer Science

Yves Bernabe
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Ilene Busch-vishniac
Visiting Professor
Department of Mechanical Engineering

Stephen A. Buser
Visiting Professor
Sloan School of Management

Gert Cauwenberghs
Visiting Professor
Department of Brain and Cognitive Sciences

Chung-hwan Chun
Visiting Professor
Department of Mechanical Engineering

Ernesto J. Cortes
Martiin Luther King, Jr.
Visiting Professor
Department of Urban Studies and Planning

Supriyp Datta
Visiting Professor
Department of Electrical Engineering and Computer Science

Arthur F. Davidsen
Visiting Professor
Center for Space Research

Lloyd Demetrius
Visiting Professor
Department of Brain and Cognitive Sciences

Catherine Z. Elgin
Visiting Professor
Department of Linguistics and Philosophy

Trevor Elliott
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Diane Ghirardo
Visiting Professor
Department of Architecture

Gosta H. Granlund
Visiting Professor
Department of Mechanical Engineering

Donald W. Hearn
Visiting Professor
Sloan School of Management

Hans Hofer
Visiting Professor
Department of Physics

W. Gerard Hurley
Visiting Professor
Department of Electrical Engineering and Computer Science

William Ibbs
Visiting Professor
Department of Civil and Environmental Engineering

Karl Karlstrom
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Richard Kitney
Visiting Professor
Department of Mechanical Engineering

Joseph Klafter
Visiting Professor
Department of Chemistry

S. P. Kothari
Visiting Professor
Sloan School of Management

John E. Kuconis
Visiting Professor
Air Force Aerospace Studies

Chang-sup Lee
Visiting Professor
Department of Ocean Engineering

Jenn-taur Lee
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Nancy G. Leveson
Visiting Professor
Jerome C. Hunsaker
Department of Aeronautics and Astronautics

Zhongwei Li
Visiting Professor
Department of Aeronautics and Astronautics

Shlomo Maital
Visiting Professor
Sloan School of Management

Hirofumi Matsuo
Visiting Professor
Operations Research Center

J. Morris Mc Innis
Visiting Professor
Sloan School of Management

Alexander Mclean
Visiting Professor
Department of Materials Science and Engineering

James A. Mirrlees
Visiting Professor
Department of Economics

Johan E. Mooij
Visiting Professor
Department of Electrical Engineering and Computer Science

Rafael Navarro-gonzalez
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Craig A. Olson
Visiting Professor
Sloan School of Management

Markos Papageorgiou
Visiting Professor
Department of Civil and Environmental Engineering

Nitin R. Patel
Visiting Professor
Sloan School of Management

Randall D. Preston
Visiting Professor
Naval Science

Ramakrishnan T. Ramadas
Visiting Professor
Department of Mathematics

Debraj Ray
Visiting Professor
Department of Economics

Stephen A. Ross
Visiting Professor
Sloan School of Management

Barry G. Silverman
Visiting Professor
Harvard-MIT Division of Health Sciences andTechnology

Winthrop Smith
Visiting Professor
Research Laboratory of Electronics

Robert F. Stengel
Visiting Professor
Department of Aeronautics and Astronautics

Charles W. Therrien
Visiting Professor
Department of Electrical Engineering and Computer Science

Pin Tong
Visiting Professor
Department of Aeronautics and Astronautics

Ramanjit S. Uppal
Visiting Professor
Sloan School of Management

Michel van den Bergh
Visiting Professor
Department of Mathematics

Ethan T. Vishniac
Visiting Professor
Department of Physics

Pao K. Wang
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Anthony B. Watts
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Zheng-ren Ye
Visiting Professor
Department of Earth, Atmospheric, and Planetary Sciences

Visiting Associate Professor

Jose R. Alvarez
Visiting Associate Professor
Department of Chemical Engineering

Yannis Bakos
Visiting Associate Professor
Sloan School of Management

Mark Bils
Visiting Associate Professor
Department of Economics

Joel Cutcher-gershenfeld
Visiting Associate Professor
Sloan School of Management

Michael A. Gevelber
Visiting Associate Professor
Laboratory for Manufacturing and Productivity

Mohamad L. Hammour
Visiting Associate Professor
Department of Economics

Haym Hirsch
Visiting Associate Professor
Department of Electrical Engineering and Computer Science

Lynda M. Jordan
Visiting Associate Professor
Department of Chemistry

Louise Kellogg
Visiting Associate Professor
Department of Earth, Atmospheric and Planetary Sciences

Pamela Mccauley-bell
Visiting Associate Professor
Department of Aeronautics and Astronautics

Christos Nikolaou
Visiting Associate Professor
Department of Ocean Engineering

John A. Quinn
Visiting Associate Professor
Center for Biomedical Engineering

Daniel J. Richards
Visiting Associate Professor
Sloan School of Management

Charles Rohrs
Visiting Associate Professor
Department of Electrical Engineering and Computer Science

Victor M. Romero-rochin
Visiting Associate Professor
Department of Chemistry

K. Geert Rouwenhorst
Visiting Associate Professor
Sloan School of Management

Michael Salinger
Visiting Associate Professor
Sloan School of Management

Winston O. Soboyejo
Visiting Associate Professor
Department of Mechanical Engineering

Michael B. Sponsler
Visiting Associate Professor
Department of Chemistry

Fernando Suarez
Visiting Associate Professor
Sloan School of Management

Jeremy M. Wolfe
Visiting Associate Professor
Department of Brain and Cognitive Sciences

Satoshi Yamashita
Visiting Associate Professor
Department of Civil and Environmental Engineering

Visiting Assistant Professor

Rajiv Dant
Visiting Assistant Professor
Sloan School of Management

M. Elen Deming
Visiting Assistant Professor
Department of Urban Studies and Planning

Kenneth C. Hall
Visiting Assistant Professor
Department of Aeronautics and Astronautics

John N. Haseltine
Visiting Assistant Professor
Department of Chemistry

Thomas J. Hudson
Visiting Assistant Professor
Department of Biology

Ruth A. Judson
Visiting Assistant Professor
Sloan School of Management

Franz X. Kaertner
Visiting Assistant Professor
Department of Electrical Engineering and Computer Science

Louise Kellogg
Visiting Assistant Professor
Department of Earth, Atmospheric, and Planetary Sciences

Andrew King
Visiting Assistant Professor
Sloan School of Management

Kin-ichi Matuyama
Visiting Assistant Professor
Department of Mechanical Engineering

Pamela Mccauley-bell
Visiting Assistant Professor
Department of Aeronautics and Astronautics

Lisa G. Mcilrath
Visiting Assistant Professor
Department of Electrical Engineering and Computer Science

Steve Meachan
Visiting Assistant Professor
Department of Earth, Atmospheric, and Planetary Sciences

Kenichi Nakashima
Visiting Assistant Professor
Laboratory for Manufacturing and Productivity

Panajiotis Sakkalis
Visiting Assistant Professor
Department of Ocean Engineering

Bernd S. Siebert
Visiting Assistant Professor
Department of Mathematics

Louis Thomas
Visiting Assistant Professor
Sloan School of Management

ADMINISTRATION

DEATHS

Richard A. Knight
Secretary of the Alumni Association
Alumni Association

Salvatore Lauricella
Manager Vending and Special Functions / Manager Walker Memorial
Food Services

Marjorie S. Lucker
Administrative Officer
Department of Humanities

Idella L. Tapley
Administrative Officer
Department of Economics

RETIREMENTS

Robert D. Blake
Alumni Affairs Officer
Alumni Association

Paul R. Bragger
House Manager
Housing

Ann F. Delaney
Staff Accountant
Lincoln Fiscal Office

William R. Dickson
Senior Vice President
Office of the Senior Vice President

William F. Downes
Assistant to the Managing Director, Alumni Activities
Alumni Association

George R. Elderd, Sr.
Sergeant
Campus Police

Daniel T. Langdale
Assistant Dean for Recruitment
Graduate Education Office

Cornelius J. Murphy
Route Supervisor, Grounds Services
Superintendent's Office

Helen M. Raine
Administrative Officer
Department of Aeronautics and Astronautics

RESIGNATIONS

Jadranka Badurina-kucan
Health Education Program Assistant
Medical Department

Jessica S. Balaban
Coordinator, Educational Services
Sloan School of Management

Sarah Bancroft
Associate Director, Corporate Development
Corporate Development

Michael Barrow
Network Engineer
Service Process

Kathryn Battillo
Principal Gifts Officer
Office of the Vice President of Resource Development

Fawzi Bayyat
Senior Database Analyst
Service Process

John J. Bentley
Analyst Programmer
Lincoln Fiscal Office

Christine L. Bodoin
Financial Administrator
MIT Computer Connection

Dorothy L. Bowe
Senior Consultant
Support Process

David J. Brittan
Director Of Publications
Sloan School of Management

William B. Bumpus
Analyst Programmer
Controller's Accounting Office

Shay Cameron
Exhibits Manager
MIT Press

Sarah M. Carothers
Assistant Dean For Development
Dean of Science

Robert N. Clark, Jr.
Audit Manager
Audit Division

Sarah W. Cliffe
Editor
Sloan School of Management

Lisa D. Cohen
Senior Research Analyst
Office of Development
Research and Systems

Hope M. Colen
Research Analyst
Office of School Development Services

D. Hugh Darden
Associate Treasurer
Treasurer's Office

Emerson P. Davis
Business System Analyst
ReEngineering-Management Reporting

Erinellene Dayl
Special Assistant to the Vice President
Vice President for Information Systems

Michele E. Desautels
Facility Administrator, Learning Center
Vice President for Information Systems

Dorothy T. Devereaux
Journals Circulation Manager
MIT Press

Patrice M. Diaz-migoyo
Systems Analyst
Sloan School of Management

Dorick J. Digenti
Program Manager for Special Executive Programs
Sloan School of Management

Bruce L. Dirks
Director of Investment Strategy
Treasurer's Office

Anne L. Drazen
Assistant Dean
Sloan School of Management

Matthew R. Duffy
Manager, Founders Project
Office of Development
Research and Systems

Carol A. Elder
Consultant
Support Process

Eric P. Epstein
Coach, Repair And Maintenance
Physical Plant

L. Acquanetta C. Farrell
Performance Consultant
Personnel Office

Craig Alan Fields
Systems Programmer
Delivery Process

Joan M. Frank
Circulation Manager/ Promotions, Technology Review
Alumni Association

David E. Geist
Associate Technology Licensing Officer
Technology Licensing Office

Jeannette L. Gerzon
Associate Director, Counseling and Preprofessional Advisor
Career Services and Preprofessional Advising

Patricia J. Gilardi
Senior Analyst Programmer
ReEngineering-Management Reporting

Barbara Gilbert Winn
Electronic Publishing Coordinator
MIT Press

Christina M. Gonzalez
Analyst Programmer
Lincoln Fiscal Office

Marjory Gooding
Acting Director of the International Scholars Office
Office of the Provost

Clifford St. Julian Goodridge
Contract Administrator
Office of Sponsored Programs

Marc D. Gunderson
Systems Analyst
Office of Development
Research and Systems

Robert Russman Halperin
Director Of Executive Education
Sloan School of Management

Seongae Han
Retirement Benefits Administrator
Personnel Office

Nancy A. Hannula
Purchasing Agent
General Purchasing Department

Stephanie Harriston-Diggs
Senior Major Gifts Officer
Office of Individual Giving

Patricia Healey
Manager, Corporate Resource Center, Career Development Office
Sloan School of Management

Nancy A. Heywood
Archival / Manuscript Specialist
Libraries

Erin Rae Hoffer
Director, I / T Staff Development and Resource Management
Vice President for Information Systems

Deborah R. Hopkins
Program Manager, Alumni Activities
Alumni Association

William S. Irving
Audit Manager
Audit Division

Anthony James Ives
Team Leader/ Member
Uesa Operations and Administration

Margaret A. Jablonski
Associate Dean And Section Head
Office of the Dean of Students and Undergraduate Education

Shyamal A. Jajodia
Auditor
ReEngineering-Management Reporting

Kristen D. Jenkins
Assistant Accounting Officer
Controller's Accounting Office

Elisabeth Kaplan
Archival / Manuscript Specialist
Libraries

Joanne M. Katz
Manager
Campus Activities Complex

Kevin Kelleher
Analyst Programmer
Student Information Systems

Cheryl A. Kennedy
Administrative Assistant
Industrial Liaison Program

Philip J. Keohan
Comptroller Emeritus
Vice President for Finance and Treasurer

Timothy W. Keohan
Assistant Director for Automated Systems
ReEngineering-Management Reporting

Jenny Lien Khuon
Analyst Programmer
Integration Process

Anita Killian
Associate Director of Resource Development
Sloan School of Management

Carol A. Lademan
Project Manager, Enterprise Forum
Alumni Association

Mark C. Lamphier
Export Sales Representative
MIT Press

John M. Landry
Associate Director Of Major Gifts
Office of Individual Giving

David R. Le Pere
Sales Manager, Domestic Sales
MIT Press

Nelson Lee
Consultant
Alumni Association

Peter Yong-Pyo Lee
Consultant
Support Process

Joseph F. Lendall
Senior Subcontract Administrator
General Purchasing Department

Bruce Lewis
Analyst Programmer
Delivery Process

Ling Li
Financial Analyst
Sloan School of Management

Wai-ming Li
Senior Analyst Programmer
ReEngineering-Management Reporting

Pamela E. Lomax
Assistant Director, School Development Services
Office of School Development Services

Philip J. Lopiccolo
Senior Editor, National Pages, Technology Review
Alumni Association

David I. Lukas
Consultant
Support Process

Brian Lynch
Licensing Associate
Technology Licensing Office

Awinash Manmade
Safety Officer and Manager, Chemical Waste Program
Safety Office

Steven J. Marcus
Editor, Technology Review
Alumni Association

Jennifer Markowitz
Admissions Counselor
Admissions Office

Elizabeth M. Martin
Program Manager for Special Executive Programs
Sloan School of Management

Gail M. Masci
Analyst Programmer
Office of Development
Research and Systems

John R. Mason
Budget Officer
Office of Budget and Financial Planning

Karon S. Mc Collin
Senior Business Systems Analyst
ReEngineering-Management Reporting

Stacy E. Mc Geever
Admissions Counselor
Admissions Office

Katherine J. Miller
Broker-Electronic Publishing
Public Relations Services

Thomas R. Moebus
Director of Corporate Relations
Office of the Vice President of Resource Development

Greta M. Morgan
Senior Research Analyst, Resource Development
Office of School Development Services

Thomas Mullins
Director For Administration and Finance, Information Systems
Vice President for Information Systems

Wendy C. Neubert
Contract Administrator
Office of Sponsored Programs

Armando Neves
Analyst Programmer
Personnel Office

Steven Anders Oakland
Analyst Programmer
Delivery Process

Nancy L. Olt
Retirement Programs Consultant
Personnel Office

Jennifer H. Pearce
Associate Director, Annual Fund, Sloan/ Coordinator of Development Data
Sloan School of Management

Colleen A. Perella
Investments Operations Administrator
Treasurer's Office

Helaine J. Posner-Dorsky
Curator
List Visual Arts Center

Brett D. Rosen
Consultant
Support Process

Christopher Salter
Coach, Repair and Maintenance
Physical Plant

John M. Saylor
Consultant
Network Business

Laura M. Scarlett
Assistant Director, School Development Services
Office of School Development Services

Linda J. Scatamacchia
Business System Analyst
ReEngineering-Management Reporting

Randall L. Schaller
Director Of Conference Planning
Endicott House

Ellen D. Schemerhorn
Administrative Assistant
Campus Activities Complex

Denise K. Scott
Administrator, Astrophysical Journal Editorial Office
Department of Physics

Laurel A. Simmons
Administrative Assistant
Department of Electrical Engineering and Computer Science

John Solmonese
Assistant Manager, Administration
Office of Development
Research and Systems

C. Alexander Soule
Coordinator of Master's Admissions
Sloan School of Management

John R. Squillante
Performance Consultant
Vice President for Human Resources-ReEngineering

Christopher Sean Tappendorf
Consultant
Support Process

Caroline M. Thomas
Coordinator, Reunion Giving
Alumni Association

Virginia D. Tulloch
Senior Analyst Programmer
Office of the Dean of Students and Undergraduate Education
Information Technology

Cynthia L. Vallino
Project Manager
Vice President for Human Resources-ReEngineering

William Velez
Systems Coordinator
Libraries

Kimball C. Warren
Consultant
ReEngineering-Management Reporting

Laurie A. Way
Senior Research Analyst, Resource Development
Office of Development
Research and Systems

Susan M. Wilson
Subcontract Buyer
Central Subcontracting Office

Zhishan Xu
Librarian
Libraries

Caryn Youngholm
Coach
Student Services Center

Carol A. Zoppel
Librarian
Libraries

NEW APPOINTMENTS

Michele C. Assaf
Program Associate
Office of the Arts

Deborah M. Atwood
Administrator
Credit Union

Michael Baenen
Staff Associate
Office of the President

Laura Baldwin
Consultant
Support Process

Joseph M. Beauregard
Financial Administrator
Sloan School of Management

Peter D. Bedrosian
Assistant to The Registrar, Classroom Management
Registrar's Office

Preston D. Todd Belton
Systems Programmer
Delivery Process

John Benditt
Editor, Technology Review
Alumni Association

Margaret M. Best
Program Administrator, System Design And Management
School of Engineering

Angela R. Blossom
Consultant
MIT Computer Connection

Florence Boisse-kilgo
Senior Production and Editorial Coordinator
MIT Press

Theresa M. Bouchard
Purchasing Agent
General Purchasing Department

Denise Brehm
Staff Writer/ Editor
Public Relations Services

Monica R. Brettler
Business System Analyst
ReEngineering-Management Reporting

Michele Brodeur
Network Administrator
Treasurer's Office

Thomas Bushnell
Systems Programmer
Delivery Process

Regina A. Caines
Special Assistant to the Vice President for Equal Opportunity and Affirmation Action Programs
Personnel Office

Donna J. Cairns
Staff Accountant
Controller's Accounting Office

Priscilla A. Caissie
Assistant Contract Administrator
Office of Sponsored Programs

Corrine L. Callahan
Circulation Manager/Promotions, Technology Review
Alumni Association

Alison S. Carrier
Assistant Director, School Development Services
Office of Development
Research and Systems

Francis D. Cassidy
Industrial Liaison Officer
Industrial Liaison Program

Cheryl Charles
Administrative Assistant
Department of Electrical Engineering and Computer Science

Roy A. Charles
Assistant Dean for Recruitment
Graduate Education Office

Lichu Carol Chen
Senior Analyst Programmer
Controller's Accounting Office

Raymond O. Cheng
Auditor
Audit Division

Daniel S. Cho
Research Analyst
Office of School Development Services

Valerie L. Chu
Personnel Officer
Personnel Office

James L. Coleman
Exhibits Manager
MIT Press

James M. Collins
Assistant to the Dean, Counseling and Support Services
Office of the Dean of Students and Undergraduate Education

Peggy Conant
Consultant
ReEngineering-Management Reporting

Richard M. Connelly
Staff Accountant
Controller's Accounting Office

Susan E. Connelly
Supervisor, Mental Health Services
Medical Department

Kevin M. Connolly
Coach, Repair and Maintenance
Physical Plant

Melissa K. Cook
Senior Analyst Programmer
Vice President For Information Systems

Nora E. Costa
Manager of Compensation
Personnel Office

Craig A. Counterman
Consultant
Support Process

Mary Coyne
Information Specialist
Industrial Liaison Program

Jennifer Crenshaw Martinez
Research Analyst
Office of School Development Services

Marilyn A. Cronin
Coordinator, Corporate Resource Center
Sloan School of Management

Francine J. Crystal
Performance Consultant
Vice President for Human Resources-ReEngineering

D'moon Cuizhang
Business System Analyst
Vice President for Information Systems

Daniel Da Cunha
Analyst Programmer
Lincoln Fiscal Office

Paul Dakin
Manager, Founders Project
Office of Development
Research and Systems

Robert Davine
School S A P Coordinator
ReEngineering-Management Reporting

Lisa L. Desautels
Senior Research Analyst, Resource Development
Office of Development
Research and Systems

John C. Desforge
Financial Administrator
Department of Mechanical Engineering

James Dezieck
Performance Consultant
Vice President for Human Resources-ReEngineering

Joseph M. Dhosi
Administrative Staff
Department of Materials Science and Engineering

Hans Dietrich
Consultant
Libraries

Allison F. Dolan
Director, I / T Staff Development and Resource Management
Vice President for Information Systems

John J. Donnelly
Budget Officer
Office of Budget and Financial Planning

George E. Dow, Jr.
Administrator
Credit Union

J. Darcy Duke
Supervisor, Circulation Services
Libraries

Christine M. Dunn
Sales Representative
MIT Press

Marylin H. Eastwood
Supervisor, Technical Processing Services
Libraries

James C. Eggleston
Librarian
Libraries

Scott R. Ehrlich
Consultant
Support Process

George R. Elderd, Jr.
Staff Accountant
Controller's Accounting Office

William A. English
ANALYST Programmer
Controller's Accounting Office

Nina L. Erlich
Staff Assistant
UESA Operations and Administration

Carole A. Ferrari
Recruiting Coordinator, Career Services
Career Services and Preprofessional Advising

Rita M. Filipowicz
Assistant Office Manager and Patent Administrator
Technology Licensing Office

Daniel W. Fitzgerald
Senior Project Manager
Delivery Process

David B. Fitzgerald, III
Consultant
ReEngineering-Management Reporting

Thomas A. Fitzgerald
Network Manager
Department of Architecture

Anthony J. Flaherty
Subcontract Administrator
Central Subcontracting Office

John J. Fothergill, Jr.
Consultant
Support Process

Abigail J. Fox
Consultant
Support Process

Terrill L. Gadde
Personnel Administrator
Harvard-MIT Division of Health Sciences and Technology

Gertraud E. Gillen
Fiscal Officer
Administrative Services: Chemical Engineering / Materials Science and Engineering

Paul G. Gillespie
Director of Advertising Sales, Technology Review
Alumni Association

Dina Marie Given
Consultant
Alumni Association

Kenneth A. Goldsmith
Budget Officer
Office of Budget and Financial Planning

Elva Green
Assistant to the Director
Student Financial Aid Office

Ricky A. Gresh
Program Coordinator For Student Activities
Office of the Dean of Students and Undergraduate Education
Operations and Administration

Jennifer M. Griffin
Auditor
Audit Division

Timothy Griffin
Consultant
Support Process

Christopher G. Griffith
Consultant
Support Process

Carrie L. Groves
Network Administrator
ODSUE Information Technology

Rosanne Guerriero
Health Educator For Students
Medical Department

Diana J. Haladay
Performance Consultant
Vice President for Human Resources-ReEngineering

Deborah Halber
Staff Writer/ Editor
Public Relations Services

Dorothy J. Hall
Consultant
Support Process

Donna M. Hayes
Supervisor of Dental Service
Medical Department

Sheila Hegarty
Operations and Financial Administrator
Department of Brain and Cognitive Sciences

Denise Heintze
Graduate Student Administrator
Department of Brain and Cognitive Sciences

Scott Hewitt
Business System Analyst
ReEngineering-Management Reporting

Anita I. Horn
Systems Analyst
Sloan School of Management

Stephanie Houston
Publications Coordinator
Office of the Dean of Students and Undergraduate Education

Nancy A. Howells
Consultant
Alumni Association

Monica A. Huggins
Coordinator, Public Service Center
Office of the Dean of Students and Undergraduate Education

Gerald Hughes
Coach, Repair And Maintenance
Physical Plant

Jonathan M. Hunt
Consultant
Support Process

Karlyne A. Hutchings
Senior Technical Writer
ReEngineering-Management Reporting

Leendert In't Veld
Curriculum Coordinator
S D M
School of Engineering

Thomas R. Ittelson
Technology Licensing Officer
Technology Licensing Office

David C. Johnson
Consultant
Libraries

Carl A. Jones
Head, Library Systems Office
Libraries

Edmund A. Jones
Staff Associate, Student Activities Finances
Office of the Dean of Students and Undergraduate Education

Heather E. Jones
Property Auditor
Lincoln Fiscal Office

Erika Lee Jonietz
Admissions Counselor
Admissions Office

Nancy E. Joyce
Senior Project Manager, Construction
Physical Plant

Donald N. Kaiser
Associate Technology Licensing Officer
Technology Licensing Office

Erja H. Kajosalo
Librarian
Libraries

Erica Kates
Research Analyst
Office of School Development Services

Margaret S. Keller
Associate Director of Resource Development
Sloan School of Management

Kristin M. Kelley
Marketing Coordinator, Technology Review
Alumni Association

Leonard Kimble
Consultant
Vice President for Information Systems

Fritz C. Kokesh
Assistant Director
Office of Sponsored Programs

Jennifer Dillman Kratochwill
School S A P Coordinator
ReEngineering-Management Reporting

Christopher J. Lacava
Systems Analyst
Graduate Education Office

Maura M. Lavalle
Financial Administrator
Center for Advanced Educational Services

Shelly Ann Lavallee
Retirement Benefits Administrator
Personnel Office

Arthur D. Leather
Systems Programmer
Delivery Process

Ann Marie Leblanc
Financial Analyst
Sloan School of Management

Monica Lee
Broker-Electronic Publishing, P S B
Public Relations Services

Kaitlyn Liao
Consultant
Support Process

Leslie A. Liu
Budget Officer
Vice President for Information Systems

Timothy P. Lizek
Research Analyst
Office of School Development Services

Peter A. Luongo
Systems Analyst
Sloan School of Management

K. Robert Malone
Administrative Officer
Harvard-MIT Division of Health Sciences and Technology

Sandra D. Manassa
Auditor
Audit Division

Michael R. Mappes
Consultant
Sloan School of Management

Helene G. Martin
Director of Development
Department of Electrical Engineering and Computer Science

Patrick K. Marx
Special Asistant to the President for Communications
Office of the President

Kimberly A. Maxwell
Librarian
Libraries

Susan S. Maynard
Alumni Affairs Officer
Alumni Association

Jacquelin S. Mc Bride
Senior Planning Officer
Planning Office

Ann G. Mc Cann
Senior Major Gifts Officer
Office of Individual Giving

Joseph A. Mc Carthy
Supervisor, Dormitory Patrol
Housing

Cassandra L. Mc Dermott
Circulation Manager/Promotions, Technology Review
Alumni Association

Mary A. Mc Gonagle
Assistant Contract Administrator
Office of Sponsored Programs

Carolyn V. Mc Kenna
Staff Accountant
Technology Licensing Office

William E. Mc Shea, Jr.
Assistant Safety Officer
Safety Office

Stephen L. Michaels
Industrial Liaison Officer
Industrial Liaison Program

Angela Mickunas
Budget Officer
Office of Budget and Financial Planning

Peter A. Milt
Analyst Programmer
Controller's Accounting Office

Stephen M. Monahan
Staff Accountant
Controller's Accounting Office

Brent H. Morgan
Assistant to the Controller
Controller's Accounting Office

Lyle Clay Morgan
Acquisition Editor
MIT Press

John A. Morgante
Facilities Analyst
Service Process

Christine L. Moulen
Assistant Head, Library Systems Office
Libraries

Peter F. Muise
Alumni Affairs Officer
Alumni Association

Ricky L. Murphy
Operations Supervisor
Campus Activities Complex

Kristen Nesselrod
Financial Administrator
MIT Computer Connection

Cuong Phu Nguyen
Systems Programmer
Delivery Process

Eric Novak
Associate Planning Officer
Planning Office

Theresa M. O'Brien
Administrator
Credit Union

Eileen L. O'keefe
Manager For Finance, MIT Health Plans
Medical Department

Allison Parisi
Financial Analyst
Medical Department

Elizabeth W. Parmelee
Academic and Personnel Coordinator
Department of Nuclear Engineering

Jagruti S. Patel
Consultant
Support Process

Mark A. Perkins
Senior Project Manager
Medical Department

Joan M. Petrowsky
Subcontract Buyer
Central Subcontracting Office

Tanya Pfeffer
System Support Assistant
MIT Press

Daniel J. Pope
Technical Writer
ReEngineering-Management Reporting

Christopher G. L Pratt
Director, Career Services And Preprofessional Advising
Office of the Dean of Students and Undergraduate Education

Antonio E. Regalado
Staff Writer/ Editor
Alumni Association

Karl W. Reid
Executive Director of Special Programs
School of Engineering

Lisa C. Reinherz
Systems Analyst
Department of Economics

Victoria M. Richardson
Assistant Acquisition Editor
MIT Press

John W. Ries
Auditor
Audit Division

Deborah S. Rosencrans
Asistant Director Career Services and Preprofessional Advising

David P. Rotman
Senior Editor, National Pages, Technology Review
Alumni Association

Ronnie B. Rump
Performance Consultant
Vice President for Human Resources-ReEngineering

Sebastien Sabre
Senior Database Analyst
Service Process

Joseph G. Schatz
Technology Licensing Officer
Technology Licensing Office

Kimberly I. Schive
Staff Writer/ Editor
Medical Department

Leanne Schnitzer
Coordinator, Alumni Relations
Sloan School of Management

Nancy C. Semonian
Assistant Director, School Development Services
Office of School Development Services

Amy Seybold-burke
Program Director For Reunions And Events
Alumni Association

Cheryl L. Sirna
Librarian
Libraries

Nancy Duvergne Smith
Assistant Communication Director
Sloan School of Management

Prajitno Ormin Soediono
Authorization Administrator
ReEngineering-Management Reporting

Patrick E. Song
Programmer/Analyst
Medical Department

Sheila M. Spahn
Associate Director, Foundation Relations And School Development Services
Office of Foundation Relations

Mary K. Speare
Senior Major Gifts Officer
Office of Individual Giving

Daniel M. Spiess
Assistant Planning Officer
Planning Office

Terry L. Spurling
Consultant
MIT Computer Connection

Blanche E. Staton
Associate Dean for Graduate Education
Graduate Education Office

Virginia Steel
Associate Director for Public Services
Libraries

Laurence C. Stone
Systems Programmer
Delivery Process

Scott R. Stordy
Electrical/Controls Engineer
Physical Plant

Anthanette L. Stotts
Export Sales Representative
MIT Press

Andrea L. Surette
Benefits Counselor
Personnel Office

Kerry E. Swift
Licensing Associate
Technology Licensing Office

Nicola Anne Tahsin
Financial Administrator
Department of Chemistry

Cecilia E. Talamantes
Financial Administrator
Department of Chemistry

Mary Tamer
Staff Writer/ Editor
Alumni Association

James G. Thompson
Accounting Officer
Controller's Accounting Office

Janice C. Thompson
Major Gifts Officer
Office of Individual Giving

Joan C. Thompson
Librarian
Libraries

Carl C. Trapani
Analyst Programmer
Property Office

David G. Turnquist
Analyst Programmer
Office of Budget and Financial Planning

Callum J. Valleli
Analyst Programmer
Physical Plant

Abigail Mieko Vargus
Alumni Affairs Officer
Alumni Association

Christine M. Verick
Consultant
Support Process

James H. Wallace
Assistant to the Director For Special Services
Physical Plant

Margaret A. Warner
Associate Director
Office of Budget and Financial Planning

Margaret H. Warren
Assistant Director, Career Development
Sloan School of Management

Michael J. Whitson
Systems Programmer
Service Process

Jennifer Wilinsky
Alumni Affairs Officer
Alumni Association

Gayle C. Willman
Consultant
Libraries

Brian C. Winsor
Construction Coordinator
Physical Plant

Chia-ying David Yang
Webmaster
Alumni Association

Rebecca Zacks
Staff Writer/ Editor
Alumni Association

Susan B. Ziemba
Instructional Course Designer
Vice President for Human Resources-ReEngineering

CHANGES OF APPOINTMENT

Maureen Ahern
Purchasing Agent
General Purchasing Department

Lyle G. Aker
Property Manager
Lincoln Fiscal Office

Louis E. Alexander
Alumni Affairs Officer
Alumni Association

Alicia L. Allen
Consultant
Support Process

Marion I. Bagley
Assistant Manager, Special Business Solutions, MCC
Service Process

Derrick Barnes
House Manager
Housing

Elizabeth Barnes
Assistant to the Director
Student Services Center

Mary Barry
Assistant to the Bursar, Student Services
Student Services Center

Claude C. R Bellot
Budget Officer
Office of Budget and Financial Planning

Denise E. Blacker
Assistant Accounting Officer
Controller's Accounting Office

Gary J. Boilard
Subcontract Administrator
General Purchasing Department

Cheryl A. Botelho
Senior Staff Accountant
Controller's Accounting Office

Michael Bowers
Auditor
Audit Division

Sharon M. Bridburg
Special Assistant to the Dean, for Personnel Administration
Office of the Dean of Students and Undergraduate Education

Steven M. Burke
Team Leader
Office of the Dean of Students and Undergraduate Education

Mary R. Callahan
Co-Director, Academic Services and Registrar
Office of the Dean of Students and Undergraduate Education

Alice Cavallo
Analyst Programmer
Office of the Dean of Students and Undergraduate Education, Information Technology

Eric F. Celeste
Asistant Director For Techology Planning And Administration
Libraries

Melinda G. Cerny
Program Coordinator, Advanced Study Programs
Center for Advanced Educational Services

Anddie M. Chan
Manager of Corporate Relations
Corporate Development

Nathanial G. Charles
Network Manager
Sloan School of Management

Alexander S. Chisholm
Major Gifts Officer
Office of Individual Giving

John H. Christel
Assistant Director, School Development Services
Office of School Development Services

Jo-anne M. Chute
Property Administrator
Property Office

Vincent P. Clark
Senior Project Manager, Construction
Physical Plant

Laurence Cohen
Associate Director for Acquisitions
MIT Press

Daniel P. Conceison
Assistant Manager
Campus Activities Complex

Daniel P. Conceison
Operations Supervisor
Campus Activities Complex

Jean Margaret Connolly
Alumni Affairs Officer
Alumni Association

Martha A. Connors
Associate Publisher, Technology Review
Alumni Association

Traci Trotzer Considine
Director of Conference Planning
Endicott House

Cecilia Ann Corey
Assistant Director, Student Financial Aid Office
Student Services Center

Leona A. Cresey
Accounting Officer
Lincoln Fiscal Office

Janet L. Cronin
Financial Administrator
Industrial Liaison Program

D'moon Cuizhang
Business System Analyst
Controller's Accounting Office

John G. Cunningham
Senior Accounting Officer
Controller's Accounting Office

Glenn T. Curtis
Purchasing Agent
General Purchasing Department

Mark J. Damian
Senior Business Systems Analyst
ReEngineering-Management Reporting

Nina J. Davis-millis
Information Technology Librarian
Libraries

Robert B. Dimmick
Alumni Affairs Officer
Alumni Association

Lisa M. Donovan
Analyst Programmer
Office of Development Research and Systems

Veronica R. Du Long
Accounting Officer
Controller's Accounting Office

Shawn P. Dunn
Analyst Programmer
ODSUE Information Technology

Lynne E. Durland
Data Base Analyst
Service Process

Cheryl I. Eccles
Assistant to the Department Head For Business Affairs
Athletic Department

Robin C. Elices
Administrative Officer
Department of Earth, Atmospheric, and Planetary Sciences

Janice Ellertsen
Section Administrative Officer
Literature Section

Margaret S. Enders
Co-Director, Academic Services and Associate Dean of Curriculum Support
Office of the Dean of Students and Undergraduate Education

Daniel T. Engelhardt
Manager, Commencement and Graduate Degree Audit
Student Services Center

John W. Erkkila
Government Property Administrator
Property Office

William J. Fitzgerald
Fiscal Officer
Vice President for Information Systems

Teresa Flannery
Alumni Affairs Officer
Alumni Association

Eileen M. Francis
Assistant Director, Capital Budget
Office of Budget and Financial Planning

Dennis W. Franczak
Business System Analyst
ReEngineering-Management Reporting

Sarah E. Gallop
Co-Director, Office of Govenment and Community Relations
Office of the President

Rod Garcia
Director of Master's Admissions
Sloan School of Management

Jane H. Gebhart
Editor-In-Chief, Sloan Management Review
Sloan School of Management

Virginia Gifford
P C Lab Manager
Sloan School of Management

Dianne M. Goldin
Director of New England Region
Office of Individual Giving

Stephen B. Goldman
Consultant
Support Process

Stephanie V. Grepo
Senior Research Analyst, Resource Development
Office of Development Research and Systems

Gary W. Gresh
Assistant Director, School Development Services
Office of School Development Services

Sarah Jane Gunter
Alumni Affairs Officer
Alumni Association

Mary L. Hanifin
Associate Director, Foundation Relation and School Developemnt Services
Office of School Development Services

Jennifer R. Havlicek
Assistant Director
Admissions Office

Paul Heffernan
Software Acquisition Coordinator
Support Process

John L. Henriques
Supervisor Of Administration Telecommunications Systems

Sarah J. Hernandez
Assistant to the Bursar, Control and Accounting
Student Services Center

Maura Herson
Program Coordinator, Master's Program
Sloan School of Management

Greg Hudson
Systems Programmer
Network Business

Marshall Hughes
Program Administrator, Freshman Intership Program
Office of the Provost

Stephen D. Immerman
Director of Project Development
Office of the Senior Vice President

Anastasia J. Janus
Accounting Officer
Controller's Accounting Office

Martha R. Jennings
Manager
President's House

Vicki S. Jennings
Sales Manager, Domestic Sales
MIT Press

Joanne Jones
Purchasing Agent
General Purchasing Department

Marilee Jones
Dean Of Admissions
Office of the Dean of Students and Undergrad Educ

Martine L. Kaiser
Associate Technology Licensing Officer
Technology Licensing Office

Lisa A. Kaminski
Director, Special Executive Programs
Sloan School of Management

Sheila M. Kanode
Assistant Dean for Finance And Personnel
School of Engineering

Joseph D. Keohan
Accounting Officer
Controller's Accounting Office

Kathryn T. Kibbee
Project Manager, I. S Training and Development
Vice President for Information Systems

Gregory A. Knight
Manager, Facilities Information
Physical Plant

Ori Kometani
Senior Designer
MIT Press

Linda L. Lancaster
Area Manager
ReEngineering-Management Reporting

Douglas J. Le Vie
Accounting Officer
Controller's Accounting Office

Kenneth F. Le Vie, Jr.
Accounting Officer
Controller's Accounting Office

Janet C. Littell
Senior Technical Writer
Support Process

Cynthia D. Lubien
Assistant Dean for Development
Dean of Science

E-ping Lucia Ma
Senior Analyst Programmer
ReEngineering-Management Reporting

Paul W. Mac Donald
Property Administrator
Property Office

Robert E. Mahoney
Senior Consultant
Service Process

Marlene Manoff
Associate Head Librarian
Libraries

Michael R. Mappes
Systems Analyst
Sloan School of Management

Steven C. Mc Cluskey
Business System Analyst
ReEngineering-Management Reporting

Melissa M. Mcnamara
Senior Staff Accountant
Lincoln Fiscal Office

Mary J. Murray
Assistant to the Bursar, Student Services
Student Services Center

Robert Murray
Communications Manager
ReEngineering-Management Reporting

David W. Myers
Manager of Design and Construction
Physical Plant

Peter J. Narbonne
Manager of Operations
Office of Development
Research and Systems

Karen A. Nilsson
Assistant Director for Administration
Physical Plant

Michael Kobina Owu
Senior Planning Officer
Planning Office

Lillian R. Paratore
Associate Director, Annual Fund, Sloan/Coordinator of Devlepoment Data
Sloan School of Management

Paul Parravano
Co-Director, Office of Government and Community Relations
Office of the President

Susan A. Petrie
Publisher, Sloan Management Review
Sloan School of Management

Susan A. Petrie
Director of Business Affairs, Sloan Management Review
Sloan School of Management

Shirley M. Picardi
Senior Project Manager
ReEngineering-Management Reporting

Christine M. Rinaldi
Director Of New York Metro/Mid-Atlantic South Region
Office of Individual Giving

Laura M. Robinson
Director, Management of Technology Program
Sloan School of Management

Janet L. Sahlstrom
Administrative Officer
Department of Political Science

Debra J. Sears
Business System Analyst
ReEngineering-Management Reporting

Janet Lynn Serman
Alumni Affairs Officer
Alumni Association

Douglas Sery
Acquisition Editor
MIT Press

Mohammad Sharari
Consultant
Integration Process

Ann Davis Shaw
Assistant Dean/Assistant Director, Office of Minoirity Education
Office of the Dean of Students and Undergraduate Education

Michael S. Sherman
Analyst Programmer
Physical Plant

Robert M. Slauzis
Senior Budget Officer
Office of Budget and Financial Planning

Marilyn T. Smith
Administrative Officer
Department of Biology

Robert W. Smyser
Senior Consultant
Support Process

Lydia S. Snover
Assistant Director, Planning And Research
Planning Office

Cynthia S. Souza
Space Information Officer
Physical Plant

Brian E. Tavares
School SAP Coordinator
ReEngineering-Management Reporting

Christine Tempesta
Alumni Affairs Officer
Alumni Association

Janice C. Thompson
Senior Major Gifts Officer
Office of Individual Giving

Scott Thorne
Technical Supervisor
Integration Process

Susan B. Tomases
Director of New Business Development
Alumni Association

Tina M. Trager
Assistant Manager, Events Planning
Campus Activities Complex

Wayne T. Turner
Assistant to the Controller
Controller's Accounting Office

William C. Van Schalkwyk
Safety Officer and Manager, Chemical Waste Program
Safety Office

Marie T. Vander Sande
Manager of Corporate Relations Communications
Industrial Liaison Program

Abigail Mieko Vargus
Staff Writer/ Editor
Alumni Association

Jonathan Jacob Venezian
Analyst Programmer
Network Business

David A. Weber
Director of Academic and Financial Services
Office of the Dean of Students and Undergraduate Education
Operations and Administration

Patricia M. Weinmann
Assistant Coordinator, Technical and Culture Seminar
Office of the Dean of Students and Undergraduate Education

Mary Catherine Weisse
Data Administrator
Integration Process

Anne Hartung Whealan
Assistant Director for Finance and Accounting
Physical Plant

Jane F. White
Consultant
ReEngineering-Management Reporting

Lori J. White
Journals Circulation Manager
MIT Press

Jean M. Wilcox
Assistant Design Manager
MIT Press

John S. Wilson
Director, Foundation Relations and School Development Services
Office of the Vice President of Resource Development

David J. Woodward
Financial Planning Officer
Office of Budget and Financial Planning

Grant A. Young
Systems Programmer
Service Process

Thomas L. Yu
Systems Programmer
Integration Process

PUBLIC RELATIONS SERVICES

The offices within Public Relations Services support the mission of the Institute by enhancing public understanding of MIT and of higher education and research more generally and supporting the community life of the Institute through communications and special events. The academic year 1997-98 was eventful for the Institute and for Public Relations Services on all these fronts.

Unquestionably the high point of the year was the 1998 Commencement exercises, which marked the first occasion on which a sitting President of the United States had spoken at MIT. Gayle M. Gallagher, Executive Officer for Commencement, showed extraordinary energy and talent in organizing the event, which involved the participation of staff from all areas of the Institute and placed exceptional demands on the staff of Conference Services, Events, and the Information Center, as well as the News Office. With the welcome cooperation of the weather, the day surpassed all expectations. Earlier in the year the Institute hosted the successful National Innovation Summit, sponsored by the Council on Competitiveness. Speakers at the Innovation Summit included the Vice President of the United States and leaders in business, government, and academia.

This marked the first full academic year of operations for the Publishing Services Bureau (PSB). PSB and the Communications Office moved to new office space shared with Campus Wide Information Systems (CWIS) in Building E28 in Kendall Square. Open for business in February, the office space provides an inviting professional environment for the staff to serve the needs of the MIT publishing community. Generous meeting space draws vendors and members of the MIT community for small and large group discussions regarding unique projects as well as publishing topics of broader interest. The new space has allowed the three offices to collaborate even more effectively on the design and delivery of information about MIT to a diverse range of audiences in a range of media.

During the year, Patrick K. Marx joined the Institute in the new position of Special Assistant to the President for Communications. Members of all the offices within Public Relations Services have been working with him in the development of strategies to bring the Institute's messages to the public, press, and government as vigorously and effectively as possible.

Kathryn A. Willmore

COMMUNICATIONS OFFICE

The Communications Office publishes official reference information on MIT's educational, research, administrative, and financial policies and programs that is current, accurate, and accessible, in print and electronic versions; distributes publications; and disseminates information available through the office. In conjunction with PSB, the Office advises and assists the MIT community regarding publishing policies and procedures.

HIGHLIGHTS OF THE YEAR

In its role as customer of and partner with the bureau, the Communications Office continues to model publishing solutions with the Institute's key reference publications. This year, for example, the Office worked closely with PSB on the design of cover templates for the *Reports to the President* and *Reports of the Treasurer*, as well as the MIT telephone directories. This work underscores the importance of design in creating and strengthening a visual identity for MIT with its publications.

Over the past year, the staff in the Communications Office collaborated with the Office of the Dean of Students and Undergraduate Education (ODSUE) on various communications projects. This work entailed supporting the development of publication plans for the former CAP Guide and a proposed student handbook; serving as team members on the ODSUE communications affinity team; developing the ODSUE web site; and contributing significantly to the team's final report to Dean Rosalind H. Williams. The focus of ongoing projects is on understanding and planning the next generation of publications (the "catalogue-of-the-future"), especially with regard to the relationship between information published in print and on the World Wide Web. Teams are conducting a communications audit of the course catalogue as well as rethinking the production of the IAP Guide (another one of four issues of the MIT Bulletin).

This year, in collaboration with Information Systems, the Office completed the delivery phase of its project to develop a web interface to the "blue pages" of the telephone directories. Information on MIT's offices and programs, stored in a FileMaker database, enables the Office to publish current information on MIT's web site as well as in print directories published annually. The site is located at http://web.mit.edu/communications/bp/

FUTURE PLANS

The Communications Office plans the following for the coming academic year:

- With Academic Services in the Dean's Office and CWIS, develop the partnership that focuses on publishing academic information for MIT's undergraduate and graduate students. This work includes the communications audit of the *MIT Bulletin*, publication of the degree charts online, and the development of a content repository for "modules" of academic information, offering Institute publishers ready access to official reference information online (agile publishing).

- With the Graduate Education Office, develop a communications strategy for the office's print and World Wide Web publications.

- With the Publishing Services Bureau, create a comprehensive organization chart for MIT designed especially for the World Wide Web. This dynamic chart will clarify the structure of the multifaceted, multilayered, complex organization that is the Institute.

- In conjunction with the Admissions Office, continue work with targeted customers. Follow up on this year's survey of 514 "early admits" who evaluated the usefulness and accessibility of information in the current print catalogue (in positive terms). Track this cohort and their reactions to changes in print and online catalogue information as they progress through MIT.

PERSONNEL

The Communications Office was delighted to offer Shannon McCord a full-time support staff position beginning last November. With this additional support, the Office was able to complete projects long on its "wish list." Shannon contributed significantly to redesign of the web site, publication of the editorial style guidelines for the course catalogue, and achieving a major milestone with the "blue pages project." This strong support has enabled the Office's two administrative staff — Barrie Gleason and Ruth Davis — to contribute in larger measure to publishing collaborations across campus, especially with the Dean's Office and the Graduate Education Office.

More information about the Communications Office can be found on the World Wide Web at http://web.mit.edu/communications/www/

Barrie Gleason

CONFERENCE SERVICES, EVENTS AND INFORMATION CENTER

The mission of the Center is to meet the informational needs of the MIT community, visitors to the campus, and the public; to promote a sense of community within MIT; and to support conferences and events which enhance MIT's role in the broader academic community.

EVENTS AND INFORMATION CENTER

The Center continued to serve as an information and welcome point for visitors, as well as a central information source for members of the MIT community. Staff in the Center distributed over 41,000 pamphlets, brochures, maps, guides, and catalogues; answered and directed to other offices thousands of telephone and in-person inquiries; and served as a clearinghouse for mail addressed simply to MIT. Head guide for the campus tours was again Atif Chaudry, '97. Terri Priest Nash, staff associate in the Center, trained 24 student guides who conducted tours for 14,225 visitors, of whom 5,101 were prospective students, 1,706 international visitors, and the remaining guests visiting MIT. Terri arranged for 60 short-term visits which brought 943 guests to campus.

Donald Ferland, assistant to the Director, handled the arrangements for nearly 300 recruitment presentations by companies and other organizations that visit MIT under the auspices of the Office of Career Services and Preprofessional Advising.

The Director also managed the campus logistics of the National Innovation Summit in March, which included an address by Vice President Albert Gore.

Commencement activities began with the Hooding Ceremony for 400 doctoral degree recipients, held in Rockwell Cage the afternoon before Commencement. The ceremony was once again a success, with over 80 faculty members on hand to help celebrate, as Dean for Graduate Education J. David Litster and the relevant department representative presented each candidate with his or her doctoral hood.

The 132nd Commencement Exercises brought many firsts to campus. Dr. David D. Ho, renowned AIDS researcher, and President William J. Clinton spoke to the largest graduating class in MIT history on June 5, 1998. President Clinton was the first sitting President to speak at the Institute. The Exercises were broadcast live on the World Wide Web. The day also brought record numbers of alumni and alumnae, family, and friends to this year's Exercises.

Also in June, the Center assisted with the logistical arrangements for the Annual Retirement Dinner and the community farewell celebration for retiring Senior Vice President William R. Dickson.

CONFERENCE SERVICES

The office of Conference Services manages the logistical arrangements for conferences and meetings sponsored by MIT faculty and staff. This past year, the Office coordinated 38 such events — ranging in size from 10 to 2,000 — which brought more than 11,000 visitors to campus.

These events included the American Astronomical Society's Division of Planetary Sciences Meeting, the National Association of Women Law Enforcement Professionals Meeting, the Whitehead Institute Annual Symposium, the Senior Congressional Staff Seminar, and the Massachusetts Special Olympics Summer Games.

The Office's collaboration with the Industrial Liaison Program continued and included assistance with the logistics of the Modeling of Industrial Materials Conference, the AI and Business Conference, the MEMS: Research and Applications in Microelectromechanical Systems Conference, the Annual Research Directors Conference, and the Supply Chain Design for Strategic Advantage Conference.

In addition, the Conference Services staff has responsibility for the event registration process for non-student events; this year more than 200 applications were processed.

PERSONNEL

The Center, under the director of Gayle Gallagher, includes Kathleen Barrett and Terri Priest Nash as Staff Associates for information dissemination, tour operations, and short-term visits; Donald Ferland as Administrative Assistant to the Director; and Lee Corbett, who joined the Center in November to assist with general information and visitor services. The Conference Services staff are supervised by Cathi Di Iulio and include Marie Seamon, Joy Hubbard, and Eva Cabone. Joy and Eva joined the staff in October and January, respectively.

Gayle M. Gallagher

NEWS OFFICE

The mission of the News Office is to achieve the highest level of public interest in MIT by finding and reporting newsworthy stories and photographs about MIT and its people; encouraging and assisting reporters to develop their own stories here; publishing the official newspaper, *MIT Tech Talk*; monitoring internal and external developments that might bring favorable or unfavorable public attention; and handling them with integrity in the best interest of MIT.

HIGHLIGHTS OF THE YEAR

The visit of President William J. Clinton to MIT to speak to the graduating seniors of 1998 brought a new level of media attention to the Institute, with more than 100 reporters and camera people attending Commencement and reporting on it. The speech was carried live on the Internet and on various broadcast media, and the entire ceremony— including the speeches by President Clinton, AIDS researcher Dr. David D. Ho, and President Charles M. Vest — was carried by the Media One cable television company, which serves Cambridge and many other communities. Another highlight of the year was the first National Innovation Summit, which was attended by more than 60 members of the media.

The News Office marked program milestones in working with MIT Video Productions to produce video news releases for the World Wide Web and sending to TV networks and stations full Beta tapes, including about 30 minutes of interviews and B-roll. The first two videos, on the Penguin boat and Cog, the humanoid robot from the Artificial Intelligence Laboratory, were well received in the US and abroad. The use of color photography in its post-Commencement issue represented a new departure for *Tech Talk*.

Following Commencement, the influential French newspaper *Le Monde* published a very complimentary full page feature on MIT and the Infinite Corridor, titling the article: "MIT: The corridor of the future." In April, the *Financial Times* of London, recognizing the reputation of MIT, put this headline on a story about a $54-million corporate gift to England's Cambridge University: "Cambridge University aims to rival MIT."

Another event that garnered major attention for MIT was a good-humored series of articles about the false Internet rumor that Kurt Vonnegut had spoken at the 1997 MIT Commencement and had advised seniors to "wear sunscreen." The Institute and its real speaker, UN Secretary General Kofi Annan, got a new round of publicity about an old speech. A hack by MIT students made national television when they lit up the windows of the Green Building in the image of an Oscar for the movie "Good Will Hunting." The movie won two Oscars for its story about a math genius from South Boston who, while working as a janitor at MIT, solves the most difficult math problem posted by an Institute professor.

MIT and its people received many awards. Three former MIT professors were honored with Nobel prizes in economics and physics. *US News and World Report* again concluded that MIT was number one in engineering, in seven engineering departments, and in economics and biology. MIT Professor Robert Langer, with more than 300 inventions to his credit, was awarded the $500,000 Lemelson-MIT Prize for invention and innovation, on the recommendation of an independent jury. Professor Wolfgang Ketterle won the *Discover Magazine* award for the development of the atom laser, with three other MIT-related inventions also receiving awards. Five MIT inventions won *R&D Magazine* Awards. World Wide Web inventor Tim Berners-Lee, now of the MIT Laboratory for Computer Science and the World Wide Web Consortium, won a $270,000 MacArthur Fellowship.

News stories that generated significant attention included many science stories; a best-selling book by historian Pauline Maier about the Declaration of Independence; and the tragic death of freshman Scott Krueger, which prompted intensive discussion of Institute policies with respect to the use of alcohol and first-year housing. Outstanding developments in science that generated major attention from the press included the atom laser; a new fuel cell; a new, more powerful battery, which substitutes inexpensive aluminum for most of the expensive cobalt; the intelligent room, which anticipates its resident's wishes; planetary observations that appear to prove Einstein's frame-dragging theory; and identification by biologists of the mechanism for aging.

Stories from past years that continued to generate news dividends included the BankBoston study, "MIT: The Impact of Innovation," the Penguin Boat, and the ever-popular RoboTuna, now in its fifth year of generating publicity for MIT.

Major Institute news included the appointments, effective August 1, 1998, of Professor Robert A. Brown to succeed Professor Joel Moses as Provost and of Professor Lawrence S. Bacow as Chancellor. Assistant Director David L. Briggs was named to succeed Walter E. Morrow Jr. as Director of Lincoln Laboratory.

Tech Talk produced a record number of pages of news. Traditionally an eight-page weekly newspaper (with supplements such as the job listings), it produced a 20-page issue this year. The News Office distributed 180 news

releases and features to the news media. Media and publishers requested 350 News Office photographs of MIT people and events. The *MIT Research Digest* was published ten times, from September through June, and two special publications were published: the *MIT Guide to Experts in Physiology, Medicine and Health*, and, for the Washington Office, a third edition of the *MIT Briefing Book.*

PERSONNEL

This was an unprecedented year for new hires, with four full-time employees coming on board: Sarah Wright, senior writer; Denise Brehm, assistant editor of *Tech Talk*; Deborah Halber, science writer; and Patricia Foley, senior office assistant/receptionist. LaKeitha Evelyn resigned as senior office assistant/receptionist. The Hometown Bureau was started, utilizing an MIT student and a summer employee to get done in record time the hometown news about students who graduated from MIT.

In addition to the recently hired staff, the News Office staff are Associate Director Robert J. Sales; Assistant Director for Photography Donna M. Coveney; Administrative Assistant Myles P. Crowley; Editorial and Design Assistant Lisa Damtoft; Administrative Secretary Mary Anne Hansen; Assistant Director for Science and Engineering Elizabeth A. Thomson; and Assistant Director and Editor of *Tech Talk* Alice C. Waugh.

More information about the News Office can be found on the World Wide Web at http://web.mit.edu/newsoffice/www/

Kenneth D. Campbell

PUBLISHING SERVICES BUREAU

The Publishing Services Bureau's mission is to act as a single coordinated channel for publishing activities across the Institute, applying the principles of supplier consolidation, strategic planning, technological awareness, cost savings, excellence in design, continuous learning, and customer satisfaction.

HIGHLIGHTS OF THE YEAR

PSB coordinated the production of over 1,300 jobs. With the help of its new database, PSB tracked all aspects of publishing activities for jobs passing through the Bureau, creating both a baseline for the analysis of design, production schedules, and printing costs as well as the creation of an archived job history.

Approximately $1.3 million was processed in print in fiscal year 1998 with an additional $1.5 million channeled directly to MIT/PSB interim print partners; an additional $200,000 in design was managed through PSB as well. Throughout the year, PSB worked with approximately 25 interim print partners, testing supplier consolidation assumptions and modeling best practice behaviors. Concurrently with the interim partnerships, PSB continued the process of evaluating, interviewing, and visiting print vendors to develop a partnership short list for the future.

PSB partnerships with both the Communications Office and Campus Wide Information Systems have led to the exchange of ideas and information about related business processes and aligned planning activities, providing seamless support interface for MIT customers in the area of electronic publishing and strategic print planning.

PSB has coordinated nearly 25 electronic publishing projects with CWIS and continued to collaborate on variations of the main MIT home page. Pursuing the concept of "offices with invisible walls," CWIS maintains an office in the Bureau space and shares computer and software resources.

Strategic alliance with the Communications Office has led to a relationship in which PSB plays a role as both a broker and a partner. In addition to advising Communications on their own publishing projects, both organizations have joined together to model and publicize effective publishing processes. Ongoing efforts include publication plan projects for Student Services, the Sloan School, the Alumni Association, the Graduate Education Office, and the Admissions Office. Other partners at MIT include the Copy Technology Centers, Mail Services, and Document Services, with PSB working to promote the services of these groups at MIT and establish smoother lines of communication and workflow.

After receiving funding from the Senior Vice President's Office, PSB began investigating and developing an identity system for the Institute to reflect MIT's mission and values as well as facilitate the operational handling of the Institute's communications. As part of its effort to establish equity in an MIT identity system, PSB has taken on several projects to design publications for high-level or high-visibility publishing efforts, such as the covers for the MIT phone directories and *Reports to the President.* Other projects have been recycled into templates for the entire MIT community. Future PSB work with the MIT identity will build on work on the freshman admissions package, the freshman admissions and financial aid application, various MIT Museum publications, invitations for departmental events in Ocean Engineering and Chemical Engineering, and a coordinated letterhead/business card system for several student services departments.

FUTURE PLANS

- PSB will remain committed to the promotion of good publishing practices exemplified by extraordinary design standards and economy of production.

- PSB will continue to promote community understanding of both the PSB mission and good publishing practices through the use of its Web site, instructional seminars, community outreach initiatives, and joint Communications Office and CWIS partnership.

- PSB will establish partnerships with selected print and design vendors.

- PSB will develop and establish an Institute-wide identity system implemented through incentives rather than mandates.

- PSB will develop an on-line catalog system for the production of letterhead, envelopes, and business cards as well as develop templates for the use of MIT publishers.

PERSONNEL

Marc Mancuso joined PSB last July, coming to us from the Cambridge teacher's volunteer program. In February, Kate Miller left PSB to move to Ireland. Monica Lee, a customer service representative from Charles River Publishing, succeeded her.

More information about the Publishing Services Bureau can be found on the World Wide Web at http://web.mit.edu/psb/

Bruce Bernstein

PROVOST

We have witnessed many changes in the leadership of this institution in the present year. Walter Morrow has retired as director of the Lincoln Laboratory after 21 years of distinguished service. He is being replaced by Dr. David Briggs, currently Assistant Director of the Laboratory. We have also announced the re-creation of the position of Associate Director, and this post will be held by Dr. Herbert Kottler who is also currently an Assistant Director of Laboratory.

Dean Glen Urban of the Sloan School has announced his intention to return to teaching and research. He has accomplished in five years all his goals for the Sloan School, a remarkable feat. A search committee has been formed, and Professor Richard Schmalensee will be Interim Dean until a new dean is appointed.

Senior Vice President William Dickson retires this year as well. The Provost's office interacts closely with Bill in matters related to budget and space. The Institute will greatly miss his sage advice.

Jay Keyser, Special Assistant to the Provost, is retiring but will continue his assignments for the Provost. In particular, Jay will continue the Keyser dinners which have played an important collegial role at MIT for nearly fifteen years. Professor Sheila Widnall has returned from public service as Secretary of the Air Force. She continues to teach in the Aeronautics and Astronautics Department and does research in the Lean Aircraft Initiative program.

It is the pleasant duty of the provost to inform faculty members of their appointment to the position of Institute Professor and MacVicar Fellows. This year we informed Professors Peter Diamond of Economics, Thomas Magnanti of Sloan and EECS, and Mario Molina of EAPS and Chemistry Departments of their appointment as Institute Professors. We also informed Professors Sylvia Ceyer of Chemistry, and Robert Jaffe of Physics of their selection as the 1998 MacVicar Fellows. This brings the number of MacVicar Fellows to 31.

SPACE CHANGES

Major renovation of Institute facilities continues, in large part to provide space for current occupants of Building 20. Building 16 has been completely renovated and occupied this year. A new Central Machine Shop was created in Building 36, partly to permit the movement of the LNS machine shop out of Building 20. In the Spring we also opened a new Student Machine Shop in Building 44 along Vassar Street.

Although not everyone had vacated Building 20, we decided to have a party in the Spring to celebrate its 55 years of existence. Professor Paul Penfield chaired the committee to develop the program, and a good time was had by many former occupants of this famous building. At about the same time an architect was selected for the complex of buildings to replace Building 20. Frank Gehry, the world famous architect, was selected. Over $75 Million have been pledged so far for the project with significant gifts currently announced that were given by Ray and Maria Stata and Alex Dreyfoos.

During the summer of 1997 we renovated ten classrooms in Building 2. These classrooms contain a large amount of educational technology, including connections to the MIT network. The Center for Advanced Educational Services relinquished lecture hall 9-150. In its place we created three rooms. One is a smaller lecture hall, a second the Kauffman Room for Teaching and Learning, and the third the Ford Motor Company Room. These three rooms are equipped for remote teaching. The Kauffman Room will be used for helping our faculty and TAs improve their teaching.

As part of the reengineering of student services, Building 11 will house most of the staff in the Registrar's Office, the Bursar's Office, and the Student Financial Aid Office. On the ground floor along the Infinite Corridor we created the Student Services Center which combines these operations. This has been a most successful undertaking from all points of view.

FACULTY, EDUCATION AND RESEARCH INITIATIVES

This is a watershed year in that 11 out of 26 tenures granted to faculty, both internal and external, were granted to women. This indicates the success in attracting women faculty of the Provost's Initiative which began seven years ago under the leadership of Provost Mark Wrighton. Unfortunately, we have not had the same level of success in

attracting minority full-time faculty. The Martin Luther King Visiting Minority Faculty program, on the other hand, had nine faculty visitors this year, a record number.

The President and Provost announced a grant of $1500 for faculty leading each Freshman Advisory Seminar. As a result over 130 such seminars have been made available to the incoming class.

Fifty graduate fellowships honoring former Provost Walter A. Rosenblith were created. Each fellowship is funded for three years at $50,000 each year. In addition five fully funded Provost's Fellowships were created. These are to be granted by the Graduate Office to the outstanding woman or minority graduate student from each school.

A new summer internship program was begun under the leadership of Professor Arthur Steinberg. This program is intended for MIT freshmen who will work in firms under the mentorship of MIT alumni. Approximately 60 students applied for these positions and nearly two dozen of them were filled.

We have added $200K to the Deans Office budget for support of student activities. It is our hope that this will permit a significant increase in the level of entertainment that can be provided on campus in the coming years.

Overall support from industry has increased considerably in the past two years. Counting all forms of support - research, fellowships, gifts, license fees, and equipment grants, the total grew from $120M in FY96 to $150M in FY97. Part of this growth has been in strategic partnerships. We have added Merck and Ford Motor Company to Amgen as strategic partners. Negotiations are underway with a few other firms for a level of support that is $3-5M per year. Issues involving intellectual property or publication rights have not required MIT to change its standard practices in any of these partnerships.

Several international agreements, largely with organizations in South East Asia, have been signed. All such agreements have been previously discussed in the Council on International Relationships. Most involve joint research as well as remote education in engineering and/or management. While the economic decline in the region has affected the level of some of these activities, we anticipate major new agreements to be signed in the coming months.

The Council on the Environment has overseen a growth in environmentally related research to nearly 10% of the entire campus's volume. A major increase in gifts for the environment has taken place with President Vest, Professor David Marks, and Cordelia Foell playing major roles. A new brochure on environmental education and research highlights the breadth of these activities. Every school and most departments now participate in these activities.

The Council on Educational Technology issued its report in the fall. It proposes creating several experiments in order to learn more about how educational technology can impact education both on the campus and on remote educational activities, such as the System Design and Management program. There is a serious need to pursue these recommendations further. In particular, MIT needs to invest in a new backbone network with higher bandwidth than at present.

FINANCES

The overall Institute budget has been constrained, largely as a result of changes in Federal policies regarding overhead reimbursements and employee benefits. These changes cost MIT about $55 million a year, far greater than the effect on its peer universities. The change in the method for paying RA and TA tuition is the largest component of this decrease in funding. This change goes into effect on July 1, 1998. Our endowment has, however, doubled in the past four years. As a result of relatively slow growth in the dividend payout, the payout on the current endowment value is approximately 3.2%, significantly lower than the nominal 5% payout.

Peer institutions that have obtained significant growth in the payout of their endowment have begun to use this increase as a competitive weapon. This year we have witnessed several peer institutions increasing their scholarship support in order to increase the number of middle class students that they can attract. MIT's response, reducing the self-help level by $1000, will benefit all students who are on financial aid. In addition MIT and its peer institutions have moderated the increase in tuition levels for the coming years. Some peer institutions have undertaken

significant efforts to hire senior faculty from other institutions with increased salary and startup offers. MIT has generally been able to match the competition.

The competitive situation as well as the changing Federal policies with no significant increase in the endowment payout have placed great stresses on the Institute's finances. President Vest has renewed a discussion with the Executive Committee of the Corporation that is expected to lead to a significant increase in the endowment payout rate by next fall. The Provost and Senior Vice President have developed parameters, such as tuition and salary growth, that would keep MIT at the forefront in the coming decade. We are optimistic that the budget can be balanced in future years and keep MIT financially competitive and healthy.

A key part of the financial transition at the Institute to heavier reliance on private support is the forthcoming capital campaign. The Provost and the members of the Education Committee of Academic Council spent much of the fall developing the academic priorities for the campaign. We anticipate that the Corporation will vote for the campaign in the coming fall term. There will be significant construction, renovation and maintenance in this campaign. The campaign will thus be truly a transforming one for the institution.

FINAL COMMENTS

This is my last report as Provost. The last three years have been quite eventful and exciting. Although we have worked under significant financial constraints, it now appears that by virtue of the growth of the endowment some of these constraints will be considerably lessened. I wish to thank President Vest and members of Academic Council for their collegiality and tireless efforts on behalf of the Institute. Doreen Morris, Assistant Provost for Administration is, as everyone should by now know, a very special member of our community and has provided invaluable support to me. My long-time administrative assistant, Mary Haas, and Rosalind Wood deserve special thanks as does Mary Calderazzo, the Financial Administrator for the Provost's Office. I am pleased to say that I leave this post with the Institute poised for additional greatness. My best wishes to the incoming Provost, Robert Brown, and the incoming Chancellor, Larry Bacow.

Joel Moses

CENTER FOR ADVANCED EDUCATIONAL SERVICES

The missions of the Center for Advanced Educational Services (CAES) all focus on education, research and service. Specifically, they are:

- To design and conduct experiments in technology-enabled learning, using pedagogical models made feasible by the new technologies
- To create and distribute MIT educational offerings world-wide, often using technologies facilitating synchronous and asynchronous distance learning
- To provide lifelong learning opportunities to practicing engineers and managers, both on and off campus
- To provide a wide range of technical multimedia and video services to the broader MIT community

Many business leaders and educators now believe that lifelong education is just as important as lifelong health care. Responding to this need, our off and on campus offerings leverage the growing capabilities of computer and telecommunication technologies. These include interactive multimedia, the Internet, the World Wide Web, simultaneous web-casting, videoconferencing, satellite TV, as well as more mature delivery mechanisms such as videotapes and books. CAES educational offerings have benefited learners of all ages, from K-12 learners downloading our NMIS web site video archives focusing on world-wide news, to on-campus students who are beginning to see the fruits of our labors in on-campus technology-enabled learning, to life long learners who take MIT subjects and programs either on campus or via distance learning.

CAES views the use of technology in education as both an opportunity and a problem. The technologies, especially in myriad possible combinations, have grown exponentially in the past decade, far beyond our knowledge in how to use them wisely. Thus, a major new CAES focus is the design and execution of educational experiments whose purpose is to create new pedagogically compelling learning environments made possible by the new technologies. CAES plans to report on these experiments over the coming years.

CAES has assembled under its "umbrella" operating units which harness the talents of faculty and staff in technology-enabled education and learning. These areas include most notably the Center for Educational Computing Initiatives (CECI), the Advanced Study Program (ASP), the Professional Institute (PI), MIT Video Productions (MVP), and our most recent addition —the Hypermedia Teaching Facility (HTF). We believe that this collection of mutually supporting assets for technology-enabled education firmly places MIT in a position of strength going forward in this ever growing domain. We have also established close internal working relationships with relevant components of Information Systems including Academic Computing and MIT Cable, as well as academic ties to the Systems Design & Management Program (SDM), the MIT/Ford Collaboration, Registrar's Office, Audio-Visual Department, the Deans of each of the five schools, and interested faculty members, to ensure collaboration and reduce duplication of effort.

MAJOR ACCOMPLISHMENTS

The 1997-98 Academic Year was a year of growth for CAES, growth in overall capabilities and growth in the number and types of initiatives undertaken. In particular, in the past year, CAES has:

- Received support from an anonymous donor in support of a major educational experiment involving a "video tutor in freshman physics," leading to a web-based learning environment using streaming video to simulate a student having a conversation with her Physics 8.01 professor
- Integrated HTF into the CAES organization
- Delivered in January and June 1998, the first workshops on Desktop Learning for the *21st Century and Beyond* to over 90 learners on campus and via distance learning technologies to remote sites in Finland, Brazil, Italy, Columbia, and the U.S.A.
- Launched a major strategic relationship with PBS The Business Channel, completing the first three of five scheduled eight week certificate based courses delivered by satellite and web-based learning
- Moved from a transactional based marketing and sales approach to establishing mutually beneficial partnerships, for long-term health and growth
- Opened three new contiguous rooms aimed at improved teaching and learning, on and off campus, enabled by new technologies
- Transitioned video post-production and delivery systems from the analog to digital domains
- Offered at MIT's Professional Institute the first ever Winter Session
- Offered the first case-oriented course in Economics by videoconference and web-based delivery methods, involving 70 students from Argentina, Peru and Chile
- Launched the MIT Learning Networks Consortium
- Hosted 88 on-campus ASP Fellows and 104 ASP distant learners
- Served learners from Argentina, Benin, Brazil, Chile, Colombia, Ecuador, Finland, France, Indonesia, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Venezuela, and the USA
- Joined the Sloan Foundation's Program on Asynchronous Learning Networks and received their support to electronically convert three or four courses in the area of Decision Technologies: *Optimization, Applied Operations Research* and *Engineering Risk-Benefit Analysis*
- Completed the four year NMIS Project (Networked Multimedia Information Systems), perhaps one of the most ambitious projects ever undertaken to demonstrate how video and other digital media can be of use in various networked educational settings
- Continued brisk sales of Deming books and videos, and completed negotiations or production on several foreign translations of Deming's books (including French, Serbian, Chinese, Portuguese, and Japanese)
- Created an *ad hoc* group of faculty who meet regularly to continue to work of the Provost's Council on Educational Technology
- Made major presentations to various forums to discuss views on technology-enabled education and its role in higher education
- Added key professional staff members to the CAES family, thereby significantly enhancing our capabilities
- Increased dramatically the number of CAES affiliated-faculty

RESEARCH ACTIVITIES

The Center for Educational Computing Initiatives (CECI) is the research and development arm of CAES. As such it undertakes a variety of projects supported by industry, governments and foundations that either develop new technologies or create innovative applications from combinations of existing ones. The over-arching goal is to learn

how various multimedia-supporting software technologies can enhance the learning process. This goal is usually accomplished by doing, that is, by creating a new tool and testing it in real learning settings. The NMIS Project cited above is an exemplar of the CECI approach.

CECI is funded by France Telecom to undertake a three year project to develop innovative, multimedia computer-human interfaces. This work includes the development of an object-oriented architecture for information about important events. This database system is the back-end to innovative, three dimensional graphical display interfaces. CECI uses VRML (Virtual Reality Markup Language) to describe three dimensional interfaces.

We continue to be an important part of the Army Research Federated Laboratory program. The ATIRP Consortium includes Lockheed-Martin, Motorola, GTE, Bellcore, the University of Maryland, the University of Delaware, Howard University and Morgan State University. This five year, $50 million research project is exploring advanced telecommunications and multimedia technologies.

Under funding from Sun Microsystems, CECI is developing a database of educationally useful Java classes that will be accessible through the Internet. The system, called JLEARN, will serve as the global repository for Java-based educational freeware and shareware.

CECI researchers are working with Prof. Henry Jenkins on a multimedia "textbook" on film studies that is funded by the National Endowment for the Humanities. This innovative design integrates hundreds of film clips (in digital video format) into the exposition of film techniques.

The staff of CECI is developing new courses that will be the core of a Master's curriculum in the Malaysia University of Science and Technology (MUST). This work, funded through the MIT Technology Development Program, includes creating syllabi, lecture notes, problem sets, examples and other ancillary material to support four new, graduate level courses that will be taught next at MUST.

CECI is providing the technology for the MIT Shakespeare Archive project under the direction of Prof. Peter Donaldson, the Head of the Literature Section of the department of Humanities. All the software that will be developed in this project is being created by CECI staff and students.

MIT Video Productions & News Office Collaboration

MVP joined forces with the News Office in a successful relationship to increase television news and science program coverage of MIT research. MVP produced video news releases that were distributed by the News Office to targeted science journalists. These videotapes included an edited overview of highlights of the research plus additional source footage, interviews and *B-roll.* This footage allows producers to package and customize their own stories. These research projects were further publicized direct from the MIT home page in the form of quick time and RealVideo™ movie files delivered to the desktop. The goal is to reach out to science journalists via the web with a series of changing research spotlight video news releases. Those interested in covering the research will come to campus to shoot or be provided with the necessary source footage. Examples of projects covered this past year include Mechanical Engineering's *Penguin Boat* and the AI Lab's *COG* project.

EDUCATIONAL INITIATIVES

Facilities

This year the large and outmoded lecture hall, "9-150," was dramatically transformed into a state-of-the-art learning and teaching environment encompassing three mutually supported rooms. This *Teaching/Learning Triad* (~2,000 s.f.) can be centrally routed from two control rooms with delivery by both fiber and satellite broadcasting and connections to a professional TV studio. A 45-seat tiered amphitheater in the lower level—*MIT Learning Networks Central or the LiNC*—is used for CAES sponsored programs; the space is technology-equipped for integrated on campus and off campus teaching, corporate training and goal-oriented learning. Networked data and power ports are available at each student's desk area. Remote controlled cameras, multiple monitors, screens and chalkboards, and gated microphones are centrally routed from a dedicated control room.

A 24-seat videotaping studio/classroom—the *Stephen P. Kaufman Family Classroom for Instruction on Teaching*—has been created to help MIT faculty and teaching assistants improve their teaching. Multiple cameras and

microphones capture classroom dynamics accurately and realistically. Tapes can then be reviewed with a professional teaching consultant. The Kaufman classroom can be scheduled (as available) for distance learning instruction as well.

The *Ford Virtual Design Studio* is a flexible and reconfigurable space that is highly networked, computer intensive, with unitstrut grid lighting. It is designed as a versatile collaborative laboratory that is conducive to goal-oriented learning primarily in the area of engineering design. The studio is equipped with room and desktop video-conferencing technologies in support of virtual engineering and education.

Given the team of dedicated professionals that CAES has on staff and with the new distance learning complex ready to go on line, CAES is poised to discover the real potential of "asynchronous, on-demand" and/or "live at a distance" interaction between students and teachers.

MVP's production and post-production services continue to be utilized by an ever increasing MIT client base. Our customers hold the quality of our work in high regard and consistently refer new business. While MVP must continue to anticipate the demands on facilities created by advances in technology, it is the creativity and expertise of the MVP staff that client's most need and value.

Computer renewal continued throughout the CAES operating areas including the clusters serving our on campus ASP students. Four of the Athena workstations were upgraded from SparcClassic to SparcStation 5. Upgrades of the PC and MACs are planned for the coming year.

Hypermedia Teaching Facility

The Hypermedia Teaching Facility (HTF) was transferred from Mechanical Engineering to CAES on July 1, 1997. Since then it grown considerably in the number of personnel, projects completed, and its integration into all other center wide initiatives. The HTF environment has been designed and built using only industry standard software, so that users by downloading software freely available from the WWW can have all the "plug-ins" they need to use all the multimedia capabilities of the environment. Recognizing the variety of capabilities available to learners on their computers, many different options are allowed, e.g., three alternative ways to view video clips. The growth and expansion of the HTF WWW virtual campus will retain this design philosophy: use industry-standard software virtually.

HTF educational activities include:

- Digital conversion of the textbook, *The Urban Operations Research* , by R. C. Larson and A. R. Odoni. This book had no electronic version and has been out-of-print. The text-book once converted into hypermedia will be used for the first time in the Fall 98 term and will become a valuable resource on-line for teaching courses on-campus and via distance delivery
- Production of a high quality hypercourse based on the textbook of Professor James Fay on *Introduction to Fluid Mechanics*. This book is currently used in four courses in the department of Mechanical Engineering at MIT
- Continuing production of "CD-TOM" for Institute Professor Tom Magnanti on *Optimization*. This CD-ROM will include audio-visual lectures of Prof. Magnanti, and numerous interactive simulations for teaching *Linear Programming in Optimization*
- Creation and operation of three instructional web-sites for the on-going PBS The Business Channel certificate courses
- Creation of the *Virtual Rotameter Experiment* for 10.26 with Prof. Clark. This is the first experiment to use a completely web animation environment to run a life-like virtual experiment on-line
- Hypermedia conversion of Institute Professor Hermann Haus' textbook, *Electromagnetic Fields and Energy;*
- Conception, development, and successfully offering of a workshop on *Desktop Learning in 21st Century and Beyond.* Offered twice: in January with 25 participants, and with 67 participants in June, 1998. Delivered by videoconferencing and the simultaneous web-casting, participants included on campus and US sites and learners in Finland, Brazil, Italy, and France
- Development of a web center for the MIT *Museum Loan Project.* HTF is developing a 3-D Virtual Reality Markup Language (VRML) art gallery for the members of *Museum Loan Project* to browse through the museum artifacts

- Maintenance of MIT web sites including the redesign of the CAES home pages and MIT's Center for Environmental Initiatives in support of their Consortium
- Creating formal ties to MIT Academic Computing, including the commitment of latter to host HTF web-based educational creations on its own servers

Special Event Documentation and Delivery
MVP deployed its portable television studio to several locations throughout the Institute to videotape and/or broadcast a variety of conferences, seminars, and special events. These included the *MIT Enterprise Forum's Lecture Series*, the *Innovation Summit*, the *Ford/MIT Roundtable*, the *Building 20 Retrospective*, the *6.270* and *2.007* contests, the *50K* competition, the *ILP Anniversary Celebration*, *Tech Day*, and the *Japan Program's Seminar Series*. In many cases, the MVP edited, and excerpted highlight events from these programs for tape distribution.

As part of the agreement with PBS The Business Channel, CAES collaborated on three special events: MIT LAB REPORTS: Wearable Computers; WHAT WILL BE: featuring Michael Dertouzos, Director of the Laboratory for Computer Science; and THE INNOVATION FACTOR: A panel discussion moderated by Professor Richard Lester.

Center for Educational Computing Initiatives Activities
This is the first full year since CECI moved into Building 9, joining the rest of the new, CAES organization. One of CECI's major goals in the past year has been to integrate its activities more effectively with those of the larger CAES organization, taking advantage of the potential synergy between CECI's research activities and the more production-oriented work at CAES. CECI has made major progress towards this goal. Highlights of this progress include:

- CECI Director, Prof. Steven Lerman, taught a course on *Internet Commerce* as part of the CAES PBS The Business Channel partnership. This course had approximately 190 students in it.
- CECI staff work closely with the HTF to develop web sites for the courses being developed for MUST, the Malaysian University of Science and Technology.
- CECI will be a significant contributor to the *Lewin/8.01* project creating an interactive collection of digital video to support the teaching of freshman physics. CECI has drawn on the capabilities of the MIT Video Production group in CAES for assistance in several of its projects.

Another important goal is the movement of prototype multimedia applications into more widespread use. The *Edgerton CD-ROM* project was completed in prototype form over a year ago, and after numerous delays (including the closure of the first publishing organization who was to issue the product quality version of the CECI-developed prototype), we are finally approaching the release date. It is expected that the MIT Press will publish the CD-ROM during 1998.

Advanced Study Program Educational Activities
- The United States and Japanese nationals represented the highest percentage of the ASP student population (30% each), on a per country basis.
- ASP offered *Economic Concepts for Engineers and Managers* to over 70 distance learners in three South American countries.
- During the Fall of 1997, ASP offered three courses using distance learning technologies to 34 "virtual" students. The subjects were *Welding, Dynamic Strategic Planning* and *Project Management*. The recipients of these courses were scattered around the U.S.A. (Detroit, Flint and Ohio), Latin America and Europe, three sites in Mexico, one site in Luxembourg, one site in Peru.

Professional Institute Activities
For the 1997 Summer Session, the average session had 28.5 registrations, compared to 22.6 in 1996 (54 Programs) and 23.5 in 1995 (57 Programs). Of the 54 Programs advertised, 11 were canceled for projected low enrollments. A total of 1255 registrations were made. In addition, there was one on-site program.

In 1997 the Special Summer Session had the following aspects:

Number of Programs, including one (1) on-site:	44
Number of Registrations:	1255
Number of Registrants	1252
• From Industry	82%
• From Government	10%
• From Education	8%

These statistics are comparable and fairly constant to those of at least the last four years.

Professional Institute's First Winter Session
In January, 1998, the Professional Institute offered its first Winter Session. A total of 127 registrations were made with an average enrollment of 15.9 registrations. Of the 18 Programs planned for the 1998 Winter Session, 10 were canceled for projected low enrollments. Considering the limiting factors of New England in January and a first time offering, this initiative was considered a success.

CAES/PBS The Business Channel Collaboration
During this period, CAES produced three certificate courses and three special event programs. Each certificate course originates in the Building 9 TV studio. It is produced internally by MIT multimedia producer(s) and the MVP technical staff. The program is distributed via satellite to students and subscribers on PBS The Business Channel. In addition to the broadcast of the program, HTF developed a supplementary website for the duration of each 8-week session. The certificate courses are as follows: *Data Informed Management Decisions*, taught by Professor Richard Larson, Institute Professor Thomas Magnanti and Professor Richard de Neufville; *System Dynamics*, taught by Dr. James Hines, Senior Lecturer at the Sloan School of Management; and *Internet Commerce*, taught by Professor Steven Lerman. Enrollments for the certificate courses continue to grow as 190 students registered for the Spring 1998 course, *Internet Commerce*. Two more certificate courses will be delivered during 1998; they are *Economics for the Global Sales Force* and *Revenue Management.*

FUTURE PLANS
Hypermedia Teaching Facility goals include:
- Design and development of hypercourses for the National Association of Budgeting Officers (NASBO), a non-profit organization supporting 50 governors' offices of the U.S.A.
- Support the development of the 8.01 Physics interactive course and simulated conversations with Professor Lewin
- Produce the first module of four courses in the area of *Information Technology* for the Malaysia University of Science and Technology with CECI. The first course on *Java Programming* will be delivered by September

Advanced Study Program goals include:
- Cultivate ongoing relationships with the former Fellows
- Expand the partnership with ILP, SDM and other key MIT programs
- Implement a site visit plan to present the ASP to potential organizations
- Increase our web presence to facilitate former fellow continuing participation in our offerings
- Increase internal MIT awareness of the ASP
- Increase course offerings based on client needs and the tracking of certificates

MIT Video Production goals include:
- Deliver more programs via the web
- Increased commitment to MIT public relations
- Obtain greater diversity in the programming produced by MVP
- Seek greater distribution of MVP programming
- Maximize the potential of the Learning/Teaching triad complex
- Initiate regular delivery of cultural programming from Kresge Auditorium
- Launch a task force to look at the design, construction, operations, maintenance and business model of all MIT electronic classrooms and videoconferencing systems.

- Propose a centralized approach to videoconferencing for the 13 system installed base

PERSONNEL
CAES added key personnel during the past year, all toward the goal of becoming a preeminent core facility at MIT for research in, and creation of, technology-enabled learning.

TRIBUTES AND SPECIAL EVENTS
President Clinton's participation in this year's Commencement introduced several new innovations to MIT's annual coverage of the ceremony in Killian Court. MIT alumni and friends throughout the globe were able to participate as the proceedings were webcast by MVP worldwide. Commentators were enlisted to provide interesting and entertaining historical perspective for the MIT Cable and web cast audiences. And thousands of family and friends in Killian Court were provided with close up views of the proceedings through the utilization of a 14' video screen. MVP has always prided itself in producing a "broadcast quality" product, so it was particularly satisfying that the switched output of our cameras were picked up and broadcast by CNN, WCVB, WBZ, CSPAN, and Media One and its 11 Massachusetts community franchises. MVP used seven cameras to document this special day and will distribute over 800 edited videotapes to MIT family and friends.

CAES Director Richard C. Larson was invited to present this year's Omega Rho distinguished honorary lecture at the annual meeting of INFORMS (The Institute for Operations Research and the Management Sciences), April 1998, Montreal. The lecture was, "Beyond the Physics of Queueing," and the accompanying overheads are available from the CAES web site. At the INFORMS meeting, Professor Larson was also awarded the Distinguished Philip M. Morse Lectureship, a two year appointment named after MIT's famous Professor of Physics, co-author of the Morse/Feshback textbook on physics, and founder of the MIT Operations Research Center, and founding President of the Operations Research Society of America.

Professor Larson gave several speeches focusing on technology-enabled education. These included an invited presentation at the *Stanford Forum* on the *Future of Higher Education* (Aspen, CO, Sept. 1997), synopses of which are published in a journal of the *Stanford Forum* and about to be published in a book; an invited plenary speech at an all-day conference at the *University of Connecticut* (Storrs); and presentations at the *University of Massachusetts at Lowell; National University of Singapore*; and *MIT's Technology and Culture Program.* Additional presentations focusing on other matters were given at *New York University* and in an experimental geometry class at *Lexington High School*, Lexington, MA.

Professor Steve Lerman serves as Associate Chair of the MIT Faculty during the current academic year and will be Faculty Chair during the academic year 1999-2000.

Both Professors Larson and Lerman have served during the past year on expert panels of the National Research Council (NRC). Professor Lerman's activities there have focused on technology-enabled learning and plausible national strategies therein for the year 2000 and beyond. Professor Larson's focus has been on technology and the services industries, including services trade with Asia and on distance learning as a new service.

Dr. Janet Murray, Senior Research Scientist at CECI, recently published a book, *Hamlet on the Holodeck.*
It has been selected by *Library Journal* as as one of the "Best Science and Technology Books of 1997," one of only two books selected in the computer category.

More information about this center can be found on the World Wide Web at the following URL:
<http://www-caes.mit.edu>

Richard C. Larson

CENTER FOR ARCHAEOLOGICAL MATERIALS/ CENTER FOR MATERIALS RESEARCH IN ARCHAEOLOGY AND ETHNOLOGY

The mission of the Center for Materials Research in Archaeology and Ethnology (CMRAE), a consortium of eight Boston-area educational and cultural institutions, is to advance our understanding of prehistoric and non-industrial

culture through analysis of the structure and properties of materials associated with human activity. Plant and animal food remains, human skeletal material, as well as metal, ceramic, stone, bone, and fiber artifacts are the objects of study, along with the environments within which these materials were produced and used. At the Center for Archaeological Materials (CAM) at MIT, investigators concentrate on the materials processing technologies that transform natural materials into cultural objects.

At MIT, CAM is administered by the Department of Materials Science and Engineering (DMSE). The DMSE faculty approved a new, undergraduate major in Archaeology and Materials, Course III-C, as well as establishment of an interdisciplinary doctoral degree program in Archaeological Materials. Both sets of curricula were reviewed by the appropriate MIT committees during the 1997-1998 academic year and will be in place in the fall 1998 semester.

The outstanding event for CAM was the move of the entire facility from Building 20 to the new, fully renovated CMRAE quarters on the fifth floor of Building 16. The CMRAE laboratories were closed during academic year 1997-1998 to prepare for and accomplish the move. As a result, we were unable to offer our annual CMRAE graduate subject in archaeological materials. On the other hand, Archaeological Science, the CMRAE/CAM undergraduate subject introduced during the 1995-1996 academic year, and offered jointly by DMSE and the Chemistry Department, continues to enjoy high popularity among students from CMRAE institutions. Seventy students enrolled: 52 from MIT, five from Brandeis University, seven from Harvard University, two from the University of Massachusetts, three from Tufts University, and one from Wellesley College; 14 faculty members from five CMRAE institutions lectured in the subject.

The new CMRAE laboratory facilities will be inaugurated in fall 1998 with a year-long graduate subject, Materials in Ancient Societies: Ceramics. We are fortunate that two new faculty members will join CAM in designing and teaching this subject: Visiting Professor Wendell Williams, emeritus professor of physics and materials science from Case Western University, and Dr. Thomas Tartaron, Lecturer in DMSE, who has been a post-doctoral associate at CAM for the past two years.

In addition to realizing the establishment of undergraduate and graduate degree-granting programs, CAM/CMRAE will respond to a new initiative undertaken by the National Science Foundation. The aim of the Foundation's Integrative Graduate Education and Research Training Program (IGERT) is to prepare doctoral candidates with multidisciplinary backgrounds and the technical, professional, and personal skills essential to addressing the varied career demands of the future ... [through] ... development of innovative, research-based, graduate education and training activities that will produce a diverse group of new scientists and engineers well-prepared for a broad spectrum of career opportunities.

CMRAE has been educating graduate students in science, engineering, social science, and the humanities since the center's establishment in 1977. We are eager to enter the new NSF competition and to bring our deep fund of experience to bear on the education of scholars broadly and in depth.

Heather Lechtman

COUNCIL ON PRIMARY AND SECONDARY EDUCATION

The Council on Primary and Secondary Education (CPSE) develops programs that bring the strengths of MIT to bear on the American K-12 educational system. There are five main programs sponsored by the Council: the MIT/Wellesley Teacher Education Program, The Institute for Learning and Teaching; Teacher Sabbaticals; the Forum on Public Education; and the MIT's Educational Outreach Programs directory. The Council's Chairman is also involved in a number of K-12 educational efforts, including the New England Science Teachers and a collaboration with the Association of American Universities.

MIT/WELLESLEY TEACHER EDUCATION PROGRAM

To foster the growth of a cadre of new teachers who meet MIT's standards of excellence in science and mathematics, yet appreciate the value of different ways of approaching and understanding a problem, MIT has created a joint program with Wellesley College, the Teacher Education Program (TEP). It prepares undergraduates for Massachusetts State Certification in mathematics and science at the middle and high school levels. This program, started in the fall

of 1993, has now been integrated into MIT's Department of Urban Studies and Planning. Enrollment in TEP's introductory Course 11.124 has steadily increased. During this four-year period, TEP has enrolled 76 students in the initial course toward completing Massachusetts State Teacher Certification. In the last two years, 16 students have completed certification and are now teaching in public middle or high schools, mostly in the Boston area. Others entering the program have been recruited by private, independent, schools, while some have gone on to become graduate students in schools of education such as Harvard, Stanford, University of California-Berkeley, and Columbia. Two students have entered the Peace Corps.

Undergraduates in the program must complete a major in the subject area in which they wish to teach. In addition, they must complete three courses at MIT and two at Wellesley; one of the latter is a seminar taken in conjunction with the required 150 hours of supervised practice teaching. Students must also complete 75 hours of supervised classroom observations.

The MIT's Class of 1952's Educational Initiatives Fund was key to launching TEP in 1993. TEP was funded from 1994-1997 by the National Science Foundation through a collaborative called TEAMS-BC (Teacher Education Addressing Math and Science in Boston and Cambridge) which included MIT, Harvard, UMASS-Boston, Wheelock College and the Boston and Cambridge school systems. TEP continues to be funded by the NSF through 1999, but now as an independent project. TEP is supervised by Professor Jeanne Bamberger. Professors Frank Levy and Ron Latanision are leading a search committee to hire a faculty member to assist Professor Bamberger. This new position in the Department of Urban Studies and Planning is MIT's first position devoted to teacher education.

The Noyce Prize, a $10,000 prize provided by the Noyce Foundation, is awarded each year to an outstanding graduating senior. In 1997 the award was given to Tim Piwowar, a graduating senior in mathematics who is now teaching at the Billerica High School. The first recipient of the prize, Sally Buta (Course 3, 1994), taught physics at Cambridge Rindge and Latin High School in Cambridge, Massachusetts for three years and is now a graduate student back at MIT in Course 3. The second recipient, Ricardo Campbell (Course 10, 1995), taught 8th grade science at the Longfellow School in Cambridge, Massachusetts for two years and is now a graduate student in physics at City University in New York. Cathy Lavelle (Course 9, 1996) is teaching mathematics in the Lincoln Middle School in Lincoln, MA.

More information about TEP can be found on the World Wide Web at the following URL:
http://web.mit.edu/teacher-ed/www/

PROFESSIONAL GROWTH OF EDUCATORS

TILT provides professional development for educators that uses a project centered around a common technology, such as water delivery systems, as a vehicle for developing skills in team building, group dynamics, effective communication, negotiation, grant writing, brainstorming, mind mapping, working with different learning styles, group reflection and debriefing, and computer use. The traditional TILT model is a community-based team of teachers, school administrators, and their champions in the community (parents, school board members, university representatives, or industrialists) that spends three-weeks in July in residence on MIT's campus followed by a year of planning how to implement and integrate TILT ideas back in the team's home community.

In 1997, TILT joined with the Whittier Institute for Learning and Teaching (WILT), a successful TILT spin-off at Whittier Regional Vocational School in Haverhill, MA. Teams from Ashtabula, OH; the ECSEL Program; Lawrence Public Schools; and Greater Lawrence Regional Vocational High School joined two teams from Whittier for an eight-day institute running August 16-23 and patterned after the TILT model. Due in part to the shortened time available, the research/technical project focus was sharpened to an in-depth study of measurement and measurement tools in a number of selected North Shore businesses.

TILT'97 was funded by the Alden Trust, Ashtabula County Schools, the Bey and Phyliss Blanchard Fund, The Council on Primary and Secondary Education, and the National Science Foundation's Engineering Coalition of Schools for Excellence in Education and Leadership.

TILT's model of professional development has been adopted by the seven universities that make up the Coalition of Schools for Excellence in Education and Leadership (ECSEL), which is supported by the National Science

Foundation (NSF). In addition, The South African Ministry of Education awarded Alan Dyson a fellowship to conduct two week-long TILT institutes in July, 1997, at the University of Natal and to spend a week talking with businesses in all the states of South Africa about forming business/university/public school partnerships to enhance educational opportunities. An impact study funded by the Noyce Foundation began in 1996. The study will focus on eight TILT teams in Massachusetts and will determine the impact of TILT on individuals, teams, school systems, curriculum, and students. A final report is due in December 1998.

Alan Dyson, one of TILT's founding members, accepted early retirement from MIT in 1996 but continues to consult actively with TILT and remains the liaison between TILT and the Ashtabula County, OH, teams. Similarly Christopher Craig, another founding member, continues to consult for TILT, and is the liaison for the Harlem Choir Academy in New York City. Professor Leon Trilling remains the on campus focal point for TILT.

More information about TILT can be found on the World Wide Web at the following URL:
http://web.mit.edu/tilt/www/

TEACHER SABBATICALS

The Class of 1952 Educational Initiatives Fund also launched the MIT Teacher Fellows Program, which brings middle and high school teachers together with MIT faculty. Not only is this program effective in helping teachers develop new and creative ways to teach math and science, it allows MIT faculty to share their expertise in the development of K-12 math and science curricula.

Three high school teachers will be on campus for the year-long sabbatical program in the coming year. These teachers are from Masconomet High School (Topsfield, MA); Sharon High School (Sharon, MA); and Phillips Exeter Academy (Exeter, NH). Although, the '52 Fund contributed to the stipends of teachers in the past, the three teachers who plan to participate will be self supporting.

FORUM ON PUBLIC EDUCATION

CPSE continued its series of seminars, the Forum on Public Education. Professor Frank Levy of MIT's Department of Urban Studies and Planning spoke on "Teaching the New Basic Skills" and Mr. Richard Ferguson, President of American College Testing (ACT) spoke on "The Skills of the American Workforce: A Reality Check" as part of this series. The Forum on Public Education is sponsored jointly by MIT's Council on Primary and Secondary Education and the Boston Museum of Science. The purpose of the seminar series is to foster conversation between leaders in the educational reform movement and the public at-large.

EDUCATIONAL OUTREACH DIRECTORY

The Council's *MIT's Educational Outreach Programs* has been widely circulated. Approximately 65 programs are listed; programs are either conducted on MIT's campus or have the involvement of a person from MIT's faculty, staff, or student body. The directory is now also available through the Council's home page on the World Wide Web.

PROGRAMS BY THE CPSE CHAIRMAN

On the advice of the presidents of six AAU member institutions - MIT, Harvard, Michigan, Stanford, Texas and Wisconsin - the Association of American Universities (AAU) President's Committee on Undergraduate Education established in October 1997 a Task Force on K-16 Education. CPSE Chair Latanision was asked to lead the Task Force in developing a collective plan for the AAU institutions that would be responsive to the implications of changes that are occurring in K-12 education on (a) university admissions policy, (b) the preparation of K-12 teachers (MIT's TEP serves as a potential model), and (c) the teaching of the freshman core curriculum in universities. Eleven AAU member institutions are represented on the Task Force along with representation from the National Research Council and the American Academy of Arts and Sciences. The Task Force presented an Interim Report to the AAU President's Committee on 20 April 1998. The Committee accepted the report and asked for a full implementation plan by the time of their 20 October 1998 meeting. This planning process is underway. The collective action of the AAU institutions, which are the major research universities in the U.S., would serve as a milestone in American K-12 education. The progress that has been made toward that goal is encouraging.

Professor Latanision directs the *Science and Engineering Program for Middle and High School Teachers*, which shares the Council's goal of science literacy for all students. Key to a good education is an enthusiastic, knowledgeable teacher. Since 1989, this program has endeavored to give educators a unique perspective of how the basic sciences, mathematics, and engineering are integrated to meet the technological challenges and needs of commerce and society. In 1998, the program ran from June 22-27 and had 55 participants from across the United States. For the first time in its 10 year history, this program was offered on a fee-bearing basis. Every participant covered his/her own expenses. One-third of the participants were fully supported (travel and room and board) by MIT Alumni Clubs throughout the US, testimony to the concern of MIT Alumni for precollege education.

The alumni of this program, now totaling approximately 550 people, become members of the New England Science Teachers (NEST). This year, NEST members came to MIT's campus on June 26th for a two-day meeting to assess the program and determine future directions for the organization.

More information about NEST can be found on the World Wide Web at the following URL:
http://web.mit.edu/nest/www/

Although, Professor Latanision stepped down as a co-principal investigator for the NSF-supported statewide systemic initiative in Massachusetts, PALMS (Partnerships Advancing the Learning of Mathematics and Science) he has continued his service to the Commonwealth by accepting membership in two statewide organizations: (1) The Mathematics and Sciences Advisory Council and (2) The Science and Technology Curriculum Frameworks Review Panel.

More information about the Council can be found on the World Wide Web at the following URL:
http:// web.mit.edu/cpse/www/

R.M. Latanision

FACILITIES USE COMMITTEE

Reporting to the Provost, the Facilities Use Committee formulates and implements policy for the use of Institute facilities by recognized MIT groups, guests from off-campus, and by non-MIT organizations hosted by Faculty and recognized campus groups.

Chaired by Stephen Immerman, Director Of Administration And Operations, Office of the Senior Vice President, this year's committee membership included Margaret Bates, Dean for Student Life, Office of the Dean of Students and Undergraduate Education; Mary Callahan, Assistant Registrar, Schedules; Gayle Gallagher, Director Conference Services, Events and Information Center, Public Relations Services; Michael Foley, Associate Director of Operations, Campus Activities Complex; Elizabeth Garvin, Director, Class Programs, Alumni Association; Anne Glavin, Chief, Campus Police; Andrew Eisenmann, Associate Dean, Residence and Campus Activities; Edmund Jones, Administrative Assistant, Music and Theater Arts; Sandra Lett, Administrative Assistant, Facilities and Scheduling, Athletics; Dan Martin, Assistant Department Head for Facilities and Operations, Athletics; Paul Parravano, Assistant for Community Relations, Office of the President; Clarise Snyder, Concert Director, Music and Theater Arts; Mary Tobin, Supervisor, Operations Center, Physical Plant; Susan Tomases, Program Director, Alumni Association; Tina Trager, Assistant Manager for Event Planning, Campus Activities Complex; and Phil Walsh, Director, Campus Activities Complex.

The following changes in committee membership occurred this year: Amy Seybold-Burke, Program Director for Reunions and Events, was added to the committee to represent the Alumni Association. She replaces Susan Tomases who left the department to accept a position with Technology Review.

Re-engineering information and updates that were shared with the Committee included the decision by the Co-Curricular Scheduling and Event Management Team to purchase a new scheduling and event management software package, which will be implemented for the 1998-99 academic year. The Fassett Garden, once renovation of the area is complete, was approved as a site that could be scheduled on a limited basis for small receptions and other

events. The Committee agreed that a review/analysis of facility use fees across campus should be conducted in the near future with assistance from an outside consultant.

During the 1997-98 year, in addition to a number of smaller meetings and events, the Institute hosted the Association for Religion and Intellectual Life, the Division of Planetary Sciences, the 7th International Workshop on Computer-Aided Scheduling of Public Transit, the Cambridge River Festival, a conference on Rethinking Artificial Intelligence, the New England Board of Higher Education, the American Association for Artificial Intelligence, the annual Martin Luther King Youth Conference, the Massachusetts Future Problem Solving Bowl, the Innovation Summit with Vice President Al Gore, the US/Japan Workshop on Interfaces, a conference on Research and Applications in Microelectronic Systems, the Senior Congressional Staff Seminar, the annual St. Paulís AME Easter Service, the Global Accords Conference, the 5th Annual Research Directors Conference, a concert by the Brookline Symphony, the American Computer Experience Camp, the City Days Festival, the annual Messiah concert by the Cambridge Community Chorus, a banquet for the Cambridge Mental Health Association, the Massachusetts State Science Fair, the Massachusetts Special Olympic Games, and a conference on Carbon Sequestration.

Stephen D. Immerman

FRESHMAN/ALUMNI SUMMER INTERNSHIP PROGRAM

The Freshman/Alumni Summer Internship Program (F/ASIP) was started this year at the suggestion of Provost Joel Moses. The objective of the program is to give freshmen experience in the work field with alumni-affiliated companies and mentors during the summer after the freshman year. The concept was augmented to include a series of workshops to enhance the students' communication and interpersonal skills by giving them a competitive edge while preparing them for the job market outside of MIT. Many students took the program for the workshops and realized that the experience would help to hone their job and interpersonal skills even if they were not accepted into an internship position.

THE PROCESS

We ran a series of workshops during the spring term which included interviewing, preparing memos, confronting difficult supervisors, and a team design project. Students must also keep journals over the summer, write a paper, and give an oral report in the fall. Completion of the requirements will earn the students six credit units in their sophomore year under F/ASIP's course SP 800. We also created a resume book of the sixty-four students to give to potential companies. We held the first annual freshman job fair where companies were invited to interview the prospective interns. We placed twenty students with companies, and expect about thirty-five to complete course work and receive credit for the program.

INSPIRING DIALOGUE AND PARTICIPATION AT THE INSTITUTE AT EVERY LEVEL

The workshops had a wonderful cadre of thirty facilitators drawn from MIT staff members and graduate students, and alumni at companies in the area, who worked closely with students and gave them very helpful feedback. Of particular interest was the energetic dialogue between students and facilitators. The facilitators also became vital resources - another support layer - for the students both inside and outside of the workshops. We found that the internship process is an exciting and rewarding way to pull alumni back into the workings of MIT. It is important to note that Alex D'Arbeloff, chairman of Teradyne and the MIT Corporation supported the initiative by accepting six students as freshmen interns. Other companies accepting interns this year include Pratt and Whitney, LCS/Telegraphics, SensAble Technologies, Glowdog, SMS Technologies, MRJ Technologies, ProductGenesis, Tabors Caramanis and Associates, Cabot, W. R. Grace, and The Technology Licensing Office at MIT.

We had an excellent response from students with sixty-four seeking positions. Twenty of them were placed in jobs, well over the projected ten placements suggested to us as a starting point. We worked with the Alumni Association to identify alumni at various companies who would help get the program established. Several of the alumni at these companies have expressed interest in mentoring and facilitating next year.

Selection of the students as interns was left to the companies. Of the twenty students accepting positions, nine were female and eleven male. Of the thirty-five seeking credit for the workshop, seventeen were female and eighteen were male.

FUTURE PLANS

Next year we expect to expand the program to place at least forty students; some in the same set of companies. We also plan to place interns in additional new companies that we will enlist during the fall term. The target area for the first year was the East and West Coasts. We are hoping to expand throughout the United States. Since the program started late in the academic year, we plan to expand the number of workshops offered to the students next spring.

The Program is directed by Professor Arthur Steinberg, and Marshall Hughes is the Program Administrator.

More information about this Program can be found on the World Wide Web at the following URL:
http://web.mit.edu/fasip/www

Arthur Steinberg

OFFICE OF EDUCATIONAL OPPORTUNITY PROGRAMS

The Office of Educational Opportunity Programs was created in January of 1992 to organizationally locate both the MIT/Wellesley Upward Bound and MIT Educational Talent Search Programs. MIT has operated the Upward Bound Program since 1966 and began operation of the Educational Talent Search Program in September of 1991.

Upward Bound and Educational Talent Search are two of six US Department of Education: Special Programs For Students From Disadvantaged Backgrounds (TRIO Programs) created under the Higher Education Act of 1965.

The goal of these Programs is to provide college admission and preparatory information, academic support, advising, career information, and college and career exploration opportunities to the economically and/or educationally disadvantaged youth of Cambridge and Somerville.

To a large extent, the development of both Programs was influenced by the research done by psychologist Kurt Lewin and his associates. Lewin's hypothesis was that ego growth and academic performance were closely related. Moreover, he concluded that a developing ego needs to experience success in a warm and personal, structured environment for greatest development, in both a personal and social sense. Lastly, it was determined that this personal and social growth could be achieved through intervention outside of the institutions of family and school. Educational Talent Search and Upward Bound, through their year-round academic support and advising, represent just such interventions.

It has been long established that the effects of failure can be reversed through gradual structured achievement. Moreover, the result of the increasing success is a corresponding increase in the individual's level of aspiration. The Educational Talent Search Program, now in its 6th year, is reporting increasing success. Further, the Upward Bound Program continues its lengthy record of success (90+ percent college enrollment of graduates and 70 percent retention of participants annually) achieved during its 31 year existence through the application of Kurt Lewin's theory and careful attention to the impact of Program expectations.

Finally, since much of what students think they can achieve has been directly related to what others think they can accomplish, the participants' perceptions of their abilities are, to a significant degree, determined by staff expectations. Thus, and largely due to this quasi-parenting relationship, the Programs are able to exert such an influence upon the participants that their academic persistence grows and results in increased post-secondary enrollments.

MIT EDUCATIONAL TALENT SEARCH

The MIT Educational Talent Search Program (ETS) is a year-round, co-educational, program, located in Building N52-130, designed to assist participants, in grades 6–12, who live and/or attend school in Cambridge and Somerville to continue in a course of education leading to graduation from secondary school and enrollment in post-secondary educational programs. The Program is funded to serve 675 participants from disadvantaged backgrounds.

The following is an overview of the Program's year-round operation:

The academic year program is designed to inform, assist and support participants during the school year through a number of after school, evening, weekend, and school holiday activities.

The ETS staff are available at our offices via appointment or on a drop-in basis, five days a week. The Program provides assistance to the two public high schools, one parochial high school and 26 elementary (K–8) schools in the target areas. ETS staff are available at Cambridge Rindge & Latin School and Somerville High School, four days per week, on an alternating schedule basis, and North Cambridge Catholic High School one day per week. Target elementary schools are served through quarterly in-school presentations, as well as weekend and vacation workshops and exploratory activities throughout the school year.

The Program also offers workshops to supplement the academic development of participants. The workshops are offered to provide more specific support or to address special interests (e.g., SAT preparation, Word Processing, Time Management, Peer Pressure, Surfing The Net, etc.) and are offered on a regular and as needed basis.

In an effort to assist participants as they attempt to cope with problems of an academic, social, family or personal nature, the Program offers support and referrals in the areas of school guidance, academic and vocational preparation, and personal adjustment.

In an effort to provide both participants and their families with information relative to college choice, preparation, and the admissions and financial aid processes, the Program held five parent and student information nights, took participants to three local College Fairs and sponsored nine college visits. The Program made four career exploration tours as part of our career exploration effort.

The Program provided seven field trips for the purpose of increasing the intellectual, social, and cultural development of the participants. Some of the sites visited were; The Computer Museum, New England Aquarium Otis AFB, and Massport. In addition, the Program regularly visits various points of interest, i.e., libraries, museums and laboratories, on the MIT campus.

The summer session provided 100 (6th - 8th) grade participants with college information and exploration through seven college tours and nine career exploration tours.

The Program's follow up survey of its members of the Class of 1997 yielded the following: 53% of all senior class members enrolled in a post-secondary educational program; 51% enrolled in two-year programs; 15% enrolled in four-year public institutions; 34% enrolled in four-year private institutions.

MIT/WELLESLEY UPWARD BOUND

The MIT/Wellesley Upward Bound Program is a year-round, co-educational, multi-racial, college preparatory program for high school youth who reside or attend school in Cambridge. Currently in its 31st year, the Program serves 70 academically promising young men and women from disadvantaged backgrounds. The goal of Upward Bound is twofold: (1) to motivate client high school youth such that they persist on to post-secondary education; and, at the same time, (2) to provide them with the fundamental skills necessary for success at the collegiate level.

The following is an overview of the Program's operational phases:

The six week summer program, conducted in residence at Wellesley College, is designed to provide the participants with a rigorous academic experience. Classes are taught by experienced high school teachers, and graduate and undergraduate students from MIT, Wellesley College and other local colleges and universities. Upward Bound participants must enroll in three classes, each of which meets for an average of five hours per week. Also, participants may request or be assigned to tutorials whenever the need arises. Each participant is required to enroll in a Mathematics course, an English course and an elective course (Social Studies, Science or Foreign Language). Science electives include; physical science, biology, chemistry and physics while Social Studies address United States, African-American and World Histories. The Foreign Language electives are Spanish I and II as well as French I and II. The Mathematics courses range from arithmetic to calculus and Language Arts courses cover basic

English and grammar through research paper writing and literature. Lastly, due to an agreement with the Cambridge Public Schools, students may receive summer school credit for failed courses taken for review.

The academic year program located at MIT, plays an equally important role in the educational development of participants. Building upon the motivation and enthusiasm developed during the summer, the academic year program is designed to assist and support the participant while in school. To accomplish this task, the following programs, staffed primarily by MIT and Wellesley College students when appropriate, (We continually strive to maintain MIT and Wellesley College students' participation through our continued involvement as a pre-practicum site for the Wellesley College Teacher Certification Program and through various outreach efforts.) have been developed.

The Upward Bound office is open for study, on a drop-in basis, four days a week: Monday and Thursday from 3:00 to 6:00 PM and Tuesday and Wednesday 3:00 to 8:00 PM. Tutors are available to assist participants with homework problems in addition to meeting individuals and/or small groups for specific content area tutorials.

The Program offers workshops monthly to address more specialized participant needs (e.g., SAT Preparation, Computers, Study Skills Development, Time Management, Job Readiness Skills, etc.).

In an effort to help participants cope with the myriad of problems; academic, social, family, etc., the Program offers support in the areas of guidance, college, career and personal adjustment. The college advising component includes campus visits to many of the local colleges and universities and attendance at two local college fairs, while the career advising component offers exposure to career options through our Speaker Series and Job Site Visitation Program.

The Program provides numerous field trips which have as their purpose, the intellectual, social and cultural development of the participants. Such trips included; the Museum of Science, the Omni Theater, theater productions, arcade, skiing, bowling, roller-skating, National TRIO Day, Celtics basketball game and Red Sox baseball game.

Ninety-two percent of the Program's graduating seniors have enrolled in the following institutions, Bunker Hill Community College, Clark Atlanta University, Lesley College, Morris Brown College, Northeastern University, Pace University, Salem State College, Tuskegee University, and University of Massachusetts at Amherst,.

Ronald S. Crichlow, Evette M. Layne

ASSOCIATE PROVOST

The mission of the Office of the Associate Provost is to assist the Provost and other academic officers in carrying out academic and program support functions. In the past year the Office has focused on several major areas. In addition to the areas discussed below, the office reviewed alcohol policy review and produced an analysis of the housing policy.

ROTC

The Associate Provost chairs the Implementation Team that President Vest established to carry out the April 1996 vote of the faculty on ROTC. Other members of the team include: Professors William Watson and Kim Vandiver, Dean Margaret Bates, and Ms. Sarah Gallop of the President's Office. Col. Rutley who commands the AFROTC unit collaborated with the team.

The faculty voted that MIT should pursue a series of actions to broaden access of students to campus ROTC programs, to support students who are disenrolled from ROTC due to sexual orientation, and to continue to advocate for national change. The desire to pursue these actions was based on two important principles which informed the vote and framed the Implementation Team's work. First, MIT is committed to a policy of non-discrimination in educational and other campus programs. Second, MIT is committed to preparing students for national service and for effective leadership. ROTC plays an important role both at MIT and on a national level. MIT recognizes that the leadership skills derived from the ROTC Program are valuable and believes that these benefits should be available to all interested civilian students.

Subject to further review, the faculty voted that continued participation in ROTC was appropriate on the understanding that MIT will seek the eventual end to discriminatory policies and, within the limits of the law, develop modifications in the ROTC program that would expand the educational benefits of ROTC to all MIT students.

Based on the Faculty Resolution, the following actions framed the team's agenda in 1997-1998. The Team explored the development of a program that might more closely tie ROTC activities to the educational mission of MIT. It identified leadership development as the area where an MIT initiative might be a relevant venue for taking advantage of the substantial contributions ROTC has to offer.

The idea was explored with colleagues across the campus, and it was concluded that the creation of an MIT leadership development program be proposed. The Team explored with the Air Force their willingness to participate in this activity, and the Air Force indicated that it would be willing to work with MIT on the program. Related to this, all of the military detachments on campus (e.g. Air Force, Navy and Army) made a presentation to the Committee on Undergraduate Policy to explore other ways of bringing the MIT military training mission more closely in touch with undergraduate educational initiatives.

The Team reviewed various legal cases as they moved through the courts and settled on the *Able Case* as the one which best represented our view that discrimination against gays and lesbians in the military was wrong and ought to be ended. The *Able* Case addresses whether the "Don't Ask, Don't Tell" Policy violates the Constitution by its restriction on free speech and expression. The U.S. District Court concluded that there was such a violation and that the policy gave voice to illegal biases.

The Team proposed to the American Council on Education (ACE) that they, on behalf of the higher education community become an amicus in the *Able Case* as it moved towards the Appeals Court review. The ACE Board agreed. MIT offered to support them with counsel and to use our efforts to identify other schools who would participate in this *amicus* appeal to the U. S. Court of Appeals. In the end, ten other schools joined with MIT and the ACE. In addition, there were more than a dozen associations from the higher education community who joined as well. The case was argued in April 1998.

The Committee on Undergraduate Admissions and Financial Aid further reviewed the reinsurance policy and made changes that guaranteed the students who were involuntarily disenrolled from ROTC because they were gay or

lesbian would be held harmless in their financial situation. Loans and grants would be available, and a public service opportunity would be available to waive loan repayment.

STUDENT INFORMATION POLICY REVIEW

We continued an Institute-wide review of student information policy and procedures. The review resulted in the development of a policy to address both individual and institutional needs regarding the collection, use, and dissemination of information about students. Faculty, students, and staff participated in this review and in the end resulted in a policy that greatly clarified the Institute's position on a variety of information and privacy issues for students. The Policy will be incorporated in *Policies and Procedures* when the legal review and editing are complete. We also initiated efforts to develop an implementation strategy on how to provide timely access and to frame the education of the community about the requirements incorporated in the new policy.

INTERNATIONAL COUNCIL

The Associate Provost chairs the International Council which is composed of 15 faculty from across the Institute. The Council considered what approach we should take to expand the geographical reach of our faculty's international activities and how best to make these activities more coherent and reflective of the research and educational mission of the Institute.

Over the course of the year, the council explored various approaches to:

- increasing faculty interest in international initiatives,
- making administrative changes that would foster improved efficiency in managing international relationships,
- exploring ways to incorporate educational goals in what are often research and development initiatives, and
- exploring how best to incorporate an international perspective in an institute campaign.

The council also received briefings on major international initiative and reviewed data on the scope of activities. The Associate Provost regularly reviewed and signed off on international proposals.

Towards the end of the year, the Council began a series of meetings that would explore activities and interests of the faculty in various parts of the world – Europe, Latin America, Africa, and the Middle East to supplement our present concentration in Asia. The first meeting in this series focused on Europe. The plan for 1998-99 is to continue this process.

Phillip L. Clay

INTERNATIONAL SCHOLARS OFFICE

The International Scholars Office (ISO) assists MIT faculty and staff in bringing international researchers and professors to campus for a variety of purposes. The ISO advises on immigration matters, issues visa documents, and provides guidance, information booklets and flyers on a wide range of issues relevant to the international scholar population. Weekly orientations are held for incoming scholars and family members.

PRIMARY ACTIVITIES

The ISO served a total of 1,404 international scholars who were affiliated with MIT during the period 7/1/97 to 6/30/98. These scholars represented 71 different countries and 70 departments, laboratories and centers. Most of the scholars, 951, were sponsored under MIT's J-1 exchange visitor program, and 151 were sponsored by MIT on the H-1B visa. The ISO also submitted 13 permanent residence petitions to the Immigration and Naturalization Service (INS) on behalf of MIT faculty members and upper-level researchers; an average of 30 permanent residence applications are typically at various stages of processing at any given time.

The primary activity of the ISO is to provide ongoing assistance to these international scholars, their families, and their MIT hosts before and after the scholars' arrival to the US. This includes advising MIT departments, laboratories and centers regarding eligibility and the appropriate immigration status for incoming and continuing international scholars and their family members, and handling related requests for initial visa sponsorship, extension of stay, and change of immigration status. To facilitate this process, the ISO regularly provides and updates informational booklets and flyers, sponsors periodic meetings for MIT administrators to address the role and procedures of the ISO

and the basics of relevant immigration regulations, and offers an annual workshop on taxes. The ISO prepares customized annual reports for the United States Information Agency, the Institute for International Education, and MIT. In addition, the ISO co-sponsors the International Open House for newcomers with the International Students Office.

CHALLENGES AND ADVOCACY EFFORTS

It is important for the ISO staff to remain informed about changing regulations and engage in advocacy efforts to clarify, prevent and/or ameliorate burdensome regulations and protect international educational exchange. There is nationwide consensus among international student and scholar offices that this has been the most challenging year ever in terms of the complexity of current policies, proposals and regulations emanating from the Department of State, Immigration and Naturalization Service (INS), Department of Labor (DOL), and the United States Information Agency, which oversees the J-1 Exchange Visitor Program. Much of this stems from the Illegal Immigration Reform and Immigrant Responsibility Act of 1996 (IIRAIRA), enacted on September 30, 1996. Although some related regulations have not been finalized, the relevant government agencies are implementing many provisions of the law on an interim basis. The ISO continues to inform scholars about the relevant provisions and to attempt to shape final regulations.

Monthly meetings between ISO staff and the associate provost provide the ISO with guidance on MIT policies, procedures and advocacy efforts related to the international scholar population. ISO staff is also active in NAFSA: Association of International Educators. Senior staff members participate in monthly meetings, regional conferences and the national conference, present at these conferences, and serve on working groups pertaining to J-1 and H-1B visa issues. The ISO director has continued as a member of NAFSA's regional Government Regulations Advisory Committee as well as the independent 25-member Consortium on Higher Education Immigration Issues. Members of the latter group communicate internally and meet with relevant government officials in attempt to interpret and influence regulations applicable to international students and scholars on our campuses.

The H-1B visa for temporary workers, used for some MIT faculty members and researchers, has been under tremendous assault throughout the year. The annual "cap" on the number of initial H-1B petitions the INS will accept was reached in early May, so that additional petitions cannot be effective until October. This is problematic for scholars already in the US, some at MIT, whose permission to work expires in the interim, and for new scholars, including faculty members, who need to join MIT prior to October. In addition, satisfying DOL's requirement that the employer justify the wage being offered to the H-1B employee continues to be an enormous challenge. Although DOL finally released a regulation recognizing a distinction between wages in industry and those in academic settings, this did not occur until May, and it only somewhat offsets the inaccurate survey material DOL refers to when issuing prevailing wage determinations. Legislation has been pending in both the House and Senate to address H-1B issues, in particular the H-1B cap problem. ISO efforts in this area have been greatly assisted by Jack Crowley, Director of MIT's Washington office, and the ISO director's membership in the American Association of Universities Immigration Advisory Group. Under the guidance of the Washington office and the associate provost, the ISO has also written letters to relevant members of congress regarding pending legislation.

PERSONNEL

Dana Bresee Keeth continues to serve as director. Marjorie Gooding, on leave from the University of Colorado at Boulder, served as acting director while Dana was on maternity leave during the fall semester. Penny Sundberg continues as advisor to international scholars, Jennifer Stephens continues as advisor to international scholars, part-time, and Ivana Hrga-Griggs continues as assistant advisor to international scholars. Katherine Linton, senior staff assistant, moved to California, and was replaced by Fulgencia Lugira, formerly of the Alumni Office.

More information about the International Scholars Office may be found at http://web.mit.edu/scholars

Dana Bresee Keeth

ASSOCIATE PROVOST FOR THE ARTS

The focus of the Office of the Associate Provost for the Arts during 1998 has been: the further development of a sense of community and agency among MIT artists; greater uses of existing resources and the development of new ones as opportunities arise.

THE ARTS COMMUNITY

The Associate Provost inaugurated the Arts Colloquia in 1997. These monthly lunchtime meetings are designed to introduce all members of the MIT Arts Community to the work of individual members in the different disciplines. During its second year, this community expanded to include members of the Council for the Arts, many of whom were thrilled to have the opportunity to gain closer contact with the arts faculty. Presenters in 1998 were Assistant Professor Brenda Cotto-Escalera from Theater Arts; Professor Ed Levine of Visual Arts; Institute Professor John Harbison of Music; Artist-in-Residence Felice Frankel of the Edgerton Center; Stephen Alter, lecturer in Writing and Humanistic Studies; and Katy Kline, director of the List Visual Arts Center.

1998 saw the selection of the first group of Council Scholars in the Arts. Sponsored and supported by the Council for the Arts at MIT, the Council Scholars is a new program which brings together student artists from all parts of the Institute for monthly events and the exchange of creative work and ideas. The charter group of Council Scholars will be announced in the fall of 1998 and will begin its inaugural year of events in September.

In terms of the larger community, the MIT Office of the Arts, in collaboration with New York University sponsored the Paucartambo Project: Andean Popular Religiosity in Representation. Produced by Maureen Costello, director of Special Events in the Office of the Arts, the Paucartambo Project was the focus of the Third Annual Conference on Politics and Performance in Latin America. The Conference has now become a collaborative effort between MIT and New York University.

The Council for the Arts at MIT celebrated its 25th Anniversary with a gala that included the announcement of Martin Rosen '62 will replace John Kunstadter '49 as the new Chairman; special appearances by Kitty Carlisle Hart and A. R. Gurney; the awarding of the McDermott Prize to media artist Toni Dove; and the Kepes Prize to Professor Stephen Benton of the Media Lab.

Alan Brody, Associate Provost for the Arts, joined the planning committee for the Mars Millennium Project, a K-12 initiative incorporating the arts, technology and science and sponsored by the NEA, NASA, the Department of Education and the Getty Foundation. Professor Brody also agreed to co-Chair the Initiatives for Children in the Arts with James Ackerman of the American Academy of Arts and Sciences and Professor Jessica Davis of the Harvard School of Education.

In its second year of operation, the Museum Loan Network (MLN) Advisory Committee recommended 30 grants totaling $485,901 which were approved by MIT for funding to museums throughout the country.

RESOURCES AND PROGRAMS

The Brad and Dorothea Endicott World Music Center (in N51) opened in the fall of 1997. A gift of the Endicotts, it had its formal dedication as part of the program for the 25th Annual meeting of the Council for the Arts.

With the support of another Council member, Bud Bezark '49, Music and Theater Arts produced its First Festival of World Music in the spring of '98.

The MIT Museum found itself the recipient of an approximately $3M bequest from the estate of Buzz Burroughs '20, for the Hart Nautical Collection. This endowment fund supports the curator of the Hart Collection and allows the General Operating Support (GOS) formerly assigned to him to shift to the curator of Architecture whose salary had heretofore come from year-to-year private donations. With the addition of part-time Educational Director Otto Loggers, the Museum expanded its educational outreach program beyond the holography lab to include programs for the Cambridge and Somerville Schools including the Piranesi exhibit, the exhibit of kinetic sculpture by Arthur Ganson and the Mathematics Room.

Plans were completed for modest student exchange programs between MIT and both the Massachusetts College of Art and the School of the Museum of Fine Arts. In the spring of 1998 ten students were chosen to participate in the inaugural year of the exchange for 1998-99. In the ongoing exchange between MIT and Harvard, MIT subjects were cross-listed with the Harvard Program Visual Arts.

As part of the 1% for the Arts Policy the renovations of Building 16 and 56 included the installation of permanent sites for rotating exhibitions of holographic pieces and media art. These exhibitions will be curated by Glorianna Davenport, principal research associate in the Media Lab, and Katy Kline, director of the List Visual Arts Center. The Associate Provost for the Arts and the Dean of the School of Architecture and Urban Planning, with the support of Senior Vice President, commissioned architect and Associate Professor Duke Reiter to draw up plans for the renovation of the facade of Buildings N51-52.

In the spring of '98 the List Visual Arts Center opened *Mirror Images: Reflections of the Women in Surrealist Art*, its most ambitious exhibition. Curated jointly by Whitney Chadwick of Berkeley University and Helaine Posner and Katy Kline of the List, the exhibit garnered praise from *The New York Times* and *The Boston Globe*. It is scheduled to move to the San Francisco Museum of Fine Arts in the summer.

ACHIEVEMENTS AND HONORS

The Director of the List Visual Arts Center, Katy Kline and Curator Helaine Posner were named as curators of the US entry in the next Venice Biennale.

Artist-in-Residence in Science and Engineering Felice Frankel's book, *On the Surface of the Things*, was published to warm critical reception. Exhibitions based the photographs in the book had gala openings at the New York Academy of Sciences and the American Association for the Advancement of Science in Washington.

An exhibition of Arthur Ganson's work opened at the Ricco-Maresca gallery in New York City. Mr. Ganson is artist-in-residence in science and engineering with the Department of Mechanical Engineering.

Institute Professor John Harbison received one of the prestigious Heinz Awards for service and excellence.

Professor Krzysztof Wodiczko won the fourth Hiroshima Art Prize from Hiroshima City, Japan for high achievement in international contemporary art and contributions to world peace.

Associate Provost for the Arts Alan Brody, saw three productions of his plays: *The Housewives of Mannheim* at the Boston Playwrights Theater, *Greytop in Love* at Philadelphia's Walnut Street Theater and *The Company of Angels* at Skidmore College in Saratoga Springs, NY. His new play, *Medea's Nurse*, won First Prize for Excellence in Playwriting from the Riverside Stage Company in Connecticut.

Assistant Professor Thomas DeFrantz danced with the Boston Pops to Morton Gould's *Tap Dance Concerto* for Tech Night at the Pops '98.

Alan Brody

LIST VISUAL ARTS CENTER

The List Visual Arts Center's (LVAC) mission is to present, through changing exhibitions as well as the publicly sited Permanent Collection and the Student Loan Art Collection, the highest quality, most challenging art and design by professionals practicing in diverse media today and to provide additional educational programs which promote a broader appreciation of the ideas within contemporary visual expression.

HIGHLIGHTS OF THE YEAR

- LVAC staff participated in all-day retreat at Endicott House July 30, 1997 to evaluate program successes and strategies for innovation or improvement.
- LVAC received second consecutive organizational support grant of $15,000 from Massachusetts Cultural Council, the maximum amount awardable to university-affiliated museums.
- LVAC named "Best Gallery" in *Boston Magazine's* annual Best of Boston awards.
- *Mirror Images: Women, Surrrealism and Self-Representation*, LVAC's most ambitious exhibition, set attendance records and received unprecedented press coverage including a major (and favorable!) review in *The New York Times*.
- Katy Kline and Helaine Posner selected by USIA and Fund for Artists at International Festivals and Exhibitions to organize a new installation by the artist Ann Hamilton in the American Pavilion at the next Venice Biennale.
- LVAC Advisory Committee met three times; major topics of discussion included new advertising and marketing initiatives, building signage, gala opening of Surrealism exhibition and building educational programs.
- LVAC and Bohen Foundation hosted well-attended publication party and book signing for Francesc Torres in Foundation's New York offices.
- Proposed outdoor signage plan to identify and direct visitors to LVAC presented by contracted graphic design firm Jon Roll Associates; approved by LVAC, Associate Provost for the Arts, LVAC Advisory Committee and returned to Planning Office for implementation.
- Art Acquisition Committee (newly constituted) met twice, to consider Department of Urban Studies and Planning's proposal to commission sculpture of giraffe by Nancy Schoen as memorial to late Prof. Donald Schoen (declined for Permanent Collection and returned to DUSP for their disposition within their own spaces) and proposal for seating sculpture by Mags Harries as latest chapter in ongoing Student Center 1% for Art Commission (approved with suggestions for improved siting).
- Photo archives of collection organized and entered on Registrar's database by intern Taro Nettleton (School of the Museum of Fine Arts); LVAC press archives organized by intern Megan McNamee (Wellesley College).

EXHIBITIONS

The Art of Detection: Surveillance in Society (Hayden and Reference Galleries, October 9 - December 28, 1997). An exhibition of video, photographic and installation work by artists addressing the role of institutional surveillance -- its pervasiveness, our responses to it and the new and sometimes invisible forms watching is afforded by the digital revolution. Catalog with essays by Timothy Druckrey and Jennifer Riddell published.

Recovering Lost Fictions: Caravaggio's 'Musicians' (Bakalar Gallery, October 9 - December 28, 1997). A project by contemporary artists Joseph Grigely and Kathleen Gilje exploring the ways we authenticate, value and appreciate works of fine art, using a supposedly "restored" version of the Caravaggio painting *The Musicians* by painter/art restorer Gilje as a case study. Brochure published mimicking National Gallery of Art monographic studies of single works.

Francesc Torres: The Repository of Absent Flesh (Hayden Gallery, January 16 - March 22, 1998). Stretching the narrative aspect of installation art to its fullest, 20 unusual objects made or found by the artist were arrayed on metal tables throughout the gallery. Visitor movement triggered spotlights on the individual objects and the recorded narration of one of 20 short stories written by the artist in which the particular object figured in the overall construction of a fictional and emotional portrait of the history and warring ideologies of the 20th century. A hardcover book with an introduction by Arthur Danto containing the stories and photos of the objects was published. A second Torres installation, ***The Fury of the Saints***, evoking physical and religious passion and struggle, was on view in the Reference Gallery from January 23 - March 22, 1998. Exhibition supported by The Rockefeller Foundation, Catalan Cultural Organization, Spanish Ministry of Foreign Affairs and the LEF Foundation.

The Squeeze Chair Project: Wendy Jacob with Temple Grandin (Bakalar Gallery, January 16 - March 22, 1998). Jacob, an artist who investigates aspects of physicality and touch and Grandin, the well-known autistic designer of humane animal handling apparatus, collaborated on the design of a mechanically operated, domestically upholstered armchair which applies a reassuring overall pressure to the sitter. Also on view were Grandin's designs for her original squeeze machine developed to calm her own autism, as well as her livestock chutes and animal handling devices. (Exhibition originated by the Krannert Art Museum, University of Illinois at Urbana-Champaign).

Mirror Images: Women, Surrealism and Self-Representation (Hayden, Reference and Bakalar Galleries, April 9 - June 28, 1998). The first exhibition to present the self-portraits or self-representations of three generations of women Surrealist or Surrealist-influenced artists, included nearly 100 paintings, drawings, photographs and sculptures dating from 1928 to 1997 by 22 artists from north and central America, Europe and Japan. Jointly curated with Whitney Chadwick (art historian and author of the seminal study *Women Artists and the Surrealist Movement*) who also edited the 200-page, illustrated book containing essays by the curators and four cultural and art historians which was published by MIT Press. Support received from the National Endowment for the Arts, the Massachusetts Cultural Council, The Dorsky Foundation and Herb and Kitty Glantz.

EDUCATION PROGRAM HIGHLIGHTS

- Lecture by Kathy Gilje on the history and biography of Caravaggio through five of his paintings which she has recreated.
- Public conversation between Wendy Jacob and Temple Grandin to overflow crowd in Bakalar Gallery and evening lecture/book signing by Temple Grandin in Rm 10-250 attracted large audience of artists, neurologists and parents of children with autism.
- Jon Roll repeated his popular IAP course on the organization and installation of contemporary art exhibitions.
- Francesc Torres discussed his recent installation work in a well-attended slide talk in Bartos Theater
- In addition to numerous gallery talks and tours to groups and art classes, ***Mirror Images*** educational events included an all-day symposium in a full-to-capacity Bartos Theater on April 25th, bringing three artists (Dorothy Cross, Paula Santiago and Rona Pondick) together with two academic 20th century art and cultural historians (Prof. Edward Sullivan, New York University and Prof. Judith Wilson, Yale University); conversations, questions and discussions moderated by Whitney Chadwick.
- A four-evening film and video series organized by Jennifer Riddell accompanied ***Mirror Images***.

COLLECTIONS

Gifts to the collection numbering 27 works were made principally by Prof. Boris Magasanik and alumnus Roger and Joan Sonnabend; highlights include 11 prints and drawings by Boston artist Aaron Fink, together with his large painting *Out for a Walk* recently installed in the Whitaker Building atrium, as well as works by Bill Thompson, John Hoyland and Terence LaNoue. Thirteen works were purchased, including a color photograph by Uta Barth and prints by Ian McKeever, Louise Bourgeois and Yukinori Yanagi.

STAFF NEWS

- Helaine Posner resigned after seven years as LVAC curator to become Director of Exhibitions at the International Center of Photography in New York.
- After nearly 19 years at MIT and more than a decade as director of the List Center, Katy Kline announced her resignation, to take effect in October, 1998. She will become director of the Bowdoin College Art Museum in Brunswick, ME.
- Jennifer Riddell, Curatorial Fellow, completed the second year of her fellowship sponsored by the College Art Association; she has been appointed Assistant Curator effective July 1, 1998.
- Katy Kline, director, served as juror for the Delaware Art Museum Biennial and the Pew Charitable Trust's Philadelphia Exhibition Initiative. She advised the Tremaine Foundation on the establishment of a new granting program for curatorial projects and continues to serve on the Williams College Museum Advisory Board.
- Sabrina Detmar continues as part-time curatorial assistant, providing support in research, educational programs, exhibition talks and collection tours.

More information about the LVAC can be found at the following URL: http://web.mit.edu/lvac/www

Katy Kline

MIT MUSEUM

The MIT Museum collects, preserves and exhibits materials which serve as a resource for the study and interpretation of the intellectual, educational and social history of MIT and MIT's role in the history of modern science and technology. Museum staff engaged in a number of activities in 1997-98 in support of that mission, serving 25,077 visitors and over 1,000 researchers.

COLLECTIONS

The MIT Museum Collections Committee successfully completed its first full year of operation, working with Collections staff to provide recommendations on new acquisitions to the permanent collections. In addition, the Committee examined a number of collections-related issues such as deaccessioning policies and the relationship between the Museum and the Institute Archives and Special Collections. The Committee will continue to address collecting concerns in FY99 and has increased its meetings to six per fiscal year.

Accessions into the permanent collections totaled 16 for FY98. Some notable acquisitions include: 1,275 study prints of photographs by Harold E. Edgerton; three bronze sculptures by former Architecture Professor Richard Filipowski; two Bitter magnets used for research in the Francis Bitter Magnet Laboratory; nine early production-run holograms made by McDonnell Douglas; an EG&G Model 549 Microflash used in high-speed photography; and four maritime paintings from the Liverpool school. In association with the exhibition *Unfolding Light: The Evolution of Ten Holographers*, the Museum purchased the hologram *Photon Drawing Series: A Drop of Light* by noted Japanese artist Setsuko Ishii.

Forty loans were made to and from the Museum in FY98. For the exhibition *Unfolding Light: The Evolution of Ten Holographers*, 18 holograms were borrowed from artists in the United States, Canada, Japan, and England. There were four lenders of works by Giovanni Battista Piranesi and Baldassare Peruzzi to the exhibition *Piranesi in Perspective: Designing the Icons of An Age*. A model of the *USS Cochrane*, on loan from the Naval Surface Warfare Center, Carderock Division, continues its long-term display in the Hart Nautical Gallery. Outgoing loans included the reinstallation of oil portraits of William Thompson Sedgwick, Samuel Cate Prescott, and Bernard Emerson Proctor in the Division of Toxicology and of John Thompson Dorrance in the lobby of Building 16. The Museum renewed the loan of a portrait of David Watson Taylor to the Naval Surface Warfare Center, Carderock Division. In addition, staff began a survey of loans from the Collections to Institute offices in an effort to better inventory works installed on campus.

The Historical Collections continued to receive heavy use by 669 MIT and outside researchers in need of reference and photographic information. Two hundred sixty photographic copy images and seven audio visual copies were furnished for historical use,and 62 use agreements were issued. Some notable MIT projects for which the collections were used include President Emeritus Howard Johnson's memoirs; a history of blacks at MIT that is being written by Clarence Williams; an exhibition organized by the Association of MIT Alumnae (AMITA) to mark the 125th year of women graduates; and the Building 20 celebration. Also, reproductions of paintings, photographs and works on paper from the Collections were licensed to Forest City Development for display in the new University Park Hotel at MIT. Items from the MIT Historical, Architectural and Hart Nautical Collections will be hung in guest rooms and public areas throughout the hotel, providing visitors with a unique perspective into the history of the Institute.

The Museum's World Wide Web site continued to receive hundreds of hits per week. Recent additions to the site include an on-line version of the Museum's Collections management policies.

ARCHITECTURAL COLLECTIONS

The Architectural Collections at the MIT Museum have experienced tremendous growth in several areas during 1997-1998. Use of the Collections has increased dramatically with 82 telephone inquiries, 37 e-mail requests, and 28 researchers who used the Collections on site. It is anticipated that this growth will continue.

In addition to answering requests for information and conducting research on various aspects of the Collections, the curator continues to collaborate with other Institute departments on special projects, such as curating exhibitions for

the School of Architecture and Planning's Wolk Gallery, developing an exhibition on Alvar Aalto's Baker House for the 1999 rededication and working with Rotch Library, the Institute Archives and the Council for the Arts.

Collaboration outside MIT has also been extensive, including work with Harvard's Loeb Library on The Architects Collaborative archive, development of public programs with Mount Auburn Cemetery and providing exhibition and collections information for the Museum of Modern Art, New York City; the Museum of Fine Arts, Boston and the Vose Gallery, among others.

The most important undertaking of the past year was the opening in December of *Piranesi in Perspective: Designing the Icons of An Age*, a selection from the Italian etcher's 1778 series, the *Vasi Candelabri, Cippi*, drawn from the Architectural Collections. The related public programs alone attracted nearly 400 participants. Among notable acquisitions were additions to the Professor Richard Filipowski (1923-) Collection, which now comprises MIT student work, sculpture, models and works of art on paper. Finally, thanks to the generosity of an MIT Dean, architect William Welles Bosworth's large watercolor view of the new Cambridge campus (ca. 1913) has been conserved and maintained for future generations. This drawing is not only significant within the Architectural Collections, but is an important artifact, key to understanding the history, development and aspirations of the Institute in the 20th century.

HART NAUTICAL COLLECTIONS

During the past year we continued to target significant research collections that require better access tools and preservation conditions and to raise funds to undertake cataloging and preservation microfilming of these important materials. Work on the Davis-Hand Collection was recently completed, and a guide is being produced and will be available for sale later this summer. We have raised $5,500 of our $10,000 goal for the George Owen '1894 Collection Project, most of it from Course XIII alumni who were George Owen's students. We expect this project to be fully funded by August and to begin work on the collection this summer. The *Guide to the Haffenreffer-Herreshoff Collection*, published last year, has been in demand by researchers and over 500 of 2,000 copies printed have been sold. The work of graduate student interns has also helped to increase control of the collections. In April 1998, Jalien Hollister produced a 21-page condition survey of the Bethlehem Steel Collection as part of a Simmons College Library Science course requirement. This survey will be most valuable in developing plans to process this important collection, the largest of the Hart Nautical Collections.

A portion of a new, permanent MIT Ocean Engineering exhibition opened in the Hart Nautical Gallery on June 3. This exhibit deals generally with the ocean sciences and the importance of ocean engineering technology to these fields of research. The main part of the exhibition will showcase MIT research and will be installed in the Hart Nautical Gallery in early December in celebration of the Year of the Ocean. The production schedule for the *Reliance* full-hull model, commissioned for the Museum by John K. Dema, has been changed to allow for dedication of the model as a central feature of an America's Cup exhibition that will open at the Museum in June/July of 1999. The model is currently under construction as part of a model making display at the Maine Maritime Museum in Bath, ME.

John Lednicky '44 once again made a generous annual gift that has been used to support part-time staff working with the curator on cataloging, reference and exhibitions. Without question the most important event of the year was a major bequest from Malcolm Burroughs, the Museum's long-time friend and Advisory Board member, to establish the Malcolm S. Burroughs '20 and Lucille P. Burroughs Fund to benefit the Hart Nautical Collections. Four major ship portraits were also part of this extraordinary gift.

EDUCATION AND OUTREACH

With increased support, including a most generous gift from A.R. Arulpragasam '77, the Museum's Education Program was able expand its services to teachers and K-12 and college students during the past year. Otto Loggers was hired in November on a consultant basis as the new education coordinator, and since then he has worked with 83 groups (60% K-12, 28% college, 12% adult) totaling 1,747 individuals. He has developed a number of special programs including holography mini-courses that were offered during IAP; math activities for K-12 students that were presented during the February school vacation week; a printmaking course in conjunction with the exhibition *Piranesi in Perspective: Designing the Icons of An Age*, that was offered during the April school vacation week; and professional development programs for teachers, youth counselors and MIT student volunteers. This summer we are

very pleased to have a Fellow from the Public Service Center, Walter Holland '01, working with us for ten weeks to help develop two new, one-week, intensive programs for K-12 students that focus on holography and stroboscopy that will be offered during the summer school vacation period.

NEW EXHIBITIONS

On the Surface of Things: An Exhibition of Images in Science and Engineering, featuring the work of Felice Frankel, MIT Artist-in-Residence and Research Scientist at the Edgerton Center, was on view from July 15 - November 2, 1997, before traveling to six venues throughout the United States.

Unfolding Light: The Evolution of Ten Holographers, a traveling exhibition organized by the MIT Museum and guest curator Rene Paul Barilleaux, opened on September 20, 1997 and ran through February 22, 1998. It will travel to museums throughout the United States through September 2000.

Piranesi in Perspective: Designing the Icons of An Age, curated by Kimberly Alexander Shilland, opened on December 4, 1997 and was on view through June 14, 1998. Two lectures, a gallery talk, walking tour, and April school vacation programs for K-12 students were presented in conjunction with the exhibition.

Never Stop Learning: The Life and Legacy of Harold Edgerton, organized by guest curator and Edgerton scholar Joyce Bedi, opened in the Fall and continues as a long-running exhibition in Strobe Alley.

MUSEUM SHOP

The Museum Shop's catalog and mail order sales are the most profitable part of the business, followed by in-store sales at the shop at the Museum. For the last several years, foot traffic and thus sales in the shop at the Student Center have decreased significantly, so we decided to close that shop on June 30, upon the termination of our lease. During the coming year we will expand the display space in the Museum Shop in order to enhance sales there and we will investigate direct catalog sales via the Internet. We are also engaged in discussions with Forest City, the developers of the new hotel at University Park, about having a Museum Shop presence in the hotel's lobby shop as another means to increase sales and encourage visitation to the Museum.

PERSONNEL

A search committee to hire a new director was appointed by Professor Alan Brody in Spring 1997. Chaired by Professor Harriet Ritvo, the committee worked diligently through 1998, and their efforts culminated in the appointment of Jane Pickering, who will assume the position of director on August 3. Ms. Pickering is currently senior curator at the Royal College of Surgeons of England, where she oversees their four museums, and was previously assistant curator of zoological collections at the Oxford University Museum. Mary Leen, who has served as acting director since July 1996, will resume her position as associate director with responsibility for fundraising.

More information about the MIT Museum can be found on the World Wide Web at the following URL: http://web.mit.edu/museum/

Kurt Hasselbalch, Mary Leen, Kara Schneiderman, Kimberly Alexander Shilland, Michael Yeates

MUSEUM LOAN NETWORK PROGRAM

The Museum Loan Network (MLN), a program funded by the John S. and James L. Knight Foundation and The Pew Charitable Trusts, was launched in October 1995 to promote collection-sharing among museums in the United States. The program, administered by the Office of the Arts, was created to encourage museums across the country to tap the potential of one of their most valuable but underutilized resources: artworks currently in storage. By making grants available to both borrowing and lending institutions for long-term loans, the MLN is helping these organizations bring to light thousands of artworks that lie hidden in storage rooms across the country and simultaneously broadening collections of borrowing museums.

Not content to merely give out grants, the program continues to expand its emphasis on network building, both through human and technological resources. A group of curatorial ambassadors were appointed to help promote MLN, assist applicants in locating potential lending partners, and increase the networking potential of the program. This group is composed of eight curators chosen from museums nationwide and representing various art historical disciplines. Development continued on a key element of the MLN: the MLN Directory, a practical means of identifying art objects available for long-term loan to eligible museums throughout the United States. The Directory, now fully functional, contains over 3,000 art objects from 20 institutions in the United States. The technological components of the database were developed by MIT's Center for Educational Computing Initiatives, while the enhancements to the website are being created by Hypermedia Teaching Facility at MIT. A further innovation was the development of mini-virtual exhibitions drawn from objects from the directory. The first exhibition, *An American Sampler*, was launched on the MLN website on May 18 to honor International Museum Day.

Press releases concerning grant awards were distributed to 1,500 museums, related organizations and the press. A newsletter, entitled *MLN Network News*, was launched in October 1997 and distributed at museum conferences and by mail. The MLN Director or Program Associate lectured about the program and related museum issues at the following annual meetings: American Association of Museums (AAM), Los Angeles; the Association of College and University Museums and Galleries, Los Angeles; the AAM Curator's Roundtable, Boston; the College Art Association (CAA), Toronto; the Mid-Atlantic Association of Museums, Rochester; Mountain Plains Museums Association, Missoula; New England Museum Association, Hartford; Southeastern Museums Conference, Raleigh; and the Western Museums Association, San Diego. In addition, MLN hosted two luncheon meetings for museum professionals: one for registrars in conjunction with the AAM meeting in Los Angeles and one primarily for curators during the CAA meeting in Toronto.

The MLN awards two types of grants to eligible nonprofit institutions in the United States: planning grants and implementation grants. At the February 1997 and May 1998 Advisory Committee meetings held at MIT, 30 grants totaling $485,901 were recommended for approval by MIT for funding to museums throughout the country. Survey grants were awarded to such prestigious institutions as the Arctic Study Center, The Hispanic Society of America; Peabody Essex Museum and the University of Pennsylvania Museum of Archaeology and Anthropology. Travel grants were awarded to the Art Museum of Western Virginia, Iñupiat Heritage Center, Massachusetts Museum of Contemporary Art, and Museum of Afro American History, Inc. Implementation grants were awarded to such diverse institutions as the Davis Museum and Cultural Center, Joslyn Art Museum, Los Angeles County Museum of Art, Museo de las Americas and Stanford Museum of Art.

In October 1998 the newly created position of Program Associate was filled by Michele Assaf, formerly registrar at the Denver Art Museum. The MLN Director was appointed a member of the CAA Museum Task Force.

More information about the MLN can be found on the WWW at the following URL: http://loanet.mit.edu/Web/

Lori Gross

OFFICE OF THE ARTS

ARTS COMMUNICATION

In the ninth year of the Office of the Arts, Arts Communication published and disseminated up-to-date information on MIT's arts programs and events while promoting and cultivating awareness of the arts at MIT, both within and outside the Institute. Significant projects included the further cultivation of press contacts that led to the placement of MIT arts stories in national publications including *The Chronicle of Higher Education*, National Public Radio, *Wall Street Journal* and *The New York Times*; a national press mailing about the Council for the Arts at MIT on the occasion of their 25th anniversary; and the further development and design of the "arts at MIT" web site.

INTERNAL (MIT)

For the third year in a row, MIT's admission application included tear-out postcards for prospective students to request information on the arts at MIT and indicate specific arts interests. Postcards were returned from 2,239 individuals and a copy of the *Student's Guide to the Arts* was sent to each with a letter from Associate Provost for the Arts Alan Brody. Students who were eventually admitted and who had indicated interests in theater were sent congratulatory letters from Professor Peter Child and Associate Professor Janet Sonenberg giving specific information on opportunities in theater at MIT. Admitted students with interests in music were sent congratulatory letters from Professor Child with information on opportunities in music at MIT.

For the ninth year, Arts Communication provided text and images for the weekly Arts Page in *Tech Talk*. Material for 21 feature Arts Pages and eight Month-at-a-Glance Arts Pages were compiled and written by Lynn Heinemann, edited by Mary Haller. The director of arts communication attended weekly News Office meetings and continued to work closely with its staff. Arts Page stories were made available on-line through the World Wide Web. Copies of the Month-at-a-Glance Arts Page (including two two-pagers) were mailed monthly to 815 individuals at their request.

Twelve feature arts-related stories and seven arts-related photos-with-captions were published in *Tech Talk*'s general spaces, including two stories and two arts photos on the front page. Authors included Mary Haller and Lynn Heinemann of the Office of the Arts, members of the News Office staff and members of the MIT arts community.

MIT arts-related photos continued to be prominent in *The Tech*, with many appearing on the cover of the paper — due, in part, to a partnership cultivated with *The Tech*'s photo editor, graduate student Gábor Csányi. Through Mr. Csányi, Arts Communication also continued to add to its collection of stock photographs.

A World Wide Web site for the arts at MIT was maintained, publicized and linked to numerous other Web pages and sites by Lynn Heinemann. Design elements were added to the site.

Arts Communication worked with MIT arts departments and programs to update arts information for the MIT Student Tour Guide Manual and the *Self-Guided Walking Tour of the MIT Campus*.

As part of a subcommittee of the Creative Arts Council formed "to articulate the role of the arts at MIT in relation to the changing nature of undergraduate education at MIT," the Director of Arts Communication prepared a discussion and outline of MIT arts accomplishments in the ten years since the Joskow Report was released. It was submitted to the Council in the late Fall of 1997 in a report, "The Arts at MIT: Prospects and Accomplishments."

Arts Communication continued to oversee ArtsNet, which consists of about 90 campus arts representatives, the "Arts at MIT" bulletin board in Lobby Seven and the weekly "Arts Hotline" (253-ARTS).

LOCAL AND NATIONAL ATTENTION

Calendar listings of MIT arts events were produced and mailed monthly to 279 members of the electronic and print media. Press releases were produced for major events and announcements and mailed locally and nationally to targeted writers and media sources.

Recognizing that MIT can now boast three substantial programs in "world music" (Gamelan Galak Tika, MITCAN and MITHAS) which offer public performances, Arts Communication, for the second year, presented these concerts

together as a series through ads placed in both the Fall '97 and Winter/Spring '98 World Music program booklets and through flyers that were mailed locally and distributed at MIT music events.

Press attention was also cultivated for MIT's world music programs: *Boston Globe* "calendar picks" were given to the April 1998 World Music Weekend and to many of the performances sponsored by MITHAS. The Oct. 29 broadcast of WGBH-TV's "Greater Boston Arts" included a short "calendar" segment featuring MIT's Gamelan Galak Tika filmed at one of their rehearsals in the new Endicott World Music Center in conjunction with their Nov. 15 performance. *The Boston Herald* noted that "In a quietly consistent way, MIT has been contributing to Boston's growing international music scene for several years."

As the result of a major press mailing and follow-up by Arts Communication, the Council for the Arts at MIT (CAMIT) was recognized in the press on the occasion of their 25th anniversary. *The Boston Globe* led their Oct. 27 "Party Lines" column with coverage — including several photographs — of the Council's Silver Anniversary Ball at the Museum of Fine Arts. An article in *The Wall Street Journal* focused on the Council's Grant Program and another in *The Tab* reported that "...For the last 25 years, the Council for the Arts at MIT has been quietly building a reputation for artistic exploration that's much akin to the institute's technological pursuits." *The Tab* concluded, "Whether the Council is renovating practice rooms, helping sponsor boundary-pushing exhibits at the List, or making project grants that reward innovations, its impact could be measured like a scientific model of ripples: each dollar given goes far beyond its worth in the lives of students and ultimately in the life of the city."

Local media attention was cultivated for various MIT artists-in-residence and guest artists:

- A *Boston Sunday Globe Magazine* story on Shakespeare & Company Artistic Director Tina Packer — in residence at MIT with members of her company — opened with a detailed description of an acting class she conducted at MIT in April 1997. Arts Communication also worked with Shakespeare & Company to publicize the second part of her "Women of Will" trilogy, which was presented at MIT in April 1998.

- The mounting of an exhibition and publication of a book featuring the color photographs of Artist-in-Residence Felice Frankel provided excellent opportunities to promote the science photographer's work at MIT. In conjunction with the book, *On the Surface of Things: Images of the Extraordinary in Science*, Frankel's work was featured prominently and praised in major national publications such as *Life* magazine, *Newsweek*, *Scientific American*, *Science News* and *The New York Times*. At the invitation of *Science* magazine, Frankel submitted an essay entitled "Envisioning Science—A Personal Perspective" that appeared, along with her photographs, in the June 12, 1998 edition.

- Artists-in-Residence Michael Wenyon and Susan Gamble inspired *The Boston Globe*'s Chet Raymo to write that "Every research institution ...should be required to have an artist-in-residence. Scientists and artists need to brush shoulders, learn from each other, pass vibes back and forth, look for the places where quarks and quasars touch the longings and passions of the human heart." (Oct. 20, 1997)

- Artist-in-Residence Arthur Ganson and his work were featured in a flattering article in the *Chronicle of Higher Education* (Feb. 6, 1998) and the May 7 *New York Times* profiled Ganson in an article titled, "Technical Art That Exalts Ideas."

Additional people and projects across the Institute receiving outside press attention through the efforts of Arts Communication included:

- Barbara Broughel's 12-foot high *Harvest Chair*, which was written up by *The Tab* in an article that praised MIT's "ever-evolving campus grounds" and was lauded by *The Boston Globe* for its "magic;"

- Graduate student Stephen McHale's public art project *Flock Mentality*, a flock of 80 pink plastic lawn flamingos which captured the attention of commuters and the media alike, including a live broadcast with McHale by WRKO-AM at the project's conclusion at Boston's City Hall Plaza.

- Professor Emeritus David Epstein's final appearance (Beethoven's Ninth Symphony) as conductor of the MIT Symphony Orchestra was recognized in *The Boston Globe* and the performance received a glowing *Globe* review. "A fine and fond farewell to a beloved maestro," concluded reviewer Susan Larson.

- The public debut of Media Lab graduate student Teresa Marrin's "Conductor's Jacket" by Boston Pops conductor Keith Lockhart at Tech Night at Pops, which attracted local, national and even international coverage (including Associated Press, *The New York Times* (picked up by *The International Herald Tribune*) and local TV stations).

- The resignation of List Visual Arts Center Director Katy Kline.

Other people and programs receiving press attention included Associate Provost for the Arts and playwright Alan Brody (for his play *The Housewives of Mannheim*); Institute Professor and composer John Harbison; Center for Advanced Visual Studies alum Chris Janney (for a collaboration with dancer Mikhail Baryshnikov), Associate Professor and composer Evan Ziporyn; sophomore Charlie Korsmo (co-starring in the film *Can't Hardly Wait*); Affiliated Artist Jean Rife; the Musical Theatre Guild's production of *Blood Brothers* and the List Visual Arts Center (received numerous positive reviews of their exhibitions, chosen to organize installation at next Venice Biennale).

More information about the Office of the Arts can be found on the World Wide Web at the following URL: http://web.mit.edu/arts/

Mary L. Haller

COUNCIL FOR THE ARTS

This year was a busy and exciting one for the Council for the Arts at MIT. Among the highlights: the Silver Anniversary Annual Meeting; the creation of the Arts Scholars Program; the appointment of a new chairman and vice-chair; the *Arts Holiday: London* excursion in May; and a bumper crop of new members, resulting in a grand total of 100 (including *ex officio* members).

COUNCIL STANDING COMMITTEES

Annual Meeting (Dorothea Endicott, chair). The Council for the Arts celebrated its 25th Anniversary in grand style on October 23 and 24, 1997 with a gala dinner-dance in the Koch Gallery at the Boston Museum of Fine Arts. Council member Kitty Carlisle Hart delighted the dinner attendees (over 170 people strong) with her one woman show *My Life on the Wicked Stage*. Another Annual Meeting highlight was the dedication of the Endicott World Music Center, donated by Bradford '49 and Dorothea Endicott and devoted to the study of World Music.

At the Friday morning business meeting Martin Rosen '62 was officially welcomed as the new Chairman of the Council, and John Kunstadter was thanked for his dedicated service as past Chairman. Alan Brody announced the Council's "Special Project": the formation of a program for students, loosely based on MIT's Burchard Scholars in the Humanities, to be called Council for the Arts at MIT Arts Scholars (see Special Programs below).

The Eugene McDermott Award and the Gyorgy Kepes Fellowship Prize were presented, respectively, to Toni Dove, New York based media artist, and Professor Stephen Benton, head of the Center for Advanced Visual Studies and E. Rudge Allen Professor of Media Arts and Sciences (see Special Programs below).

Communications (Pepi Weis, chair). The Communications committee produced three issues of the Council newsletter, *Council Currents*, this year, to great success. *Currents* is written by Council members, for Council members.

Development (Daniel Vershbow '45, chair). Seventy-five Council members provided unrestricted contributions averaging $3,430. Fifteen non-member donors contributed unrestricted gifts averaging $595. The total raised was $266,200. In addition to unrestricted gifts, 14 Council members gave a total of $391,523 to other MIT arts projects.

Grants Program (Bradford M. Endicott '49, chair). Under the leadership of Chairman Bradford M. Endicott '49, $65,000 in the form of 38 grants were awarded to projects such as a bagpipe recital held in honor of Scottish poet Robert Burns' birthday; funds for the development of an oral history videotape on the life and work of the late Lawrence B. Anderson '30 (former head of Architecture and member of the Council for the Arts); and the recording of Professor David Epstein's farewell concert as conductor of the MIT Symphony Orchestra.

Membership (Bernard G. Palitz '47, chair). At the writing of this report (7/98), Council membership stands at 95, plus five ex officio members. Eight individuals accepted appointment to the Council upon the invitation of President Vest: Marilyn Breslow, Patricia Lamson Chute, Michael Rechtin '70, Brit D'Arbeloff '61, Beth Marcus '86, Darryl Pomicter '68. Anne Street '69, and Stanley Proctor '43. With deep sadness this report must note the passing of Robert Rudy '37, a beloved member of the Council, and longtime supporter of the Theater Arts Section.

Special Events Committee (Catherine N. Stratton, chair). The Special Events committee kicked off its career with a spectacular event, the *Arts Holiday: London*, a jam-packed four and a half days (28 May - 1 June 1998) full of theater, architecture, visual arts, delicious food and good fellowship. Approximately 40 Council members and guests attended. Kimberly Shilland, the curator of Architectural Collections at the MIT Museum, provided fascinating architectural tours of London, and proved once again that MIT has connections with everything (in this case, the architectural style of the Victorian era). Clive Norris (Sloan Fellow 1992), the head of the MIT Club of Great Britain, gave us a charming welcome at the opening cocktail reception, at which a number of London-area MIT alumni joined the Council members.

List Visual Arts Center (LVAC) Advisory Committee (Kitty Glantz, chair) The List Visual Arts Center enjoyed great critical acclaim with the exhibition entitled *Mirror Images: Women, Surrealism and Self-Representation*, curated by art historian Whitney Chadwick, Katy Kline and Helaine Posner. The exhibition will go on to travel around the country after it closes on June 28, 1998. The LVAC announced major personnel changes near the end of the fiscal year - Curator Helaine Posner left at the end of May 1998 and Director Katy Kline announced her resignation in late June. Posner has gone on to the International Center of Photography in New York, while Kline will be the director of the Bowdoin College Museum in Brunswick, ME.

MIT Museum Advisory Board (Harvey I. Steinberg '54, chair). A new director was chosen for the Museum this year. Jane Pickering, former curator for the Royal College of Surgeons in the United Kingdom, will take up the reins in September.

Artist-in-Residence Committee (Stephen Memishian '70, chair). Organized along the lines of the MIT Museum and LVAC Boards described above. This committee works with MIT Office of the Arts Director of Special Programs Maureen Costello and a panel of arts professionals, Council Members and artists to bring artists to the MIT campus to work throughout the Institute.

SPECIAL PROGRAMS

A very exciting program was established this year: the **Council for the Arts at MIT Arts Scholars Program**. The Arts Scholars will be a group of 25-30 undergraduates who will meet each month for a program on the arts (a lecture, a visit to a performance with a backstage tour, or the opportunity for the student artists themselves to share their work with their peers, etc.) and dinner. Council members and MIT arts faculty will also attend the monthly meetings. The goal of the program is to create a community of student artists, from all of the arts disciplines taught at MIT, who otherwise would have little opportunity to meet each other. The students are chosen by a committee made up of one faculty member and one Council member with expertise in each of the branches of the arts taught at MIT, namely music, architecture, writing, visual arts, media arts and theater. The first meeting of the committee as a whole took place on May 15, resulting in all 23 applicants being accepted as the inaugural class of Council Scholars.

Since 1980, the Council has underwritten MIT's enrollment in the **University Membership Program offered by the Boston Museum of Fine Arts**. This program provides free admission and discount benefits to all MIT undergraduate and graduate students, as well as ten membership cards for the daily use of MIT faculty and staff.

The **free-ticket program with the Boston Symphony Orchestra** continued this year. MIT students can obtain, with their student ID, free admittance to Open Rehearsals, Thursday evening and Friday afternoon concerts on a day-of-show, stand-by basis. The success of this unique program continues unabated.

The successful **Student Performing Arts Excursions Series** continued, with each event enjoying full attendance, an average of 50 students per event. The Council provided tickets to see the Huntington Theatre production of *Game of Love and Chance* and ART's production of Brecht's *In the Jungle of Cities*; World Music's presentation of the Balé Folclorico de Bahia; Boston Baroque's presentations of *L'Allegro/Messiah* and Classical Masters (works of Mozart and Bach); Alan Brody's *Housewives of Mannheim*; a recital by cellist Carlos Prieto '58 at the Boston Conservatory; a performance by Luis Alfaro presented by the Theater Offensive; the Mark Morris and Alvin Ailey dance troupes; and Pilgrim Theatre's *Guys Dreamin'*.

The **Gyorgy Kepes Fellowship Prize** was presented by Alan Brody to Professor Stephen Benton at the Annual Meeting luncheon on Friday October 24. At the gala Annual Meeting ball, the **Eugene McDermott Award** was presented by Dorothea Endicott (McDermott Award Committee chair) and Glorianna Davenport (Ms. Dove's nominator) to Toni Dove, media artist, who will be returning to MIT in the fall of 1998 to work with students in the Media Lab.

At the Institute Awards Convocation on May 13, Associate Provost for the Arts Alan Brody presented the **Laya and Jerome B. Wiesner Student Art Awards** to Elaine Chew (G) and Kevin Simmons '98 . The **Louis Sudler Prize** was presented to Stephen Tistaert '98 for his achievement as a musician.

More information about the Council for the Arts can be found at the following URL:
http://web.mit.edu/arts/camit.all.html

Susan R. Cohen

SPECIAL PROGRAMS

Special Programs created a distinguished Advisory Board for the Artist-in-Residence Program. Artists-in-residence continued to gain national prominence. Felice Frankel, artist-in-residence at the Edgerton Center in the School of Engineering, received national recognition for her book and touring exhibition of science photographs, both entitled *On the Surface of Things*. Kinetic sculptor Arthur Ganson was selected to design the prestigious Lemelson Prize for Invention and Innovation.

ARTIST-IN-RESIDENCE PROGRAM ADVISORY BOARD

In the Artist-in-Residence Program's seventh year, an Advisory Board was created to both strengthen the mission of the program and to consider how to expand as an endowment is raised. The Board is chaired by Steve Memishian G'70, and distinguished membership includes MIT faculty members such as Paul Joskow, Economics; former director of the Bunting Institute at Radcliffe Florence Ladd; and ceramic artist Jim Melchert, who created the mural in MIT's Biology Building. Substantial time was devoted to the cultivation of the Board, which met three times in its first year.

A contribution was made to the Artist-in-Residence Program Endowment in memory of Alan Katzenstein '42.

SCHOOL OF HUMANITIES AND SOCIAL SCIENCE

The Office of the Arts joined the Latin American Politics and Performance Consortium along with the David Rockefeller Center at Harvard, the New York University Tisch School of the Performing Arts, and Dartmouth College. A symposium entitled *The Paucartambo Project: Andean Popular Religiosity in Representation* was presented at NYU by Professor Brenda Cotto-Escalera, Theater Section; Professor Nicolás Wey-Gómez, Foreign Languages and Literatures; and visiting artists Miguel Rubio, artistic director of Grupo Cultural Yuyachkani and documentary film producer Miguel Villafañe.

The Theater Section Residency Committee developed a three year plan for visiting artists.

The Music Section, in collaboration with MIT Heritage of the Arts of South Asia (MITHAS), offered a three day Residency and concert program with Indian dancer Chitdresh Das.

The Foreign Languages and Literatures Section formed a Residency Committee and commemorated the 100th anniversary of the birth of playwright Bertolt Brecht with a residency program with Holger Teschke, chief dramaturg of the Berliner Ensemble. Scene 13 of Brecht's *Galileo Galilei* was staged in German and English in collaboration with the Goethe-Institut Boston. A symposium on Brecht was presented at the Goethe-Institut.

In collaboration with the Program in Women's Studies, novelist Achy Obejas was keynote speaker at the OutWrite Lite conference on gay and lesbian writers held at MIT. A residency program followed.

A planning symposium for the Race and Cyberspace Conference was held in collaboration with the Media in Transition Project and the Program in Women's Studies.

The Office of the Arts consulted with American Repertory Theater and the Ford Foundation on the development of the Arts and Civic Dialogue Summer Program which is directed by Anna Deveare Smith and includes work with visiting artists Shu Lea Cheang and Donald Byrd.

SCHOOL OF ARCHITECTURE

Toni Dove, 1997 McDermott Awardee, filmmaker and new media artist, began the first of a two part Residency program by meeting with students in the Interactive Cinema group of the Media Lab.

SCHOOL OF ENGINEERING

The initiative to create productive pairings between artists and engineers gained momentum. With support from the National Science Foundation, Felice Frankel began the development of a curriculum on visualizing science. Her exhibition of science photography of MIT and Harvard research began its national tour at the American Academy of the Advancement of Science in New York, and continued to Washington DC and several other American cites. Feature articles appeared in *Science News* and *Science.*

Arthur Ganson, kinetic sculptor, conducted mechanical engineering classes in his exhibition *Gestural Engineering* at the MIT Museum and fully participated in Course 2.72, Elements of Mechanical Design. National Public Radio taped a portion of this course for later broadcast. Ganson contributed his artistic viewpoint in Media Lab classes and in the Visual Arts Program. An exhibition of Ganson's work opened at Ricco-Maresca Gallery in New York City. *The Chronicle of Higher Education* featured a story about Ganson entitled, "Fighting Physics to Engineer Sculpture." "Cybertimes," the *New York Times* on-line edition and "Circuits" the hardcopy edition also featured stories about Ganson's work.

The Page Hazelgrove Artist-in-Residence Program in the Glass Lab of the Center for Materials Science and Engineering was developed in memory of Page, who passed away very unexpectedly. Peter Ivey opened this program with a public talk and several workshops. Seed funding for an endowment for this program was secured. Fundraising materials were designed.

HAYSTACK OBSERVATORY

Susan Gamble and Michael Wenyon, holography and media artists, worked with research scientists at the Observatory. A digital camera was mounted on the observatory rotor to "observe the observers," a theme in a new work to be developed at Haystack and posted on the World Wide Web by Wenyon and Gamble. Wenyon and Gamble spoke about the Haystack Residency during the *Physics and Art* Exhibition at the Fuller Museum of Art in Brockton, MA.

LIST FOUNDATION FELLOWSHIP PROGRAM IN THE ARTS

Eto Otitigbe '99 studied printmaking with the esteemed printmaker Robert Blackburn at The Printmaking Workshop, an internationally acclaimed studio in New York City. Eto worked with professional designers to learn how to create an exhibition of his work for the Wiesner Gallery. Eto received first place in the Schnitzer Award and continued to distinguish himself, being named 1997-98 Cordover Scholar in the Arts.

Two List Fellowships, the first in musical disciplines, were awarded. Sumita Pennathur '00, majoring in Aeronautics and Astronautics studied Karnatic vocal music in India and jazz saxophone locally. Isela Rodriguez '99, of the Urban Studies and Planning Department, took lessons with renowned vocal coach Kamal Scott and showed her progress in mariachi vocal music with a Chapel Concert.

The continuation of the List Fellowship was insured through support from the Office of the Provost while the search for a private donor continues.

INSTITUTE COMMITTEES

Membership in the Dr. Martin Luther King Jr. Committee ended after six years of service. Membership to the Committee on Campus Race Relations began. RACE 2000! a series on race relations was created and opened with a symposium with activists Professor Noam Chomsky and Kathleen Cleaver. This program was broadcast nationally on C-Span. Film producer Lee Lew-Lee offered a Residency program of public screenings, course visits and talks on his award winning film, *All Power to the People! The Black Panther Party and Beyond.* Substantial alliances were renewed with diverse students associations in the development of RACE 2000! programming.

The Office of Special Programs received an Multicultural Distinguished Service Award for advancing the cause of race relations at the Institute.

More information about Special Programs in the Office of the Arts can be found on the World Wide Web at the following URL: http://web.mit.edu/arts/specprogs.all.html

Maureen Costello

DEAN OF STUDENTS AND UNDERGRADUATE EDUCATION

During the past year, the Office of the Dean of Students and Undergraduate Education (ODSUE) has achieved an organizational structure that is both stable and flexible. Major leadership positions have been filled: Marilee Jones as Dean of Admissions, Christopher Pratt as Director of the Office of Career Services and Preprofessional Advising, and Mary Callahan as Registrar and Codirector, with Peggy Enders, of the Academic Services Office. The structure of the offices comprising ODSUE has been clarified with the appointments of Andrew Eisenmann as head of the Residential Life Office, Larry Maguire as Head of the MIT Card Office, Phil Walsh as head of the Office of Campus Dining (in addition to his position as head of the Campus Activities Complex), and Carolyn Bunker as head of Student Financial Services. At the same time, the lateral connections within ODSUE have been nurtured. The Student Services Center continues to strengthen the connections between academic and financial services, while MIT Student Information Services, directed by Robert Rippcondi, provides a common source of support and development for computer technology. An ODSUE administrative team is being assembled around two key appointments: Deborah Fairchild as Special Assistant to the Dean for Finance, and Sharon Bridburg as Special Assistant to the Dean for Personnel. During the spring they collaborated with Rippcondi, Richard Brewer, Mary Callahan, and David Weber to propose an ODSUE administrative structure that will balance a robust common planning process with reliance upon decentralized networks of local experts for many administrative functions. During the coming months, the emerging administrative team will interact intensively with the heads of ODSUE's offices to refine and implement this plan.

As a result of all these organizational steps, Student Services Reengineering is now fully integrated with the ongoing work of ODSUE. Reengineering affinity teams have been absorbed by the common administrative networks, while the activities of special project teams have been folded into the ongoing work of various offices. The principles of Student Services Reengineering -- unrelenting attention to improved service, equally unrelenting attention to reduced costs, reliance on measurable performance criteria, and coordination of work across the range of ODSUE activities -- are being pursued within existing organizational structures, with clear lines of accountability and authority.

In a normal year, the successful integration of ODSUE would be the focus of this report, and the cause of some degree of self-congratulation. This has not been a normal year, however, and we in ODSUE cannot afford to dwell on our organizational accomplishments when more substantial challenges lie directly before us. While ODSUE's organizational changes have been proceeding, they have been crosscut and often disrupted by much less predictable, much more powerful currents of cultural change.

During the past academic year, MIT suffered six student deaths. Each gave rise to shock, grief, and questioning. However, the particular circumstances of the death of Scott Krueger on September 29 -- he was a freshman, living in a Boston fraternity, who consumed too much alcohol in a fraternity-related event -- led to great attention beyond MIT (from the media, courts, governmental agencies, and other educational institutions, among others) and to even greater attention from all quarters of the MIT community (undergraduate and graduate students, faculty, staff, parents, alumni/ae). For us at MIT, Scott Krueger's death, forcefully revived debates about student orientation, housing selection, alcohol policies, and student social life that have been discussed repeatedly in recent years. The underlying issues are deep, involving as they do fundamental questions about the role of residential experience in an MIT education, the interaction between academic and social life, the relationship between undergraduate students and other members of the MIT community, and the balance between individual and institutional accountability.

These are the kinds of issues raised with the ODSUE visiting committee when it met with us in early March. Its visit came only 11 months after its first review of the newly created dean's office in the spring of 1997. At that time, committee members had felt that so much was happening in ODSUE that they should not wait for the usual two-year interval to return. They could hardly have imagined that the topics they would be reviewing would involve not only major organizational changes, but also fundamental principles of MIT's residential education. As the committee's 1998 report indicates, within ODSUE we have come far in attaining equilibrium and self-understanding. During the coming year, or more likely years, ODSUE must provide support and leadership so MIT as a whole can work through some major transitions and arrive at a new equilibrium and level of self-understanding of itself as a learning community.

ADMISSIONS OFFICE

The Admissions Office has had a successful year during a period marked by uncertainty and an increasingly competitive marketplace. Two main changes have affected the context of our work. First, Admissions has a new Dean and now works within the larger environment of ODSUE. This requires us to be more visible within MIT as well as to be more cooperative across offices. Second, the competitive nature of our business has increased substantially with the change in Princeton's financial aid policies. On the basis of this competitive challenge, MIT responded by lowering the self-help by $1,000 and establishing a task force to investigate the effect of financial aid on enrollment patterns.

UNDERGRADUATE ADMISSIONS

Our freshman applications were up 5% to a record high of 8250. Much of that increase was reflected in Early Action applications, up 10% over the previous year's record number. Most of our competitor schools saw no growth or even a decrease in their applications during the same period. Due to our recruitment work with minorities, women and the top academicians, we admitted and will enroll a record number of all three cohorts: the freshman class will be made up of 17% minorities, 43% women and 6% academic superstars. The class will include citizens of 47 states and 50 countries. Other significant statistics from undergraduate admissions are as follows:

- Our selection rate is 23%, the smallest applicant-to-admit ratio in MIT history.
- We will enroll a smaller freshman class size - 1050 instead of last year's 1070.
- We admitted 33 from our wait list (Yale, Princeton, Stanford all went to their wait list - Harvard did not) and currently have a yield of 56%.
- In order to help ease the anticipated crowding situation in the housing system, we will enroll just 20 transfer students this fall.

EDUCATIONAL COUNSELORS

- There is a record high number of ECs - 1859, representing all 50 states, DC, Puerto Rico, the Virgin Islands and 47 foreign countries. Alumnae = 389 (21%); minorities = 58 (3%).
- ECs interviewed 87% of applicants overall, 89% of US applicants.
- EC s arranged 86 central recruiting meetings for admissions staff around the US in 78 cities last fall. They also sponsored 38 receptions for newly-admitted students in the spring.

NEW INITIATIVES

- For the first time, the admissions offer and the financial aid award were packaged together in the admit packet, mailed on the usual mailing date of March 17.
- With a new Filemaker Pro database, we substantially increased our recruitment capabilities and expanded them to include the academic superstars.
- We added a mid-cycle selection day called "extreme round-up" in order to get more admit decisions at an earlier time to the Financial Aid Office.
- We recruited more faculty and staff to help us select the class.
- We had graduate students read applications for the first time.
- In the hopes of increasing the yield of our 'academic superstar' admits, we experimented with offering 13 paid UROPs to admitted pre-frosh.
- We initiated a special "context committee" to oversee the admission and enrollment of special cases that are not clear admits. Committee members are counseling and academic deans, disability experts and admissions staff.
- We initiated and coordinated an ODSUE-wide committee to oversee spring yield activities for admitted pre-frosh.
- We created a special homepage for admitted prefrosh that would segue into the orientation homepage.
- The role of the Educational Counselor is being expanded to include several tracks from which alumni may choose to participate. This will expand our outreach and recruitment efforts and should serve to increase the number of minority and female alumni in the EC network.
- We put the freshman and graduate applications on line in a PDF version, adding that option to our other two electronic options: CollegeLink (floppy disk) and CollegeEdge (Web based). A total of 10% of our freshman applicants used one of these forms of electronic applications this year, up from 3% last year.

GRADUATE ADMISSIONS

Graduate applications were down 5% from 12,785 in '97 to 12, 098 for entrance '98. The yield for admits is up, however, from 51% last year to 53%.

NEW INITIATIVES

The graduate admissions database has been redesigned in cooperation with ODSUE-IT and tested by a pilot group of 7 departments. It will be fully operational for the Spring, 1999 graduate admissions cycle. This client server system will provide:

- automatic application mailings by a mailinghouse
- applicant tracking capability to eliminate redundant mailings and to provide recruitment opportunities
- data entry can be done in diverse areas and can be imported into any department's own database system

This new system will:

- provide MIT with a central but shared graduate database
- provide departments with the info they need while maintaining their own flexible systems should they choose to keep those
- save MIT $$ in postage costs by eliminating redundant mailings
- save departments $$ by eliminating the need for duplicate data entry

Marilee Jones

ATHLETICS, PHYSICAL EDUCATION, AND RECREATION DEPARTMENT

The Department is dedicated to providing "adaptable, high-quality, student-oriented physical education, athletics, recreation and intramural programs that encourage opportunities for participation, competition, confidence, and leadership while enhancing the MIT athletics and health fitness environment for the entire MIT community."

The Department's association with other units in the Dean's Office is proving to enhance the quality of education experiences for student-life and learning, and community services at MIT. The Department's reporting relationship is to Professor Rosalind Williams, Dean of Students and Undergraduate Education.

STRATEGIC OBJECTIVES AUDIT FOR 1998

The Department hosted its bi-annual Visiting Committee May 4-5. The Committee saw a Power Point presentation which showed progress made on the 1996 Visiting Committee recommendations, the MIT Athletics Story (with videos), the Central Athletic Facility 12 point plan, and identification of the challenges facing the Department in the areas of facilities, personnel and budget/programs. Separate roundtable discussions were held with students and with faculty/coaches. The sports of women's ice hockey, women's indoor track & field, and men's ice hockey were recommended for elevation to varsity status.

Several personnel changes were put in place to support the leadership of the Department. Associate Professor Candace Royer was named Director of Physical Education and Associate Department Head. John Benedick, accepted a promotion from Associate Professor/Coach to Assistant Athletics Director. Associate Professor Jean Heiney assumed the duties of Senior Women's Administrator and Intercollegiate Scheduling Coordinator. Larry Anderson, was named Director of Club Sports, and Mayrene Earle was named Associate Director of the Pierce Boathouse. Cheryl Eccles was hired from the Chemistry Department to serve as Administrative Officer for Business Affairs. She is assisted by Greg Algarin-Marquez. Carol Matsuzaki '96 replaced Merrilee Keller at mid-year as Women's Tennis Coach, and was supported in her J.B.Carr Indoor Tennis management by Barbara Wiget. Leaves of absence were granted to Assistant Professor/Coach Halston Taylor (to work with ODSUE), Assistant Professor/Coach Mary Ellen McLaughlin (maternity), Instructor/Coach Joe Quinn (medical), and Associate Professor Gordon Kelly (sabbatical). Kimberly Goulding resigned from her position as Athletic Trainer in December (marriage). Dance instructor Stephan Driscoll's resignation will be a significant loss to the physical education program.

Serious searches for full-time coaches resulted in the hiring of three persons. MacDaniel Singleton was named Assistant Professor/Coach of Baseball, Melissa Hart was hired as Instructor/Coach of Women's Soccer and

Basketball, and Mary Ellen McLaughlin, was selected as Assistant Professor/Coach of Men's/Women's Swimming. The Department was unsuccessful identifying qualified candidates for the position of coach of Women's Volleyball/Softball which resulted in part-time head coach utilization in those sports (Paul Dill-Volleyball and George Rollins -Softball). Additional part-time new hires were in Men's/Women's Pistol (John Holland), Men's Golf (Kenneth Bellerose), Men's Water Polo (Jeff Ma '96), and Men's/Women's Nordic Skiing (Jessie Donovan). Richard MacKenzie was named interim Men's Cross Country/Men's Track & Field coach filling in for Halston Taylor (leave of absence).

In continuing interest in the upgrading of all facilities, the Institute has made a $40 million commitment toward the development of the Central Athletics Facility that includes a 50 meter swimming pool, Health Fitness center, Sports Medicine facility, additional locker rooms, and other projected venues. During the Summer of 1997 the existing Health Fitness Center was renovated thanks to a generous financial commitment from Paul Rudovsky '66. Repair has begun on the west wall of the du Pont Gymnasium to reinforce crumbling masonry. The Steinbrenner and Johnson Center tracks were repaired and relined. Tarpaulins were purchased for the baseball and softball fields, and the softball infield was "skinned" to provide a 100% dirt surface. The strength of town and gown relationships continue to be reinforced as MIT hosted over 30 outside events in Athletics Department spaces.

Sale of Athletics Cards climbed nearly 11% during this fiscal year to 8,327, as computerized systems were refined to enhance the ease with which cards could be purchased. A stronger monitoring program was implemented to restrict facility use to valid card-holders.

PHYSICAL EDUCATION

After 14 years as Director of Physical Education, Associate Professor Gordon Kelly stepped down from the position. During his tenure, Physical Education class offerings were greatly expanded. Professor Kelly will remain in the Department providing expertise as a senior member of the teaching staff.

Registrations for 1997-98 were 7,507, which is 757 lower than in 1996-97. Explanations include leaves of absence for three staff members, restructuring of some positions which required reductions in class assignments for three faculty-coaches and one faculty member, and a reduction in number of sections offered due to reduced demand in select activities.

In 1998, following in the successful footsteps of the Athena-based registration lottery system (PELOTT), the Department in collaboration with ODSUE will implement a new WWW-based registration system. This format will permit students to register for their physical education classes "on-line" from anywhere in the world.

INTRAMURALS AND CLUB SPORTS

Intramural participation increased slightly as 8,841 students representing 796 teams (down from 812 in 1996-97) exhibited their loyalties in competing for their dormitory floors or fraternity houses in 17 activities.

Club Sports program needs were analyzed and financial support guidelines were established and implemented, resulting in more equitable distribution of funding. Of the 43 programs registered this year, 17 competing Club Sports received financial assistance. Participation figures were up 3% from 1996-97, and 40% of participants were women (up 4%).

STUDENT-ATHLETE ACCOMPLISHMENTS

The actual number of outstanding performances by our student-athletes are too great in number to comprehensively mention in this document. Highlights of the 1997-98 academic year, however, are as follows:

- Robert B. Gray '98 became one of the most decorated student/athletes in MIT history. Among Gray's awards were the Walter Byers Scholarship from the NCAA (the top male student-athlete in the NCAA), and a Marshall Scholarship.
- Tracey C. Ho '99 won the National Rifle Association individual championship in air pistol, and led MIT to the team title in the event. Jane J. Sohn '98 and Hattie R. Gruneissen '00 were each named All-Americas in the event along with Ho.

- Michael T. Butville '98 became the first MIT male athlete to be named GTE Academic All-America in two different sports (football & lacrosse) in the same academic year. He was a first team selection in both sports.
- J.C. Olson '00 and Sonja J. Ellefson '01 each broke the Institute all-around record in men's and women's gymnastics respectively.
- The men's basketball team posted the second largest increase in number of wins in the NCAA, going from three in 1996-97 to 18 in 1997-98. The women's team's 17 wins broke the Institute record of 14 set in 1985-86. The men's water polo record of 14-8 was the best in Institute history.
- Eleven people in five different sports were named All-America in 1997-98. Eighteen student/athletes in seven sports were named to regional or national scholar/athlete teams.

SELECT FISCAL YEAR 1999 PLANNING OBJECTIVES

- Continue efforts to diversify the Department through the identification, recruitment, and employment of more women and minorities in administrative, management, head coaching, and teaching positions.
- Continue efforts to fully integrate the Department into the Office for the Dean of Students and Undergraduate Education (ODSUE).
- Continue development of a planned approach to funding the Central Athletics Facility, along with the renovation of existing facilities based on the ODSUE audit results. Explore marketing and promotional activities aimed at creating revenue streams for facilities expenses.
- Continue to improve the efficiency and effectiveness of daily operations through an on-going review of processes and utilization of computer technology.
- Continue the development of the Department's Strategic Plan while devoting special focus to our current intercollegiate sports programs, identifying opportunities for "de-teaming" or creating additional funding support.
- Develop a planned approach to involve faculty/coaches and other staff in research and other scholarly professional endeavors. Continue active participation in the planning of the Center for Sports Research.

More information about the Athletics, Physical Education and Recreation Department can be found on the World Wide Web at the following URL: http://web.mit.edu/athletics/www/index.html

Richard A. Hill

BURSAR'S OFFICE

The mission of the Bursar's Office is to gather, bill, and collect tuition and related fees; to disburse, bill and collect student, parent and staff loans; and to counsel students, parents, and alumni on payment options, indebtedness, and financial management.

MIT continued its participation in the federal William D. Ford Direct Stafford Loan Program. During the fiscal year we disbursed $17,776,700 of federal money to students who value the program because the process is efficient.

Student loans receivable totaled $71,656,567 at year-end. These notes were funded by $16,321,500 of MIT loan funds established by friends and alumni of the Institute; $32,770,350 of federal funds in support of the Perkins Loan Program; and $23,000,000 borrowed from Bank Boston.

In 1997, MIT's cohort default rate on Perkins/National Direct Student Loans was 6%.

Student tuition, fees and other charges increased by 4.5% to $266,211,495. There were 1,332,820 transactions to the student accounts receivable system. Income from late payment fees was $256,455; income from finance charges was $191,300.

There were 162 active Parent Loan Plan (PLP) accounts. A total of $1,722,613 was disbursed during the year and $1,591,863 in principal was collected. The PLP receivable at the end of the fiscal year was $2,026,066.

In addition to our regular services, this past year we have:

- Collaborated with the Registrar's Office, Student Financial Aid Office, Student Information Systems, and Undergraduate Academic Affairs Office in establishing the Student Services Center;

- Collaborated with the Registrar's Office, Student Financial Aid Office, Student Information Systems, and Undergraduate Academic Affairs Office to create a new organization which will provide integrated service to students;
- Worked with academic departments to deliver loan counseling to their locations, which increased student satisfaction and eliminated hundreds of student visits to the Bursar's Office;
- ang Designed, developed and implemented Web-based loan entrance counseling for students;
- Designed, developed and implemented an on-line system of printing refund checks for students;
- Planned and delivered the staff migration from Macintosh to PC;
- Worked with Student Information Systems, the Controller's Accounting Office, and the Academic schools and departments to develop a process for complying with the reporting requirements of the Tax Relief Act of 1997;
- Designed, developed and produced with MIT Audio-Visual Services a new loan exit video to deliver financial information to students;
- Collaborated with the Student Financial Aid Office to combine and reorganize the offices into a team-based Office of Student Financial Services;
- Worked with the Registrar's Office, Student Financial Aid Office, Student Information Systems, and HKT architects, to design the renovated space in Building 11.

Cheryl Baranauskas, Mary Barry, Dwayne Daughtry, Sarah Hernandez, Erin McCoy, and Mary Murray transferred to the Student Services Center when it opened in August. Shawn Dunn transferred to ODSUE IT as part of the reorganization of student services. Sandra Chauncey,Carlene Chisom-Freeman, and Barbara Johnson accepted positions as team leaders in Student Financial Services, the new organization formed by the reorganization of the Bursar's Office and Student Financial Aid Office.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/bursar/

Carolyn Bunker

CAMPUS ACTIVITIES COMPLEX

The mission and purpose of the Campus Activities Complex (CAC) is to be the center of campus life for students, faculty, staff, alumni/ae, retirees, and guests. Through its programs, services, and facilities, it offers educational, recreational, and social opportunities for both community interaction and the exchange of ideas, concerns, and interests. With the support of its affiliated volunteer organizations and the CAC Advisory Board, the department strives to foster individual growth and build community spirit.

Now in its second year as part of the Office of the Dean of Students and Undergraduate Education (ODSUE), the Campus Activities Complex (CAC) has had new opportunities to further realize its mission. CAC has established vital links and affiliations that have enabled both the CAC and other Student Life departments, including Residence and Campus Activities (RCA) and the MIT Card, Housing, and Food Services (HFS), to better serve the MIT community through the improvement of services, programs, and operations. A new phase of major renovations to CAC facilities has begun, and the office has developed a new Community Programs and Services function. This year has also concluded the final planning phases and the commencement of the implementation of both the new Office of Campus Dining and the Scheduling and Event Management System.

THE CHAPLAINCY

The Programs housed in W-11 (or W-heaven as some now call it) continue to serve the MIT community well despite the turnover in Chaplains. Sister Mary Karen Powers left the Catholic chaplaincy in the fall of 1997 following heart surgery to return home to Kentucky. She will be replaced in the fall of 1998 by Sister Kathleen Crowley who comes to MIT after a very successful tenure at Salem State College. Bob Sawyer has taken new responsibilities for Campus Crusade for Christ and a replacement has not been named. Mr. Suheil Laher has been appointed Associate Chaplain serving the Muslim Community, and Dr. Cyrus Mehta has joined the chaplaincy to continue his work with Hindu students and those whose tradition is Zoroastrian.

The chaplaincy at MIT continues to model a vigorous interfaith program made possible by strong cooperative bonds tying groups to one another. This is illustrated by the role MIT has taken in developing an interfaith calendar offering the holy days of twenty different religious groups and produced and distributed under the aegis of MIT, Harvard, and Wellesley College. This project gives the dates of the holidays of the world's major and minor faiths and information on the particular demands of each day for the faithful. The pamphlet is designed to be a resource for the next three years as faculty and staff plan meetings, schedule exams and other university exercises. At the same time the publication of this information testifies to the religious diversity on our campuses. Available this fall and produced on a three year cycle, the interfaith calendars may be used by other colleges or universities.

COMMUNITY PROGRAMS AND SERVICES

Organizational changes were made in order to effectively respond to increased needs to build and support community at MIT. The CAC Programs area and the Office of Special Community Services have been functionally aligned in order to provide a more broad-based programming unit that is responsive to the whole MIT community, from students, faculty, and staff to MIT's alumni/ae, and retirees. As well,
CAC began supporting Talbot House and the Awards Convocation, enabling RCA to focus on providing more cohesive support for student activities.

This year's Awards Convocation exemplified the MIT community's support for the program, as both the number of nominations and the attendance at the ceremony increased. Michael Bryzek '00 was honored as the first recipient of the Priscilla King Gray Award for Public Service. The Talbot House facility in Vermont underwent several major improvements including the installation of a fire protection system and a new roof. The House's local area caretaker, Robert Holden, retired after 30 years of service to the MIT community.

ARTS AND RECREATION

The Student Art Association (SAA) again reached capacity enrollment of 1,090 students. The SAA is in the process of developing the capability for digital photography, for which space has been designated. The Wiesner Student Art Gallery exhibited a variety of student art work, including photography, Chinese painting, ceramics, and woodwork. Works of the winners of the List Fellowships and the Schnitzer Prizes in the Visual Arts highlighted the exhibition season. Currently on display in the Gallery is the first annual show of photographs from the SAA.

With 191 new student members, the Hobby Shop's membership reached 360. Members, which include students, alumni, faculty, staff, and their spouses, engaged in a broad range of individual projects such as a telescope, an ergonomic computer desk, and a decoupage screen. The Shop was also utilized for students' academic projects, including the Stagecraft, Woodwork Seminar SP.751, Music of Africa, several UROP's, and both undergraduate and graduate theses in mechanical engineering. Once again, the Shop provided instruction and facilities to Phi Delta Theta in their annual effort to build several hundred toys for needy children as part of the Public Service Center's Giving Tree project. This year, the fraternity was honored with the James R. Killian, Jr. Community Service Award, as part of the Awards Convocation. The position of chair of the Hobby Shop Committee was assumed by Professor Alexander Slocum.

PROGRAM AND ADVISORY BOARDS

The CAC Advisory Board, chaired by Theresa Raine '98, selected several community issues to address over the course of the year. Identifying the Stratton Student Center Reading Room as an area requiring renovation, the Board began to develop a plan to improve the facility and its program. Following conversations with the Class of '98, the Reading Room renovation has been selected as the 1998 class gift. Members of the Board also represented the MIT community on the selection committees for several open CAC staff positions and on the committee overseeing the renovation of Kresge Auditorium. Additionally, the Board assisted various members of the CAC staff in improving their programs and services, including this year's financial operations marketing survey and the further development of the CAC Program Board.

In its second year, under the leadership of Jason Dailey '99, the CAC Program Board concentrated its efforts on responding to the community's need for increased alcohol-free social programming. Its efforts resulted in the sponsoring or co-sponsoring of several weekend parties and entertainers and in the strengthening of the Spring Weekend Committee, co-chaired by the Board's Christine Hartmann '98 and the Undergraduate Association's Stuart Jackson '00. The second annual "Take Your Professor to Lunch" Week saw an increase in both faculty and student

participation and community business sponsorship. Finally, through the Games Tournament, three students placed regionally and competed nationally in the Association of College Unions International table tennis tournament.

SPECIAL COMMUNITY SERVICES

The Office of Special Community Services (OSCS) is responsible for augmenting MIT employees' quality of life by helping to meet their work/life needs through the provision of a wide range of community programs and services. OSCS is pleased to announce that this year's annual United Way Campaign, under co-chairs Professor Travis Merritt and Physical Plant's William Wohlfarth, surpassed its goal of $315,000. The MIT Activities Committee (MITAC), co-convened by Muriel Petranic from MIT's campus and Michael Clifford from Lincoln Laboratory, organized more than 80 events for approximately 4,700 members of the community. One of MITAC's highlights was its participation in WGBH's Membership Telethon Drive, which not only increased membership for WGBH, but also developed MIT community team spirit.

The Association of MIT Retirees, co-chaired by Dorothy Bowe and Walter Milne, provided a variety of programs and volunteer efforts, including: publication of the annual membership directory with 850 listings; creation of the "Senior Focus" newsletter; appointment of a retiree to the MIT Medical Advisory Board; and assistance to MIT service projects, such as assembling 11,000 packets for distribution by the Community Service Fund. In addition, the Association accepted responsibility for the American Association of Retired Persons (AARP) Travel Program after the MIT-Cambridge AARP Chapter #2893 disbanded in the Fall. Under the leadership of James Fandel, the Quarter Century Club (QCC), inducted 119 new members to bring its membership roster to over 2,800. In honor of MIT's retiring Senior Vice President, the QCC established the William R. Dickson Retiree Education Fund to assist retirees in pursuing their educational goals. At the annual President's Retirement Dinner, 55 retiring members of the MIT community were honored.

FACILITY AND EVENT OPERATIONS

CAC operations staff were available 24 hours a day, seven days a week to provide event planning, support, and supervision to more than 12,750 events across MIT's campus, with a combined attendance of over 600,000 people. In addition, CAC was responsible for coordinating the operational and logistical aspects of many of the Institute's major events, including the Infinite Buffet, Innovation Summit, Commencement and Tech Days, Residence/Orientation, William R. Dickson's Retirement Event, Spring Weekend, Building 20 Remembered, the ILP Research Director's Conference, the Massachusetts State Science Fair, and the ceremony to commemorate the relaunch of the Technology Review magazine.

CAC continued to maintain and service the Stratton Student Center, Walker Memorial, the MIT Chapel, the Religious Activities Center, Kresge Auditorium, and Tang Center, which house many stores, services, multipurpose facilities, and departmental and student organization offices. Lighting and seating in common areas was upgraded to better serve the recreational and educational needs of students. In addition, facility use evaluation and planning continued in an effort to more effectively use limited space in meeting the needs of the MIT community. Ongoing safety and health standards efforts also continued, with a particular focus on aiding student organizations with dark rooms and printing processes in maintaining standards as part of the site visit by the Environmental Protection Agency.

Working with RCA and other departments, CAC further developed the event planning process at MIT which included improving communication with the Registrar's Schedules Office through their participation in weekly event reviews and streamlining the Event Registration Process to encourage more on campus events. Efforts to provide more centralized services for student organizations continued, including the expansion of the Student Center student activity office key distribution system to include Walker Memorial.

FACILITY RENOVATION

The first phase of the Kresge Renovation project, focusing on ADA and life safety issues, was begun. The lighting and sound systems are being upgraded, new seating is being placed into the main auditorium, and all necessary renovation to meet ADA compliance will be completed. This phase of the renovation will stop on August 8, 1998 and then be completed during IAP 1999. Efforts have been ongoing to plan and identify funding for the second phase of the project, which will include mechanical system and audiovisual upgrades, as well as renovations to the MIT Chapel.

With the closing of Building 20, plans were made to move OSCS to the more central location of Walker Memorial. Space in the lower lobby was renovated to house its staff and programs. The renovation included the creation of a conference room which will be available for use by both OSCS and the several student organizations with offices in Walker.

SCHEDULING AND EVENT MANAGEMENT SYSTEM PROJECT

The Co-curricular Implementation (CCI) Team has completed the review of the Scheduling and Event Management System and selected the Dean Evans Event Management System (EMS) software package. The new system will fulfill the scheduling needs of both the Campus Activities Complex and the Athletics Department. This unified system will enable the two departments to maximize the schedulable facilities and provide improved customer support. In addition, EMS has the capability to link with MITSIS and to facilitate the event registration process utilized by the Campus Police, Conference Services, and RCA.

ADMINISTRATIVE AND FINANCIAL OPERATIONS

CAC's administrative and financial area concentrated its efforts on the implementation of SAP, the integration of financial reporting with other areas of ODSUE, and the further development of CAC's Business Enterprise Program. This year, the Student Center's portfolio of retail tenants maintained full occupancy; with three tenants submitting their notice of non-renewal for the upcoming fiscal year. In March, with the volunteer assistance of students participating in the Alternate Spring Break program, a marketing survey was conducted to assess the shopping patterns and needs of the MIT Community. The information gathered will better enable CAC to provide a proper mix of retail services in the Stratton Student Center and will inform current efforts through community outreach and MIT Real Estate to identify new tenants.

BUSINESS ENTERPRISE PROGRAM

This was the first full operating year of CAC's Business Enterprise Program which has been designed to provide effective management and support to both the programmatic and fiscal aspects of various campus services. With the integration of the 24 Hour Coffeehouse, the Gameroom, the Source Box Office, and the Student Center Lobby Vendor Program, the Business Enterprise Program has enabled the Student Center to better meet the needs of the MIT community. The Program has also enabled CAC to fund other programs and services, including the CAC Program Board, and provide growth and development opportunities to approximately 65 student employees.

Through collaboration with the Lecture Series Committee, a movie theater-style ticket service was added to the Source, enabling on-demand ticket printing for a multitude of campus events. This service has reduced both the event planning cost of having tickets printed by off-campus vendors and the labor cost of various groups selling tickets for their individual events.

STAFFING AND STUDENT EMPLOYMENT

This year, CAC underwent several staffing changes. Joanne Katz, Manager, resigned; the position was reclassified as Assistant Manager and accepted by Daniel Conceison from HFS. The previous vacancy of Assistant Manager was reclassified as Operations Supervisor and filled by Ricky Murphy. Derrick Barnes, Operations Supervisor, accepted a position with HFS and was replaced by Sean McGehearty. An Administrative Staff Assistant search is in progress to replace Ellen Schemerhorn, who resigned. Ricky Gresh filled the temporary full-time position of Program Coordinator for Student Activities, a position shared jointly with RCA. Debra Fair, Administrative Assistant, accepted a position with the Department of Chemistry, and was replaced by Annmarie Cameron from the Center for International Studies. Finally, Tina Trager was promoted from Event Coordinator to Assistant Manager for Event Planning.

CAC continued to provide employment opportunities for over 75 students. CAC further developed its Student Employment Program, which works to support the personal and academic growth of student employees, by centrally coordinating hiring processes and providing study care packages for each employee during both fall and spring term finals. In addition, CAC worked collaboratively with RCA to expand some of the Program's benefits to students working in RCA. In addition to hiring MIT students, CAC offered several Graduate Assistantships for students in Higher Education Administration programs at local universities. Michael Taylor and Blake Naughton, graduate students enrolled at Northeastern and Harvard Universities, respectively, provided programming support to

Community Programs and Services over the past year, and Sean McGehearty, a graduate student enrolled at Boston College, supported the Student Employment Program during the spring term.

CAMPUS DINING

The Institute Dining Review process was completed in mid-November with the submission of the Working Group's report. The plan recommended the reorganization and centralization of all food and beverage operations on campus under a new Office of Campus Dining that is guided by an educational mission statement and a Campus Dining Board. The report was reviewed and approved, and the proposed changes are now being implemented.

More information about the Campus Activities Complex can be found on the World Wide Web at the following URL: http://web.mit.edu/campus-activities/www

Peter Cummings, Michael Foley, Ricky Gresh, Ted Johnson, Edward McCluney, Elizabeth Mulcahy, Kenneth Stone, Tina Trager, Phillip Walsh

CAREER SERVICES AND PREPROFESSIONAL ADVISING

> *"Career Management is seen as an ongoing problem-solving process in which information is gathered, awareness of oneself and the environment is increased, career goals and strategies are developed, and feedback is obtained. This process can help individuals deal with the tasks and issues they face in various stages of their careers." - Jeffrey H. Greenhaus*
>
> *"Real learning gets to the heart of what it means to be human. Through learning we re-create ourselves. Through learning we become able to do something we never were able to do. Through learning we reperceive the world and our relationship to it. Through learning we extend our capacity to create, to be part of the generative process of life. There is within each of us the deep hunger for this type of learning. This, then, is the basic meaning of a "learning organization" -an organization that is continually expanding its capacity to create its future....."generative learning", learning that enhances our capacity to create." - Peter Senge*

The Office of Career Services and Preprofessional Advising (OCSPA) philosophy is that career development is an ongoing process that includes: self-assessment, competency development, research into career options, experiential learning, and preparation for the job search or for the graduate/professional school application process, and productive, rewarding lives. Above all else, it is a generative process. Students are encouraged to begin their career education early, including a visit to OCSPA during freshman year or the first year of graduate school, to learn what career resources are available.

In striving to better serve our students, employers, alumni, faculty, and other administrators, Career Services and Preprofessional Advising is seeking to contribute to a dialogue about Institute-wide learning. Our academic role at MIT is to build and maintain enabling systems which encourage us as a community, and especially our students, to become self-managed learners who can contribute to learning organizations where we work and live.
OCSPA assists students in learning about the relationship between what they are doing at MIT and life after graduation; exploring career options in relation to choice of major; understanding the competencies required beyond their technical knowledge to succeed in the competitive global marketplace, and contribute to civilization; networking, informational interviewing, mentoring, internships, summer jobs and other opportunities to gain experience in fields of interest; applying to medical, law or other graduate/professional school; study abroad; writing a resume and conducting interviews; and finding employment after graduation.

Employers, like society at large, hire and most certainly promote on the basis of competencies, not majors. The required competencies get the job, but these competencies are not major dependent. It is important to ask where at MIT students learn what employers and society expect of them. In addition to technical knowledge, the desired competencies are: effective communication, critical thinking, team building, information technology, change management, leadership, diversity, social responsibility, and self-managed learning. It is also important to ask what are other or will be new competencies that civilization will require of us.

OCSPA's efforts to focus on generative learning is intended to help us, both ask that question and find shared answers. In OCSPA we are working together to build on many of the themes presented in the reengineering reports, the five-year plans, and similar documents. We are moving forward with many of the initiatives proposed in the previous documents. We put in place some new approaches in preparation for the beginning of classes and employment recruiting, so they were least disruptive to our clients.

In order to continue this growth, OCSPA, with MIT, faces many challenges. The ratio of professional staff to students has been less than 1 staff member for every 1910 students, not to mention alumni who also request our services. That ratio has allowed for little or no specialization. Additionally, the over 1000 employer organizations which recruit students and alumni, require special attention in meeting their needs. For us, this means discovering the best balance of information technology uses and personal delivery of our services. OCSPA has serious needs in terms of facilities, equipment, and perhaps, most significantly staffing and location.

MAJOR ACCOMPLISHMENTS

OCSPA offices and human resources have been reorganized and renovated to bring together staff to provide more consistent and collaborative services to all students. Cross training of our staff has begun in order to help us deliver consistent and quality information to students. A new leadership team management approach has been created to ensure participatory decision-making and to equitably distributed OCSPA management responsibility among a leadership team composed of the director, two associate directors and an administrative assistant. Outreach by the director and the new leadership team has been increased to students, faculty, alumni, administrators, professional schools and employers. Integration of Preprofessional Advising into the OCSPA as a whole has been initiated. A plan to reduce the ratio of OCSPA staff per student has been initiated. This plan will result in a reduction from about 1910/1 to an average across the five schools of 541/1, a 72% decrease in the ratio which translates into a concomitant increase in staff available to students across the institute. Instruments have been implemented that will enable us to measure customer satisfaction; track career advising appointments and workshops; track post-graduation plans; and survey departmental academic and administrative career assistance activities, resources and needs. Dozens of workshops for students were offered by the department.

RESEARCH ACTIVITIES

Two major research efforts conducted by OCSPA this year were a survey of career-related services available across the MIT campus, and a survey of graduating students. The first survey resulted in responses from 27 departments with whom we are currently following up to build a more thorough picture of where at MIT students can access the services they need. OCSPA also conducted a survey of graduating students in the Class of 1998 which resulted in an excellent return rate of 1819 respondents which is 82.68% of 2200 students. The survey was conducted over four days as graduates picked up their caps and gowns in the Coop. We plan to follow up with students who may have been missed, and those who may need further assistance. Following an SPSS analysis, a report of the survey will be distributed to the MIT community. We have already learned some things from the process that will help us do it better next year, and we will learn more as we go through the surveys. For now, we have taken the first major step forward building a data base for future program planning and decision making.

PREPROFESSIONAL ADVISING

In 1997 there were a total of 198 MIT applicants—a huge leap if one looks back at the 1980's. (For example, in 1988, only 99 applied, including only 69 seniors.) In 1997, 110 seniors applied to medical school and 64% gained admission. The number of alumni applicants has doubled since 1988 and nearly tripled since 1986. Also, in 1997, 77 MIT alumni applied to medical school. In 1997, a total of 98 men and 100 women (undergraduates, graduate students, and alumni) applied to medical school and the rates of acceptance were 67% for the men and 60% for the women, a percentage that includes re-applicants. The MIT acceptance rate for all applicants (undergraduates, graduate students, and alumni) is 62%, as compared with the national acceptance rate for all applicants (undergraduates, graduate students, and alumni) which is 40.2%.

Clearly MIT remains an excellent choice for premedical studies, and despite higher criteria for acceptance, our students continue to do well. However, the preprofessional advising system which was designed to handle about sixty students per year has become overburdened and undermined by the loss of faculty advisors and lack of quality assurance in the face of demand from more than three times the number of students for which it was intended. The Director and other members of the OCSPA leadership team have met with Suzanne Flynn, Gene Brown, Lisa

Steiner, Thomas Greytak and others to seek input on designing a new way to more effectively assist students seeking to attend medical school.

EMPLOYMENT RECRUITING

OCSPA has partnered with Jobtrak Corporation for 1998 to deliver an on-line, fully web-based program. Over 500 employers have already begun to use the system, and that number will nearly double by the Fall. Through the new system students and employers will be able to communicate with each other throughout the job search process twenty four hours a day and seven days a week posting jobs, resumes and building their interview schedule. During 1997-98, 2,100 students participated in the OCSPA employment recruiting program. This number included 1,243 bachelor candidates (35.7% of the bachelor candidates , and including 445 students interviewing for summer positions,), 290 master's candidates, 9 MBA candidates, 228 master's in engineering candidates, 227 doctoral candidates, 8 post-doctoral students, and 95 undeclared.

There was a 3.4% increase in employers visiting the campus for 1998 compared to the 10.9% leap from the previous year. 740 companies, from just about every sector of the market participated in the employment recruiting program compared to 715 in 1997 and 637 in 1996. Employer Recruiting is scheduled to almost full capacity for the fall of 1998, which indicates that there will again be a slight increase in the employers who will visit the office for the coming year. The most sought after students were those with skills, knowledge and experience in information technology. Electrical engineers and computer science majors were the number one department employers looked for candidates. The starting salaries also increased this year for these students due to their increased demand.

PERSONNEL

A new Director, Dr. Christopher Pratt was hired and started on January 5, 1998 following a national search by a faculty led committee. A new organizational structure has been designed to assign teams to serve each of the five schools: Engineering, Science, Humanities and Social Sciences, Management, and Architecture and Planning. To implement this plan, school based teams are being established. Each team is composed of an Assistant Director, Career Development Counselor, Graduate Assistants and Peer Advisors. Four new Career Development Counselors are being hired. Two of the four positions have been filled, one of whom will start August 1, 1998 and the other September 1, 1998. Five new Graduate Assistants who are attending MEd. programs at local graduate schools are also being hired. And six to eight new Peer Advisors are also being added. Regarding Affirmative Action two women, an Asian American Assistant Director, and an African American Administrative Assistant were hired.

FUTURE PLANS

OCSPA seeks to integrate a career development focus for learning, and has drafted a Comprehensive Student Plan for Career Development which is being circulated for input from faculty, students, employers, alumni, and other administrators. An essential part of the plan is the concept of integrating career management education into students' academic experience. We are seeking to introduce students to the concept of competency development and the importance this has in future outcomes of their career choices.

The Department is creating a menu of career development workshops to be offered on a recurring schedule in settings across campus including FS/ILGs and for various groups of students. The capacity of the OCSPA website is also being expanded to incorporate interactive portions which encourage and support student learning. This Fall, OCSPA will participate in Freshman Orientation for the first time. We also plan to conduct routine assessments of student competency development to measure and provide feedback.

OCSPA strives to integrate its work with developmental theory presented in research and literature, and with the educational mission of ODSUE; to that end, OCSPA will teach students to continually learn how to develop their competency skills; encourage and support the expansion of experiential learning opportunities for MIT students; develop the students' understanding that career is about life, not a job; expand the capacity of the OCSPA website to incorporate interactive portions to encourage and support student learning; plan to present an introduction to the OCSPA to all entering Freshman during Orientation; participate with the faculty in programs that they offer and continue to out reach to faculty to engage in more career related programs; and seek to integrate career/life learning with the curriculum.

In order to accomplish these goals complete implementation of the current staffing plan and staff training and development initiatives are required to ensure the delivery quality services. Space and facilities - offices, IT, equipment, furniture continue to be needed to allow the delivery of quality services to MIT and students. Continuous data collection is required to serve as a basis for decision making and to provide a basis for analysis and outcomes assessment in order to measure the quality of our services, and from which to provide statistical report, including feedback to the Institute on where students go and what great things they do. Top level endorsement of OCSPA's efforts is required to actualize the departments potential.

OCSPA is evolving toward a more student-friendly and learner-centered approach to the delivery of our services. As visitors to OCSPA note, we have already made some important physical changes, and have begun some deeper organizational changes. More information about this department can be found on the OCSPA web site: http://web.mit.edu/career/www/

Christopher Pratt

COUNSELING AND SUPPORT SERVICES

The 1997-98 academic year was an uncommonly difficult one for many MIT students and a large part of the Institute community. Because of six student deaths, a considerable number of individuals and groups were deeply affected by these unsettling and, in certain instances, very tragic events. The rapidly escalating volume of demands and requests placed upon campus mental health resources throughout the fall and spring semesters underscored the need to maintain an effective and accessible Counseling and Support Services(CSS) office able to coordinate efforts with MIT Medical, especially its Mental Health service. CSS continued to work closely with the medical department, as well as with faculty, housemasters, student family members, campus police, chaplains and hospital staff to help and serve students and others affiliated with the Institute. Because many of this year's most critical issues originated within student living groups, CSS deans frequently teamed with other support professionals and visited dormitories and fraternities on and off of the campus. One particularly alarming observation has been a significant increase in cases of reported drug abuse among our student population. The counseling staff also focused on a range of evolving administrative matters, particularly those associated with undergraduate student withdrawals. It met periodically with representatives from Financial Aid, the Bursar, MIT Medical and the Registrar to review the consequences of existing policies and to improve collaboration between the providers of these vital services. Counseling and Support Services made a strong commitment to supporting the Committee on Academic Performance and helping it to review matters where academic and personal issues intersected. Nightline and Contact Line, the Institute's peer counseling hotlines, continued receiving supervision and support from CSS staff. The office also presented several workshops, training sessions and small groups to address student and staff needs.

In addition to assisting, counseling and advising a broad range of students during the academic year, Ms. Lynn Roberson collaborated with other administrators and members of the faculty to provide several very informative, helpful programs and workshops for women students. They included but were not limited to: the Graduate Women's Discussion and Support Group(co-advisor Dean Blanche Staton), Color Creations(co-advisor Professor Helen Elaine Lee), Asian American Women's Lunch (co-leader Dr. Kristine Cha) and "Handling Critical Feedback" with Dr. Holly Sweet. She also continued her work with Mujeres Latinas, and co-led workshops with Ms. Tracy Desovich, MIT Health Educator, on "Making Decisions About Sex and Intimacy". Another popular program was the Graduate Women's Lunch Series that included speakers Dr. Mary Rowe, MIT Ombudsperson, Dean Blanche Staton, Graduate Office, and Dr. Lynda Jordan, Martin Luther King, Jr. Visiting Professor, who lectured on "Women In Science". Dean Ayida Mthembu hosted and coordinated two traditional events: the annual Black Women's Brunch and Latina Brunch. Dean Kim McGlothin and Ms. Roberson also coordinated the Freshwomen Lunch.

Mr. Richard Goldhammer, Learning Disabilities Specialist, met regularly with and assisted 35 MIT students with documented learning disabilities. There are currently 61 documented LD/ADHD students at the Institute. During the 1997-98 academic year, he had 597 scheduled appointments with students who expressed concerns about learning disabilities issues. His work has greatly enhanced MIT's ability to meet the needs of students who may require additional consultation and support. He has also enabled the Committee On Academic Performance to assess student disabilities issues objectively and constructively.

Dean Ayida Mthembu moderated a well-attended, televised discussion between Professor Noam Chomsky and Professor Kathleen Cleaver on the political activism of the 1960s and its legacy today. She also helped to produce the African American and Latino Living Museum with Professor Tommy De Frantz and Professor Brenda Cotto-Escalera. Film maker Lee Lew-Lee showed and discussed his documentary about 60s protest and rebellion, All Power To The People. Dean Mthembu also participated in Race 2000, sponsored by the Campus Race Relations Committee, as well as Kwanzaa, Puerto Rican Week and Hispanic Month. Dean Arnold Henderson, Jr. continued his involvement with the Martin Luther King Committee and helped with the organization of its annual celebratory breakfast.

Dean Jacqueline Simonis continued to discuss aspects of student counseling with academic administrators. Her listening group involved eight professionals who met regularly to learn more about responding to students in distress. The group's activities included everything from written exercises to ongoing case discussion from participants' own experiences, and also exposed them to several other MIT helping resources. Dean Arnold Henderson, Jr. met with the combined staffs of two departments and spoke with them about students' personal and academic expectations, and determining how to refer individuals who appear to be experiencing serious problems. Henderson was also a panelist at the September Orientation for New MIT Faculty and a participant in the IAP Teaching Forum, "Never Use A Red Pen".

Two Malaysian delegations visited MIT in September 1997. Dean Arnold Henderson, Jr. met with representatives from these delegations to exchange ideas and views of counseling and student support services for undergraduate and graduate students at major research universities. In addition to reviewing some of the immediate and long-term issues facing students from different backgrounds, there was also an opportunity to consider what factors make counseling and mental health services effective.

Progress achieved against goals includes:

- To counsel and advise undergraduate and graduate students on a wide range of personal, academic and career matters.
- To consult with Institute faculty, staff, family and friends on a variety of personal issues; on the necessity for intervention and the provision of support; and on the potential impact of personal difficulties on academic life.
- To respond to personal student crises and emergencies, assessing risk, offering advice and assistance to the MIT community as needed, and making appropriate referrals to medical personnel and others.
- To provide special support for women, minority, and gay/lesbian/bisexual students, and for students with learning disabilities.
- To promote and support the concept of peer counseling through training, supervision and the administration of peer services at MIT.

The staff of Counseling and Support Services made a strong and committed effort to meet its established goals. Because of the character and intensity of this past year, meeting the needs of our clients was especially challenging. As a staff, CSS is grateful and encouraged that an additional counseling dean's position has been created. This has been a long-standing need of a modestly sized department that frequently must respond to major community problems.

Ms. Rachel Pilla, Senior Office Assistant, left the Institute in May of this year to pursue new professional goals. Mr. James Collins assumed his new position as Assistant to the Dean, CSS, in December 1997.

The Counseling and Support Services staff will continue to look at how its counseling contact hours can be most effectively distributed. Because the office provides support that may range from long-term therapy to walk-in appointments, it is frequently helpful to examine the service's existing system and determine if there are better ways to serve clients. Another goal is to expand staff development by identifying opportunities for further education and training, bringing in outside speakers and visiting colleagues at other institutions. The office will also continue its policy of reaching out to all segments of the Institute community and pooling efforts with other colleagues, providers and educators.

Associate Dean Ayida Mthembu was selected as the Massachusetts Institute of Technology's Black Achiever for 1997.

Arnold R. Henderson, Jr.

MIT CARD OFFICE, HOUSING AND FOOD SERVICES

The MIT Card Office was created to provide an identification card to the MIT community. Since its inception, it has developed into a tool for purchasing food and other services as well as for accessing MIT community only areas.

During the past year, the MIT Card Office concentrated on year 2000 compliance projects by modifying the identification database and upgrading hardware and software for the security system.

In addition, the office provided technical support to Linguistics and Philosophy, Urban Studies and Planning, Division of Comparative Medicine, and MIT Libraries as these departments installed door access security systems. The staff also consulted at Lincoln Lab about options for deploying the MIT Card.

Staff development objectives focused on technical skills to reflect the growing dependence of the office on technology. Specifically, staff were encouraged to develop Microsoft Access programming expertise, learn maintenance procedures and develop facility for troubleshooting in the Windows NT, SQL Server, and VMS environments. To support these objectives, the staff developed a training curriculum which includes courses on- and off-campus, on-the-job training, peer mentoring, and reference material.

The MIT Card Office plans to convert the identification database to Oracle. This change will enable the Card Office to provide quicker response from the MIT Card Office to satellites including the Student Services Center.

The MIT Card will collaborate with the Department of Athletics to implement use of the MIT Card for security and business processes.

HOUSING

The landscape of the department is changing however the mission over the past several years has been to enable students to receive their MIT education and to provide the means for the MIT community do its daily work by successfully managing housing facilities, dining operations, and MIT Card services.

Housing's primary responsibility has been to support MIT's educational mission by producing the finest student and community services possible in a way that is cost efficient. Housing has continued to work toward understanding and communicating its goals and also toward creating an infrastructure that connects people, offices and departments in order to successfully support MIT's educational objectives.

The Housing Office in the past year has taken the opportunity to integrate crucial functions across Housing, Residence and Campus Activities and Student Programs. As of July 1, 1998 , this effort will have led to the creation of a new organization called Residential Life and Student Programs. The goal of the housing component of the area is to provide clean, secure, and well maintained accommodations where students can be at ease and can have a sense of community in each residence.

The Housing Office is very supportive of a House Manager model that is key to the new residential system and management goals. A new development over the past year has been House Teams made up of Housemasters, House Managers, GRT's, and student governments. It is anticipated these Teams will help formulate plans to promote mutual respect and enable students from diverse backgrounds to flourish and create learning both inside and outside of the classroom.

During the 1998 fiscal year a facility audit was performed on all 16 residences to determine the condition of the system. Information gathered during the audit has proven invaluable in planning for capital expenditures necessary to repair and upgrade the state of MIT's residential facilities. Current budget constraints restrict the ability of the Housing Office to adequately address the issues brought forth by the audit.

STRATEGIC OBJECTIVES FROM FISCAL YEAR 1998

Baker was closed before graduation in the first year of a two year rehabilitation project that put a strain on finding housing for our students, special programs, alumni, and conferences.

Completed capital maintenance projects for fiscal year 1998 include:

- Roof Replacement: W1, 62-64,E55
- Window Replacement: NW61
- Waterproofing/Pointing: E55,W1,W61,W84,W85
- Bathroom Renovations: E55,62-64,W13,NW61,W4,W51,W61,W70,W71,W85
- Kitchen Renovations: 62-64,W51,W85
- Plumbing/Mechanical Renovations: E55,62-64,W1,W13,W4,W51,W61,W70,W71,W84,W85
- Electrical Renovations: W51 Suite Lighting
- Paint Program: All Dorms
- Fire Alarm: E55

Other major projects completed in fiscal year 1998 were:

- Housemaster's Apartment Renovation: 62-64
- Desk Renovation: W70
- Mailbox Replacement: W61

Select fiscal year 1999 capital planning objectives include:

- Roof Replacement: W4, W70, W71, W61 ongoing
- Window Replacement: NW61 ongoing
- Waterproofing/Pointing: 62-64, E55, W1, W4, W7, W13, W51, W84
- Bathroom Renovations: 62-64, E55, NW61, W4, W13, W51, W61, W70, W71, W85
- Kitchen Renovations: E55, W13, W51, W70, W71, W85
- Plumbing/Mech.Renovations: 62-64, E55, NW61, W1, W4, W13, W51, W61, W70, W71, W84, W85
- Electrical Renovations: 62-64, E55, W1, W4, W51, W85
- Paint Program: All Dorms
- Fire Alarm: W85
- Fire Alarm: E55 Complete

The estimated cost for the 1999 fiscal year is $3.9 million in renovations and maintenance in the residential system and of the major projects, 62% of the cost addresses a portion of the crucial needs identified by the facility audit.

OFF CAMPUS HOUSING

The office continues to provide a valuable service to the very diverse MIT Community and its visitors. In addition to rental listings, the service offers information on leases, landlord/tenant issues and rights, transportation, and other housing issues. The On-line Data Base Program for access to the off campus rental listings has been completed. Due to budget constraints, we have not been able to hire an employee to maintain the system. We hope to fill this slot later this year.

SINGLE GRADUATE AND STUDENT FAMILY HOUSING

The off campus rental market continues to escalate in cost and is in low supply. The vacancy rate for the Greater Boston area is at an all time low, increasing demand for our limited campus facilities.

We are able to accommodate 28% of all graduate students in campus housing. This accommodated 90% of new graduate students who requested on campus housing, and also accounted for 10% of graduate students currently enrolled who desired space. The volume of applicants is growing each year. New graduate housing is still in the planning stage and will be a necessary addition to our campus housing facilities.

Graduate students are a vital part of our community. The high cost and low availability of housing in this geographic area places a high stress factor on both new and continuing students at MIT. It affects applying families to a higher degree because they are limited in the type of housing for which they are able to contract. We are noticing a larger

percentage of older students coming to campus with their families, thus increasing the demand for our student family housing.

The inclusion of graduate student issues in the ODSUE organizational structure is a welcome addition. We are sure the graduate students will react favorably to future improvements in both the housing and the student support areas. Families, in particular, have a higher need for institutional support and programs which include them as part of our community.

Computing and use of the MITSIS system continues to offer improvements in our ability to communicate, obtain and share information. We will continue to explore various areas in computing to facilitate our service to the graduate students and families residing in campus housing.

Lawrence E. Maguire

ODSUE INFORMATION TECHNOLOGY

The mission of ODSUE IT is to provide high quality information services support to a wide ranging set of users within ODSUE and MIT. This support focuses on the automation of business processes and information systems to provide students, faculty and administrators with timely and accurate information and support.

This was the first full year of existence for our "new" department. Several major events took place this year including an internal reorganization, many new systems deployed and an ODSUE-wide desktop computer upgrade.

REORGANIZATION

In order to provide IT support for all of ODSUE and in conjunction with the reorganization of three significant administrative offices that we support, ODSUE IT reorganized around four teams: Academic Services, Administration and Desktop Support, Financial Services, and Systems Infrastructure. These teams provide a focused, although not exclusive, mission for it's members and provide our users with a clear structure for support. To clearly communicate the role of this department the name ODSUE Information Technology was chosen.

As part of our reorganization, Steve Burke (from UESA central to Administration and Desktop Support), Alice Cavallo (from the Student Financial Aid Office to our Financial Services Team) and Shawn Dunn (from Bursar's Office to our Financial Services Team) joined the new ODSUE IT organization. Their roles are crucial to the continued success of the department.

Desktop Support

To provide timely and efficient support for ODSUE desktop computer users we organized around a network of department-focused Local Experts backed up by the full-time technologists of the Desktop Support team. The Local Experts work together as the ODSUE IT Affinity Team to provide daily close-at-hand support.

In order for desktop computers to keep pace with the increasing needs of demanding users and the applications they use we instituted a yearly desktop computer replacement program. This replacement program also provides us with a set of hardware that is easier to maintain.

As we completed the year, we had a major role in planning and supporting the numerous ODSUE office moves that occurred over the summer.

New Development

In collaboration with our users the following major projects were completed this year:

- Client/Server Architecture. Designed and implemented a reusable client/server architecture. This architecture is supporting real-time connections to existing applications (e.g. Graduate Admissions, MITSIS, WebSIS, Data Warehouse, Roles Database).
- Federal Work Study. This new system, for use by the Financial Services office, will improve the employment, billing and voucher processes as well as provide greater control over student timesheets. This system was

developed as part of our department's project to develop a reusable client server architecture using PowerBuilder technology.

- Financial Aid Processing. Streamlined the processing of Financial Aid applications, improving the efficiency of Financial Aid administrators.
- Freshman Essay Evaluation. We developed a fully functional web site for the freshman summer essay evaluation pilot project. The project enables a truer test of writing ability than the current on-campus, longhand method, because it allows students to use a computer to compose their essays and to have several days to work on them. Over half of the freshmen class participated in the project including 51 students from 31 foreign countries.
- Graduate Housing. Developed this application to provide the Housing office with the ability to generate and maintain Housing Contracts for graduate students and to create and maintain Contract Templates. Additionally, the application provides reporting features to generate more meaningful reports for the Graduate Housing office.
- HASS-D & PE Lotteries. Redesigned online (Athena) access for students to provide access via the Web. This new access provides significantly more features, is easier to use and provides more timely results to the student.
- Job Track Career Tracking System. Investigated, in support of the Career Services and Pre-Professional Advising office, an automated student/employer resume and appointment system. This system makes it easier for students, employers and MIT administrators to manage daily functions such as resume review and appointment setting.
- Labels. Supported changes to the interface with Mail Services that will result in cost savings to the Institute.
- SAP/MITSIS. Collaborated with CAO and Management Reporting to convert MITSIS to handle the new accounting structure of SAP. MITSIS is one of the first large systems to interface with SAP.
- Scheduling and Event Management. Investigated, in support of the Residence and Campus Activities office, a new event scheduling system. This system, when installed in July of 1998, will provide more scheduling and reviewing capability to a wider set of users across the Institute.
- WebREG. Provided faculty and administrators with easy to use class lists access via the Web.
- WebSIS. Implemented Student Loan Counseling and Summer Term Pre-Registration to this Web-based Student Information System, continuing to automate effort-intensive manual processes for the student community.

PERSONNEL

We entered the year with a full staff of highly qualified information technologists. Unfortunately, two recently hired analyst programmers left the department amidst the increasingly competitive information systems marketplace. More aggressive and creative approaches to finding and retaining qualified personnel will be required.

The challenges of retaining MIT staff and the level of support for maintaining our current systems while developing new features new requires us to supplement our permanent staff with technical consultants. We continue to rely heavily on their technical skills and knowledge of MIT systems.

There were several key promotions that took place during the year: Steve Burke was promoted to Leader, Administration and Desktop Support, Alice Cavallo was promoted to Analyst/Programmer III, Carrie Groves was promoted to Network Administrator and JoAnne Stevenson was promoted to Associate Director ODSUE IT, Senior Project Leader.

We ended the year with a team of productive, experienced personnel who are providing excellent support for our users across MIT.

FUTURE PLANS

Early in FY 99 the office will be moving to building 11, allowing the entire department to be co-located while moving closer to our users. This will enable us to provide for more timely and efficient support of desktop computers, maintenance of existing systems, and the analysis and implementation of new functions.

A more in-depth and careful planning process will be implemented throughout ODSUE. This will enable our department to work more closely with other ODSUE departments to plan resources for developing new and better ways to serve students, faculty and administrators.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/odsue/odsue-it/

Robert A. Rippcondi

OFFICE OF ACADEMIC SERVICES

The Office of Academic Services was created in October 1997 as the result of a merger between the Registrar's Office and the former office of Undergraduate Academic Affairs (UAA). This new office combines the resources and services of two of MIT's principal educational support enterprises.

Staff members who were formerly housed in Building 20 moved to Building 7 in April; the relocation this summer of staff from Building E19 to spaces in Buildings 5, 7, and 11, will bring all staff in close proximity and in new working relationships.

ACADEMIC RESOURCE CENTER

This area of the office includes many of the principal non-departmental academic resources for students and their advisors. The ARC places particular emphasis on freshman-focused services and activities, having responsibility for new-student orientation, freshman advising recruitment, training, and management, and freshman-year programming in general.

Freshman Advising

The Class of 2001 was advised primarily through the highly successful Freshman Advising Seminar (FAS) system. While the number of FASes declined this year – from 125 to 118 – a seminar was available to nearly every freshman who wanted to be in one. Approximately 88 per cent of the freshman class opted to be in an FAS, while the other 12 per cent were advised by 45 non-seminar-based advisors in randomly assigned groups of two-to-seven freshmen each. In all, the freshman advising system consisted of a total of 184 volunteer Freshman Advisors -- 94 faculty members, 12 non-faculty teaching staff, 14 research scientists, 52 administrators, and two graduate students. Working in tandem with Freshman Advisors were 200 Associate Advisors, of whom 155 worked with seminar leaders and 45 with traditional advisors. In Spring 1998 we offered a pilot Advisor Workshop on "Transitioning to the Sophomore Year," attended by a mix of 34 seminar and traditional advisors.

Freshman Advising Seminars

A CUP Subcommittee on Freshman Advising, chaired by Professor Stephen Benton, initiated conversations with the provost and the president to find ways to stabilize the FAS program and encourage faculty participation. These conversations resulted in the ability to offer of a Scholarly Allowance of $1,500 to faculty who teach an Advising Seminar in the Fall of 1998. In addition, non-faculty FAS leaders (e.g., visiting and adjunct faculty; lecturers and instructors; research and administrative staff) are able to request from the ARC Staff Development Grants of up to $1,500 to be used to support "educationally beneficial" activities, including the seminar itself. Subsequent publicity about the Scholarly Allowance, through articles in the MIT Faculty Newsletter and Tech Talk, as well as an e-mail recruitment letter to the faculty from Professor Benton, resulted in the generation of a record-breaking 128 seminars for Fall 1998.

Independent Activities Period

Ninety-one out of the more than 700 activities offered during IAP '98 were offered for credit – up from 81 activities during IAP '97. In preparation for IAP '99, Web-based proposal forms are being developed for both credit and non-credit activities.

Orientation

Residence/Orientation Week '97 was directed successfully under the leadership of three student interns: Wesley Chan, Logistics Intern; Reshma Patil, Personnel and Publicity Intern; and Tom Lee, Programs Intern. They were supported by 40 student volunteers who worked on the various sub-committees.

In the Spring of 1998 a review of Residence/Orientation Week was undertaken by an ad hoc task force chaired by Professor Kim Vandiver and consisting of faculty, students, and staff who had been involved in some aspect of Orientation in the past. Significant changes in orientation '98 were the result.

Undergraduate Research Opportunities Program

Boosted greatly by last year's establishment of the Paul Gray Endowment Fund for UROP, funds for UROP endowment have continued to grow. The current total is approximately $4 million to which the Gray Fund alone has contributed $2 million, the UROP Endowment Fund $766,000, and the remainder from a number of smaller endowed funds. Two alumni funds for UROP were created in the name of the Classes of 1948 and 1973. While one significant grant from the General Electric Foundation ended last year, the Corporation voted UROP $50,000 yearly income "for the foreseeable future" from the John Reed Fund which very nearly replaces it.

Pay continues to be vital to participation; the ratio of pay to credit is 60 per cent to 40 per cent in favor of pay. Seventy-eight per cent of student pay came from faculty sponsored research grants during the academic year.

Other activities this year included an invitation from the Coalition for National Science Funding to NSF-funded UROPers to attend the Washington, D. C., poster session. Throughout the academic year UROPers presented research findings at conferences and professional society meetings and authored or co-authored research papers with their faculty supervisors and research group colleagues.

The January Mentor program served the Research Mentors and Pre-UROPers well with most reporting enthusiastically about their experiences. Pre-UROPers learned valuable laboratory skills and techniques that help them in their scientific careers. In several cases Pre-UROPers were asked to join their Mentor's research groups.

PROGRAM ON THE WRITING REQUIREMENT

In August 1997, the Class of 2001 took the Freshman Essay Evaluation. Of the 962 students taking the evaluation, 164 (17.0%) passed and received credit for Phase One. Of the remaining 798 students, 583 (60.6%) received the score of "Not Acceptable," while the remaining 215 students (22.3%) were encouraged to enroll in a writing subject immediately.

The Committee on the Writing Requirement approved a pilot project jointly proposed by the Chair of the Committee on Undergraduate Education and Financial Aid (CUAFA) and the Dean for Undergraduate Curriculum to administer an online Essay Evaluation to the Class of 2002 during the summer of 1998. The project is underway, and all indications point to its being a resounding success and a viable alternative for the timed essay evaluation given during Orientation.

During academic year 1997-98, the Writing Requirement Office evaluated 380 Phase One papers, and 331 students completed Phase One through the paper option. Another 393 students completed Phase One through subjects offered by the Program in Writing and Humanistic Studies and the English as a Second Language Program in Foreign Languages and Literatures.

Of the 1054 students receiving the S. B. Degree during the 1997-98 academic year, 464 (44%) completed Phase One through the Freshman Essay Evaluation or Advanced Placement Tests, 238 (23%) by submitting a Phase One paper, and 353 (33%) by satisfactorily completing a Phase One subject. The Undergraduate Technical Writing Cooperative was used by 452 students (43%) to complete Phase Two, while 292 students (28%) completed Phase Two by writing departmentally-based papers, and 310 (29%) students completed the Requirement through a Phase Two Writing Subject.

CURRICULUM DEVELOPMENT AND FACULTY SUPPORT INITIATIVES

Physical space moves are underway that house together such services as classroom maintenance and scheduling; the office of Educational Research; support to many of the major faculty committees; MIT subject evaluation; and support to the activities of the Teaching and Learning Laboratory (including the Classroom Videotape Consulting Program, seminars on teaching, the new faculty orientation program, and support to educational innovation and assessment). In addition, a team of staff working together to improve the coordination and integrity of academic information and communications – both in print and on the Web – are included as part of this new office unit.

ACADEMIC INFORMATION AND COMMUNICATION

This area – established in the spring of 1997 to provide information resources which help students, and the faculty who advise and teach them, plan and achieve their academic goals at MIT. Recent activity in this area includes

- Working with the Academic Resource Center to publish a preliminary and final version of the 1998-99 Freshman Handbook in hard copy and on the Web. In addition, Web pages are being created and maintained that contain generic academic information specifically designed for incoming first year students.
- Publishing on the Web a completely rewritten version of the "MIT Academic Guide for Undergraduates and their Advisors."
- Leading a pilot for Web-based submittal and publication of IAP information.
- Developing "modules" of generic academic information as the first step in designing a database of information that is organized according to user and need. This effort is another highly collaborative one and brings together the talents of staff in ODSUE IT and the MIT Communications Office as well as in Academic Services.

CLASSROOM MANAGEMENT AND SCHEDULING

Highlights include:

- The office spearheaded a major collaborative effort with faculty, Academic Computing, Physical Plant, and the Planning Office in the renovation and upgrade of over a dozen classrooms spread through the campus.
- "How to Write on a Blackboard Without Chalk" was an event offered during IAP as part of efforts designed to help faculty and staff appreciate the role of technology in teaching.
- A major training partnership with Audio/Visual Services and Academic Computing resulted in several sessions each term that outlined the teaching possibilities in the technologically-equipped rooms.

COMMUNICATIONS REQUIREMENT AND RELATED ACTIVITIES

CUP-charged experiments are being guided and will be evaluated by a Subcommittee of the CUP co-chaired by Professors Gene Brown and Langley Keyes, Jr. The office is providing the administrative support for this vital initiative of the Faculty.

MIT's development of a communication-intensive undergraduate program is being partially supported by a two-year grant from the NSF.

In support of the development of the program, the Writing Requirement Office and the Writing Initiative collaborated with Dr. Lori Breslow of the Sloan School and Ms. Diana Strange of the MIT Alumni Association to develop a new seminar, "Communication in the Workplace." Students developed interviewing, writing, speaking, and teamwork skills by interviewing alumni/ae on the nature, function, and importance of professional communication in scientific and technical careers.

In addition to the seminar, the staff of the Writing Requirement Office has helped departments and individuals in developing and assessing communication-intensive pilot projects and in expanding existing programs. Support has been provided in the development of the novel and bold educational platform, the *Biology Undergraduate Journal (BUG)*; in improving the Biology Project Laboratory; in the training of graduate students as writing tutors in 8.059, Quantum Mechanics III; and in assisting students with presentation skills in the Architecture Design Studio.

EDUCATIONAL RESEARCH

Beginning in 1988, Interphase students have been systematically surveyed.

During the summer of 1997, an ad-hoc subcommittee was formed to develop plans to survey students about their attitudes toward orientation.

During the late fall, the CUP Subcommittee on Intermediate Grades launched a survey to examine faculty and student opinion about various grading system options, including the experimental grading system that had been in operation since fall 1995

In Spring 1994, seniors completed the first in-depth survey of graduating students. With the Class of 1994 Senior Survey as a baseline, a second Senior Survey was undertaken this spring. This survey examined the students who

entered in Fall 1994, the same group of students who were surveyed about their 1994 freshman year experience, providing the opportunity to examine the same cohort of students at two points in time.

Other educational research activities included assisting with the assessment of the Course 6 M.Eng. program, undertaking a survey of student attitudes about evening exams for daytime classes, working with several faculty committees, and participating in the development of an in-house subject evaluation process. The Educational Research Office has also been working with students who developed Feedback Forum, a web-based tool designed by two graduate students to give administrators, faculty, and students an opportunity to give and receive anonymous feedback. It was used this year to collect survey data for some of the activities mentioned above.

The Educational Studies Working Group (ESWG) continued to play an important role this past year, bringing together people from many parts of the Institute who share an interest in gathering educational data and conducting studies about the educational experience and student life.

FACULTY SUPPORT PROGRAM

Primary staff support to formal faculty committees is provided to the CUP, CWR, the Committee on Academic Performance (CAP), the Committee on Curricula (CoC), and the IAP Policy Committee. In addition, much assistance has been provided this year to the new Committee on the First Year Program, to a variety of CUP subcommittees, and to the Task Force on Student Life and Learning. Academic Services staff are ex-officio members of the CAP, the Committee on Discipline, the CoC, CUAFA, the Committee on Graduate School Policy, and the IAP Policy Committee. The activities of these committees are described in detail in the section of this report entitled "Chair of the Faculty."

Academic Services staff assisted in the development and implementation of two major efforts that emerged as the result of CUP recommendations this year:

- A cross-registration agreement was developed with the Massachusetts College of Art and the School of the Museum of Fine Arts.
- A pilot program has been developed that provides instructors with information about students enrolled in specific subjects without the stated prerequisites.

TEACHING AND LEARNING LABORATORY

The Teaching and Learning Laboratory (TLL) continued to develop new programs and activities in the 1997-1998 academic year to improve teaching and learning at MIT. Among the highlights of the year include:

Work has been completed on the Steven P. Kaufman (EC '63) and Family Classroom for the Instruction in Teaching. The Kaufman Classroom, part of the new Teaching and Learning Triad in Building 9, is a specially equipped classroom/ videotaping studio that will allow TLL to expand and improve the videotape/consulting program.

Along with the Center for Advanced Educational Services (CAES) and the School of Engineering, TLL is coordinating a search for a nationally recognized expert in assessment and evaluation who initially will be at the Institute on a two-year appointment.

At the request of graduate students in several MIT departments (e.g., Course 18, Course 7, Course 6), TLL convened a series of meetings to examine the opportunities for PhD students to improve their teaching skills and to learn about issues related to science and engineering education.

TLL organized and co-led a three-session workshop on teaching for the undergraduates who participated in Teach for America, which was part of the 1998 Alternative Spring Break program. Approximately 40 students attended.

In addition to these activities, TLL continued to provide the services and programs it regularly makes available to the Institute community. These include: *Videotaping* faculty and teaching assistants in their classrooms (approximately 100 faculty and TA's were taped and met with a consultant); organizing the *"New Faculty Orientation"* and the *"Graduate Teaching Staff Orientation"* at the beginning of the fall semester (approximately 40

new faculty and 100 TA's attended); and coordinating the IAP series "*Better Teaching @ MIT.*" (this year's series introduced several new topics, including "Problem Solving" and "Teaching in a Distance Learning Classroom").

Among the *workshops* offered this year were: Microteaching Workshops for graduate students and post docs in the Department of Mathematics; training in the teaching and evaluation of writing for Writing Fellows; faculty workshops for the departments of Chemistry and Mechanical Engineering; training in presentation skills for graduate students in the departments of Political Science and Civil Engineering, as well as for graduates and undergraduates participating in the $50K competition.

OTHER CURRICULUM SUPPORT ACTIVITIES

Administrative support is provided to the Class of 1951 Fund for Excellence in Education, the Class of 1955 Fund for Excellence in Teaching, and, starting this year, the 1972 Fund for Educational Innovation. Eight proposals were awarded a total of about $80K in funding for projects to be undertaken in the coming year.

A small working group has been formed to help finalize the Student Information Policy (SIP) statement and to implement the SIP dimension as new electronic resources are made available to instructors and advisors.

This office has assumed responsibility for administration of the subject evaluation system on behalf of MIT. This year, further refinements to the process have been made, including working toward the establishment of an MIT-designed scanning and analysis system, linking evaluation data to on-line subject catalogue pages, and providing written comments to faculty and departments in a more timely way. This activity is being undertaken in close association with I/S, MITSIS, and students connected to the Course Evaluation Guide.

At the suggestion of Dean for Undergraduate Curriculum Kip Hodges, this office, the Planning Office, and the School deans' offices are working together to develop a comprehensive teaching information data source that can be accessed by all participants through MITSIS as appropriate. The pilot involved all Engineering and Science academic departments and is intended as a bridge toward a goal where MITSIS can collect all the necessary data and becomes the sole such database.

Registrar's Office

Commencement this year was a very special occasion with the commencement address given by the President of the United States, William Clinton. The office adapted to the extraordinary circumstances of its being the largest-ever commencement and having a very special guest by taking a more proactive approach to communication with students using the Web and e-mail.

The opening of the Student Services Center has resulted in our being able to provide better service to students, including a quicker turn-around for transcript requests. The office is participating in the training of SSC staff.

Highlights of the year include:

- The conceptualization and implementation of WebReg through a close collaboration with ODSUE I/T. WebReg is an on-line information system for faculty and administrators that provides access to class lists. A major effort was begun to train academic administrators and some faculty in the use of the system.
- Collaboration with Financial Services, the Budget Office, and the Provost's Office to normalize the flow of SDM and CAES tuition.
- Facilitating the development of new degree programs and divisions, including III-C (Archaeology and Materials), TPP, and BEH.
- Working with ODSUE I/T and Financial Services to provide Woods Hole staff with access to MITSIS and student information.
- Continuing to improve WebSIS based upon student feedback.

REGISTRATION

In 1997-98 student enrollment was 9,880, compared with 9,947 in 1996-97. There were 4,381 undergraduates (4,429 the previous year) and 5,499 graduate students (5,518 the previous year). The international student population was 2,176, representing eight percent of the undergraduate and 33 percent of the graduate populations. These students were citizens of 108 countries. (Students with permanent residence status are included with US citizens.)

In 1997-98, there were 3,101 women students (1,747 undergraduate and 1,354 graduate) at the Institute, compared with 3,085 (1,749 undergraduate and 1,336 graduate) in 1996-97. In September 1997, 406 first-year women entered MIT, representing 38 percent of the freshman class of 1,066 students.

In 1997-98, there were, as self-reported by students, 2,691 minority students (1,997 undergraduate and 694 graduate) at the Institute, compared with 2,753 (1,997 undergraduate and 756 graduate) in 1996-97. Minority students included 401 African Americans (non-Hispanic), 63 Native Americans, 555 Hispanic Americans, and 1,672 Asian Americans. The first-year class entering in September 1997 included 509 minority students, representing 48 percent of the class.

DEGREES AWARDED

Degrees awarded by the Institute in 1997-98 included 1,184 bachelor's degrees, 1,492 master's degrees, 16 engineer's degrees, and 521 doctoral degrees -- a total of 3,213 (compared with 3,109 in 1996-97).

Mary Callahan and Margaret Enders were promoted to serve as Co-Directors of the Office of Academic Services. Ms. Callahan has also been promoted to the position of Registrar. Mr. Peter Bedrosian was promoted to the position of Assistant to the Registrar.

New staff in the office include Ms. Kathleen Connolly and Mr. Peter Hayes (Registrar's Office); Ms. Nina Erlich, working with us part-time on a variety of faculty support projects; Mr. Anders Hove (Task Force on Student Life and Learning); Ms. Melissa Martin (UROP office); Ms. Jennifer Max (Writing Requirement office); and Mr. Joseph Kilcawley and Ms. Laurie Ward (Academic Resource Center).

Ms. Traci Trotzer Considine left her position with the Task Force on Student Life and Learning to join the staff at MIT's Endicott House. Ms. Carrie Groves left her position to become Network Administrator for Student Information Systems.

OFFICE OF MINORITY EDUCATION

Over two and a half decades ago, the Massachusetts Institute of Technology established the Office of Minority Education to provide academic and personal support to minority students who decided to attend MIT and pursue a degree in Engineering or Science. The establishment of the Office was a clear sign of MIT's commitment to minority students presence and its desire to ensure their success in achieving their academic goals. Over the years, the Institute has implemented several academic enrichment programs to support and develop minority students' intellectual ability to handle the academic rigors of MIT. Over the past four years, MIT has reaffirmed its commitment to guarantee the presence, and where possible, to provide academic enrichment programs to ensure the success of minority students who decide to attend MIT.

The primary purpose of the Institute is to provide a rigorous venue for education and related research which is relevant to the practical world. As a result of this reaffirmation, the Office of Minority Education has strengthened its long standing partnership with MIT's educational goal for its students who come to the Institute to aspire to be engineers and scientists.

To that end, the mission of the Office of Minority Education is to provide effective academic enrichment programs to enhance matriculation, promote higher retention and greater excellence in underrepresented minority (African American, Mexican American, Native American and Puerto Rican/Hispanic) students' academic and general educational achievements, and to encourage their pursuits of higher degrees and professional careers. OME's mission embrace a strategy to address academic and graduation gaps between underrepresented minority and non-minority students on MIT campus.

With an eye on our mission, the OME has the set the following goals:

- To offer an introduction and orientation to MIT which will aid in the adjustment of minority students to the academic environment at MIT.

- To strengthen ties and relationships with academic and other support offices in order to increase the visibility and use of OME resources.
- To re-establish an effective freshmen advising program for underrepresented minority students that will focus on academic and social transitions to the rigors of MIT.
- To design and implement an infrastructure to support academic advising in the Schools of Engineering, Science and Humanities and Social Sciences to encourage and actualize higher academic performance from underrepresented minority students.
- To determine what variables or conditions influence underrepresented minority students' achievement and retention.
- To develop and implement a Minority Student Leadership Institute with particular focus on leadership development for underrepresented minority students in engineering.

1996-97 ACADEMIC YEAR IN REVIEW

With the appointment of Ms. Ann Davis Shaw as Assistant Dean of Students and Undergraduate Education/Assistant Director of the Office Minority Education in July of 1997, the OME was able to provide a higher level of academic and personal support to underrepresented minority students served by the Office. The OME continued to provide underrepresented minority students with a cadre of academic enrichment and professional programs designed to enhance students' opportunities to succeed at MIT.

The Office continued to strengthen its past and present programmatic achievements, increased awareness of the Office programs and support services to a broad range of communities within and without the Institute. These communities include non-minority community, underrepresented minority community and private industry. As ex-officio members of several Institute committees, the Office continued to further defined its advocacy role on behalf of underrepresented minority students. The ability of the Office to provide effective academic and support services is rooted in the commitment of the faculty, staff and students to the mission of the OME.

MIT experienced a growth of underrepresented minority students over the last nine years due to an effective recruitment strategy developed and articulated by the Admissions Office. As a result of this effective strategy, there was a growth in the minority student population which created a higher level of demand on the staff of the OME in recent years. There are approximately 700 or 15% underrepresented minority students out of approximately 4500 undergraduate students attending MIT. In the past year through innovative planning, the faculty, staff and students continued to heighten its visibility, accessibility, and increased the quality of services offered to the underrepresented students. The OME staff was represented on an array of Institute committees during the 1997-98 academic year.

This section highlights a productive year of providing effective programs sponsored and operated by the OME from July 1996 to June 1997. Additional activities and program successes will be noted in this section.

Project Interphase is one of MIT's major commitments to ensure the academic success of its underrepresented minority students. This year Project Interphase enrolled sixty-one students in its academic enhancement program which constituted one-third of the admitted underrepresented minority students. The program is an eight-week rigorous academic experience with a curriculum that covers Physics, Calculus, Chemistry, Writing, Physical Education and a myriad of co-curricular activities prior to their first year at MIT.

The academic staff of tenured faculty and instructors, with the assistance of graduate and undergraduate tutors, make up the teaching core of Project Interphase. Through the leadership of Professor Anthony French as the Academic Officer, the faculty and tutors made major contributions in preparing underrepresented minority students to face the rigors of MIT. As teachers, advisors and mentors, the academic staff provided invaluable contributions to the intellectual growth of the students in PI '97.

Sixty-one students were admitted into the program in 1997. The ethnic and gender profiles were consistent with previous years, and also closely reflects the minority freshmen class of 2001. There were thirty African Americans or 49%. Mexican Americans represented 38% while Puerto Rican participation slipped to 6% of the 61 participants. There was a significant drop in the overall participation of Puerto Rican students in the program (22% to 6%). Native American participation remains the lowest of all groups at 6% and other (Hispanic surname) students is at

1%. This year, women representation in the program was at 43% or 26 of 61. This represented an increase from the previous year.

This year's Project Interphase expanded on ways to enhance students' academic abilities for the fall term and beyond. Seventeen students or 27.8% received advance placement credit for 18.01. In writing, students were referred to the Writing Center and encouraged to complete Phase One of MIT's Writing Requirement. We are pleased to announce that 30 participants or 49.1% of 61, passed Phase One. These positive outcomes are two factors to measure the worth and success of the program.

PROGRAM EXCEL

For the 1997-98 academic year, Program XL continued to be an effective academic enrichment program for first-year underrepresented minority and non-minority students. Participants are divided into small interactive learning/study groups focusing on Calculus, Physics, Chemistry and other freshmen core courses in the fall and spring semester. The XL groups met twice a week for one and a half hours during the fall and spring semester. All study groups were coordinated by XL Facilitators, who are upper-class and graduate students. Facilitators oversee the interactive discussion of materials covered in the subjects. During the fall and spring semesters, the XL Program utilized an array of facilitators from a broad range of academic disciplines and ethnic backgrounds to provide scholastic support to participants in the program.

The participation of the Class of 2001 during the 1997-98 academic year was consistent with previous years. Ninety-six minority and non-minority students registered for the XL Program during the fall and spring term. During the first semester, sixty-seven students participated in the program which resulted in 12 XL groups covering Calculus, Chemistry and Physics. The spring semester had twenty-nine students registered for 10 XL groups covering Calculus (18.01 and 18.02), Chemistry (5.11 and 5.60), Physics (8.02 and 8.02X) and Computer Science (6.001). The majority of the students who participated in the XL Program passed the core curriculum for the freshmen year.

TUTORIAL SERVICES ROOM

The Office of Minority Education's Tutorial Services Room continued to provide tutorial services to a significant number of underrepresented minority and non-minority students. This year, the experienced a growth in the number of student users (see TSR Report) as the result of strong staff leadership coupled with an effective marketing strategy. The OME employed over ninety undergraduate and graduate students from an array of ethnic background and disciplines to tutor in over sixty-five courses. The Director of the OME, in conjunction with the Assistant Director, interviewed, hired and trained all tutors for the program. To ensure quality control within the program, all tutors' academic records were verified.

Freshmen and sophomores continue to represents the majority users of the TSR. Last year, the TSR provided academic support to 1108 students during the fall and spring term. As in the past, the number of women utilizing the TSR continued to be significantly higher than male students. At present, women account for 47% and males are less than 30% of the tutorial hours, respectively. The unspecified gender category increased last year to 22.9%.

The total number of Service Hours provided by the TSR was 3488 hours. Service Hours include tutorials, independent study, and Athena use. Below is the Tutorial Services Room Annual Report for the 1997-98 academic year. The report provides key information on the total number of service hours, service hours by class year, service hours by type of service, and students' ethnicity and gender.

TSR ANNUAL REPORT: ACADEMIC YEAR 96/97

Total Number Of Student-Clients:	1,108 (Fall + Spring Totals. Some repeats included)
Total Number Of Visits:	2,505 (Repetitive of students)
Total Number Of Service Hours:	3,488 (Includes tutorials, independent study and Athena usage)

Service Hours by Class

Class	Hours	Percentage
1	1411.3	40.4
2	671.5	19.2
3	347.5	10.0
4	95.0	2.7
5>	8.0	2.3
Unspecified	955.3	27.3
TOTAL	3,488.6	100.0

SECOND SUMMER PROGRAM

The Second Summer Program entered its 27th year and has complemented MIT's academic experience in an array of professional disciplines. SSP is an academic program that enriches and supports students' intellectual growth while assisting them to develop a keen sense of their professional possibilities. Program interns explore possible fields of interest, while making real contributions in their assigned workplace. Participants in the program return to their classrooms in the Fall with a depth of knowledge and experience that greatly enhances their learning.

48 underrepresented minority students qualified to participate in the Second Summer Program by attending three orientation sessions and passing the core curriculum for the freshmen year during the first semester. Students were also required to participate in the Program's Engineering Design Workshop that was held during the Independent Activity Period (IAP).

SSP participants were divided into teams and each team was required to design and build a product for either an accessory for an automobile or a functional product for a dormitory. At the end of the two-week period, each team competed in the program's engineering design competition. Through the support and direction of Professor Alex Slocum of the Mechanical Engineering Department, Academic Officer for the Engineering Design Workshop, the winning team's product has been funded to be patterned this year. After completing the SSP Engineering Design Workshop, participants entered an intensive interviewing process with the OME's Industrial Advisory Council for Minority Education (IACME) companies participating in the Second Summer Program. Twenty students were placed with 14 companies in engineering intern positions. For students who were not placed through the SSP process, efforts were made to place them at non-participating companies. MIT faculty continued to strengthen its partnership with the OME/SSP by volunteering to visit interns on-site and to report on the students' experiences. Faculty will visit 12 participating IACME companies.

This year, with the support of a grant ($2500) from Ford Motor Company, the winning team from the SSP competition has begun the patent process for the product they developed during IAP. Over the next five years, the winning team will receive $2,500 to patent the winning product.

INDUSTRIAL ADVISORY COUNCIL FOR MINORITY EDUCATION

The purpose of the Industrial Advisory Council for Minority Education is to help ensure greater retention and higher academic achievement of MIT's underrepresented minority students through active support of, and participation in, the realization of the OME mission and goals.

To that end, members of IACME provide financial support to enhance the OME's ability to organize effective academic and professional development programs to assist our professional student organizations: AISES (American Indian Science and Engineering Society), NSBE (National Society of Black Engineers) and SHPE (Society of Hispanic Professional Engineers). During the course of this academic year, the OME contributed over $10,000 to support an array of professional and cultural organizations.

During the academic year, members of IACME took a leadership role in discussing a variety of issues that impact the academic success of underrepresented minority students at MIT. The academic achievements of underrepresented minority students remain a paramount concern for IACME. This year, three new companies joined IACME to further their diversity initiatives within their companies as well as providing additional internship opportunities through the Second Summer Program.

SECRETS AND STRATEGIES FOR ACADEMIC SUCCESS

Since the inception of OME, SSAS has educated numerous students on the hidden curriculum of MIT. The primary aim of the SSAS program is to expose underrepresented minority students to the Institute's survival network of academic and support services. This year, coordinators of the SSAS Program observed a significant increase in participation by underrepresented minority students in the sessions held both in the Fall and Spring terms. The following topics were presented during the academic year:

- "Time Management"
- "Ways to Develop Effective Study Skills"
- "How to Choose a Major"
- "Planning for Graduate School"
- "How to Succeed at MIT"

Once again, the SSAS Program had an outstanding year.

OFFICE OF MINORITY EDUCATION STUDENT ADVISORY COUNCIL

OMESAC was created to provide a mechanism for minority students to bring their concerns and issues to the Associate Dean of Undergraduate Education and Director of the OME. OMESAC's membership consists of a cross-section of underrepresented minority student professional and social organizations.

The 1997-98 academic year brought new challenges for OMESAC and its constituencies. The Council, in conjunction with the Office of Minority Education, initiated two programs which were beneficial to the minority community. The leadership of OMESAC coordinated and held a Minority Male Breakfast to address the myriad of issues that impact minority male students' success at MIT.

The Council initiated also the Robert Robinson Taylor Lecture Series. The purpose of the Lecture Series is to bring prominent minority alumni/ae and other professionals to MIT to provide insight into their success in their discipline. Speakers will be representatives from higher education, professoriate, engineers, scientists, artists, and politicians.

This year, OMESAC held two lectures. The first lecture was given by Four Star General Lloyd Newton of the US Air Force. General Newton was introduced by the former Secretary of the Air Force, Professor Shelia Widnal of the Aeronautics and Astronautics Department. The lecture was titled "Success is Earned, not Given".

The second lecturer was Professor Rafael Bras, Head of the Department of Civil and Environmental Engineering. Professor Bras' topic was "Arguments Against Affirmative Action are Nonsense." Both lecture series were successful. Over eighty minority students as well as a number of prefrosh attended the series.

The OME continues to be a repository for information for internships and scholarships that target underrepresented minority students. Minority students receive scholarships from public, private and corporate organizations. This year, the OME facilitated partial and full scholarship support for over thirty minority students, with amounts ranging from $1,000 to $26,000 to be applied to tuition, room and board, fees and books.

The Office of Minority Education held its Twentieth Annual Minority Awards Banquet at the end of 1997-98 academic year. This year, the keynote speaker was Dr. Oliver McGee, past Martin Luther King Visiting Professor in Civil Engineering Department and now Advisor to President Bill Clinton on Science and Technology. Dr. Robert J. Birgeneau, Dean of the School of Science presented the Academic Awards. He lauded the achievements of all students who received awards at the Banquet. In the "spirit" of community, the Awards Banquet was supported by the Office of Minority Education, the Counseling and Support Services, the Office of Career Services and Preprofessional Advising, the Office of the Dean for the Graduate School, the Office of the President, and Residence and Campus Activities. Two hundred and fifty faculty, administrators, staff, and students attended the event to

recognize the achievements and accomplishments of our minority students. Graduate and undergraduate students received academic and community service awards for their contributions for improving the quality of life for minority students at MIT.

RESIDENCE AND CAMPUS ACTIVITIES

This past year has been a demanding one for Residence and Campus Activities (RCA), ODSUE and MIT. It has been a unique mix of tragedies, challenges and opportunities. The most difficult tragedies involved the deaths of our students, notably that of freshman, Scott Krueger. Scott's alcohol-related death catalyzed self-examination and review of issues relating to alcohol use and abuse, housing and student life, and institutional policies and procedures, both at MIT and across the entire country. Some of these efforts had already been in process, such as the Presidential Task Force on Student Life and Learning, Residence/Orientation and examination of the first-year program. Other efforts, such as the Working Group on Dangerous Drinking and alcohol citations were directly related to the events of the Fall.

Some of the other major challenges and opportunities this past year dealt with organizational change. Within the larger ODSUE change effort, particularly important have been the Residential System Integration Team (RSIT) effort to bring together our office with the Housing Office and the Food Services Working Group which is creating the Office of Campus Dining, involving the Campus Activities Complex, Food Services, MIT Card Office, and RCA.

As we have restructured our organization from Residence and Campus Activities (in conjunction with Campus Activities Complex and Housing and Food Services), we provide guiding principles shared by the emerging Student Life Programs and Residential Life areas. These principles are based on the mission statement of RCA and are likely shared by all ODSUE Student Life areas:

- Provide a quality and supportive environment that will foster self-governance, respect for community standards, and appreciation for the diversity existing within the community.
- Provide opportunities for the development of the "whole" student, including leadership, interpersonal, and coping skills, in order to enhance the academic, personal and professional development of MIT's graduate and undergraduate students.
- Contribute to the education of students by providing opportunities for them to experience service and by nurturing committed and sustained involvement within and beyond the MIT community.
- Full educational development should include respecting the diversity, building the self-esteem, and nurturing the academic growth of all students.

Within the domain of these shared principles, RCA's efforts were focused on two inter-related, yet distinct, areas: Student Life Programs and Residential Life. These two areas both have shared and individual issues to consider; therefore, we present emerging mission statements in each area that are being formulated both through formal change processes and through evolving practice.

Student Life Programs

The mission of Student Life Programs is to offer a cohesive unit of programming and support for student events, ideas, and organizations and to create and foster increased opportunities to develop the "whole" student. Student Life Programs at MIT seek to facilitate student learning beyond the classroom. The six key components -- Leadership Development, LBGT Programs, Multicultural Programs, Public Service, Residential Programs, and Student Activities -- work in concert with one another to offer support and resources for a wide variety of student initiatives.

Residential System Integration Team

As noted by Dean Williams, the primary vehicle for coordinating changes in the residential system this past year was RSIT. The Team envisions a residential community for MIT which is the best in the world, one which is integral to and supportive of MIT's educational mission and enables all of its members to maximize their potential.

The mission of RSIT is to create such a residential community by extending the work of the Housing and Residential Life (HARL) Committee, under the sponsorship of the Dean of Students and Undergraduate Education and Senior Vice President, by consolidating existing core processes and designing and implementing an integrated residential system.

It is RSIT's mission to create a residential system which works towards the following goals:
- promote mutual respect and enable students of diverse backgrounds and living styles to flourish,
- strengthen the sense of community in each residence,
- provide clean, secure, well maintained accommodations where students can be at ease,
- promote learning inside and outside the classroom.

It is RSIT's mission to create a residential system which operates in the following ways:
- develop standards against which to measure performance,
- increase faculty involvement in and understanding of residential life,
- operate as a coherent whole while responding flexibly to diverse needs,
- plan for change,
- incorporate input from all sectors of the community in plans,
- make decisions reflecting community priorities, encourage staff in all areas of residential life to work collaboratively towards these goals, e.g., sharing information as widely as possible, sharing responsibilities, making decisions in teams.

As noted in it's mission, the focus of RSIT this past year has been two-fold: 1. to extend the work of the Housing and Residential Life (HARL) Committee and 2. designing and implementing an integrated residential system. In the first goal, a number of studies and efforts resulted particularly in the areas of audits and inventories of existing facilities and space use, as well as the examination of standards in our residential system. Of particular importance in that has been the work and recommendations of the Facilities Management Team (FMAT), a cross-functional and cross-departmental team facilitating more efficient use of resources, increased customer satisfaction and better maintained facilities.

With regard to the second goal, efforts have been directed both externally and internally to RCA. Collaborative discussions and work have been fostered between the Interfraternity Council and Dorm Com and within and across residences. Internally, significant time was spent on developing an integrated office, which resulted in the formation of the Office of Residential Life and Student Life Programs on July 1, 1998

UNDERGRADUATE HOUSING

The number of students who were placed in one of their top three choices rose from approximately 95 percent to 99.3 percent. In order to optimize top three choices, there was a decrease in the number of students receiving their first choice house from approximately 84 percent to 68 percent.

Crowding of first-year students was not as great a problem this year as in previous years. There were 120 crowds at the beginning of the year, compared with 135 the previous year. Looking ahead, however, the crowding level for next fall is currently being projected as over 200 students. The uncertainty in the numbers of students who will pledge has led us to reduce the projected number of pledges from 375 (our projected number last year) to 250. In a response to the projected crowding for the 1998 Fall Semester, 72 spaces from Tang Hall were set aside for undergraduates.

The publication "The Guide to First Year Student Residences" has been produced in conjunction with "The Student Handbook" for the second year in a row, this year with more and better information to aid new students in residence selection. In response to a request for more information regarding Fraternities, we included thumbnail comparisons of the FSILG's listing information on 19 different categories, including a parental and alumnus contact for each of the FSILG's. The Undergraduate Residence Life handbook was revised so that this book will also become a resource for faculty and staff, and the distribution of the book will include all administrative offices and all undergraduate academic officers.

FACULTY/GRADUATE RESIDENTS AND THE HOUSE FELLOWS PROGRAM

Graduate Residents and GRT's provided programs on a variety of topics, such as health, diversity, safety, and relationships, and increased their role in helping undergraduates understand the issues of alcohol on campus.

In response to the HARL and RSIT recommendations, Faculty Residents and GRTs began this year to work in Residence Teams with House Managers and, when appropriate, with student government leaders. The Team in each house has undertaken to plan programs, social activities, and building renovations in conjunction with Institute-wide planning.

Twenty-four faculty and alumni served as House Fellows in undergraduate and graduate residence halls and independent living groups, including fraternities. By informal activities, such as ski trips, research discussions, and dinners, they came to know students outside the academic arena and became colleagues and mentors for approximately eight hundred students.

FRATERNITIES, SORORITIES and INDEPENDENT LIVING GROUPS

Sigma Kappa Sorority became the Institute's thirty-seventh Independent Living Group (ILG) last August with the Institute's purchase and renovation of a four story building located at 480 Commonwealth Avenue in Boston. Twenty-four members and a full time house director occupy the building. This is MIT's fourth all-female ILG.

This year's FSILG rush resulted in 360 pledges, compared to 375-380 expected, due to adverse effects of the alcohol related death of a fraternity pledge at LSU that occurred during our R/O. A number of parents expressed their concern about alcohol in our fraternities during Parents' R/O.

After the death of a fraternity member from alcohol poisoning early in the term, The InterFraternity council (IFC) responded by instituting a ban on alcohol at fraternity events while it and the Alumni Interfraternity Conference (AIFC) developed reforms in its policies and the use of alcohol by its member organizations. Over the next few weeks several other alcohol related incidents were reported at MIT fraternities, resulting in increased scrutiny of the fraternity system and criticism of MIT's housing selection process within MIT and by local community.

The IFC formed three committees to study the issues surrounding freshman residence selection and alcohol in ILG:

Activities and Culture Committee
Committee on Social Policy and Liability/Risk
ManagementIFC R/O Proposal Committee

Which resulted in reports and policy changes approved by the entire organization.

At the October 15, faculty meeting a motion was introduced that would have all freshmen live in on-campus residence halls, effectively ending a decades old tradition of first year students residing in fraternities. The motion was amended in November to read, "it is the sense of the Faculty that MIT should move immediately to begin a comprehensive, deliberate examination of its residential system."

In March, the IFC permitted fraternities which met all requirements listed in the risk Management Policy adopted on November 12, to resume the service of alcohol on a controlled basis. The new three-strike policy set sanctions for alcohol violations: a 120-day alcohol ban at events for the first and second violations and loss of rush privileges for a third violation. The new policy requires events for new members to be alcohol-free and appointment of risk management and safety officers at each fraternity. It also bans tap systems and kegs, and prohibits spending house funds on alcohol and the purchase of alcohol for guests by the chapter acting as a group.

Once certified, a fraternity may hold BYOB events or parties with outside vendors serving alcohol. The IFC has five requirements for certification:

- Two-thirds of house members must attend a program that covers alcohol physiology, emergency alcohol medical response and safe alcohol use.
- The president, social chairs and risk manager from each house must attend a legal liability education program.

- One third of house members must learn TIPS (Training and Intervention Procedures) on how to serve alcohol responsibly.
- At least two house member must be certified in CPR.
- IFC certification must be renewed each year.

The IFC and this office combined to make available programs in all these areas for FSILGs.

Events this last fall also revealed a serious concern on the part of both parents and the general community for the level of supervision by MIT over its thirty-seven independent living groups. The Institute announced that it would require all ILG's to have Resident Advisors in place for the coming fall term. Although the decision to ask ILG's to identify an RA over the summer was initially met with resistance and concern, it is anticipated that most, if not all, of the groups will have their RA in place when the fall term begins.

DISCIPLINE AND CONFLICT RESOLUTION

In the majority of conflicts and disciplinary matters arising in residence halls, the GRT's and Housemasters handled the situation and prevented escalation to a matter for the Dean's Office. RCA staff handled dozens of discipline matters and complaints through actions ranging from conferring with Housemasters over minor undesirable behavior to chairing and serving on Dean's Office Hearing and COD panels where the sanction might be recommendation of expulsion. A more detailed report including general statistics on mediated conflicts and other areas will be submitted to the faculty.

Demand for training in constructive conflict resolution continues to increase, and training is a major function of mediation@mit. In addition to the annual thirty-six-hour Basic Training in Mediation during IAP for twenty-four students and staff, mediation@mit staff also offered seven shorter training sessions and classes for over two hundred- fifty students. Through mediation@mit, undergraduate and graduate students resolved disputes with the facilitation of volunteer mediators who contributed fifty-eight hours of intense work.

STUDENT ACTIVITIES AND CAMPUS SOCIAL LIFE

The past year was one of new activities and change in student activities, including the formation of many new groups, the addition of leadership and multicultural training, the renewal of Spring Weekend as a major event on campus, and the rejuvenation of the class councils. Over the course of the year RCA increased advising and other services to encourage new programming initiatives and collaborated with staff from the Public Service Center to develop a new base for student programming support. We also coordinated with CAC Program staff to develop both a more cohesive advising structure within student activities and a more effective community-wide programming unit within Campus Activities Complex.

During this past year there has also been increased focus on campus social life, including the re-birth of a significant spring weekend. The addition of the Program Coordinator staff position has enhanced advising for campus programming and specific support to the student organizations most involved in programming. Efforts were also made to bring these major organizations together to begin to address social life concerns as a group. These discussions have lead to increased communication, the development of joint activities for this coming fall, and increased attention to developing a campus calendar of student social events. Review of process and policies for events on campus continues. Most information is now available on the web. Substantial work lead to development of an interim alcohol policy for events, and that work is ongoing

To help keep financial reins on expanded student activities programs, a new staff member, Edmund Jones, joined the team in February of 1998 and in his first four months has worked diligently to improve the finance operation. Efforts to work with groups in deficit have increased, with the goal of total debt reduction to be completed by fall 1998. Staff will work with the students to develop a system that facilitates clear oversight and auditing procedures. The addition of the Provost's funds will allow for review of all financial operations. The number of student activities who have registered their outside bank accounts has increased significantly and ASA and our staff are implementing enforcement and oversight mechanisms.

LEADERSHIP TRAINING AND ORGANIZATIONAL DEVELOPMENT

Event planning workshops were held and were attended by over 30 student organizations. Training programs on financial systems and planning were held throughout the Spring semester and addressed funding and system issues. A weekend retreat for the Program Board was facilitated for all officers with the support of the CAC and Student Activities staff. Individual training for student groups was provided on request and addressed issues such as meeting management, conflict resolution, and event planning.

In the summer of 1997, the Publications Board was established. It includes representatives from all of the student publications on campus and is staffed by our office. Issues addressed this year include conflict resolution and communication among publications, distribution, training, and crisis response. Professional training is being planned for the fall of 1998 in conjunction with the MIT News Office.

MESH, A residential academic program for high school students, is running this year with 45 residential students. Staff are working with the two student directors to ensure a safe environment for the students.

UNDERGRADUATE ASSOCIATION

The Undergraduate Association had a productive year. The Social Committee contributed to a number of large, alcohol-free social events on campus. It teamed up with the CAC Program Board to produce a successful Spring Weekend, and with the class councils for the Battle of the Classes and Ski Day. The Committee on Student Life permanently established the free and very popular Logan Shuttle during finals week. The Student Committee on Educational Policy used regular mailings to inform undergraduates of the faculty regulations which effect them. The Nominations Committee forwarded the names of a select group of dedicated students eager to serve on Institute committees.

The Class Councils had a very active and productive year. The Freshman, Sophomore, and Junior Classes collaborated on programs, the largest being the Undergraduate Career Fair. The Freshman Class was awarded a Stewart Award for their contributions to student life.

In response to fall events, the UA established an Alcohol Awareness Committee to educate students on the dangers of alcohol abuse. The newly revived Committee on Housing and R/O was active in seeking student opinions on proposed changes to these areas and communicating these opinions to the administration.

PUBLIC SERVICE CENTER

The Public Service Center (PSC) contributes to the education of students by providing opportunities for them to experience service and by nurturing committed and sustained involvement within the community, focusing on efforts that enhance public education in Cambridge. In addition, the PSC served as an umbrella organization for various campus groups that engage in community service, as a clearinghouse, directing both undergraduate and graduate students to hundreds of local service agencies who need their specific talents or services, and as the liaison between area agencies and the MIT community.

Over one third of the MIT undergraduates participated in at least one of the PSC sponsored programs this past year. Programs included the following: the day-long CityDays Festival for Cambridge Public School children; LINKS, a year-long program to improve the quality of science education in the Cambridge Schools; KEY's to Empowering Youth, a student-run program science and technology workshops matching MIT student mentors and 160 11-13 year-old girls from the Greater Boston area; the America Reads Program responding to President Clinton's challenge and conducted in cooperation with the Student Employment Office; The Volunteer Community Connection that allows non-profit agencies in the area without access to the Internet to recruit volunteers on the Internet via the VCC search engine; The Panhellenic Giving Tree program which solicited donations for over 1,200 gifts to 30 local agencies and shelters; Project Health a multi-disciplinary community service program; The Alternative Spring Break program; the MIT LeaderShape program with the School of Engineering, and the annual MIT/Cambridge Science Expo held at MIT.

Seventeen PSC Fellowships were awarded to students who worked with 7th and 8th grade science teachers in various Cambridge schools, Coordinators of Educational Technology in other schools, at the Cambridge YWCA, Boston Ace, and the MIT Museum.

PUBLICATIONS AND FUNDING

Copies of OUTREACH: *A Resource Guide for Volunteering in Cambridge and the Greater Boston Area*, with a listing of over 100 local agencies, were sent out to interested undergraduates and other constituencies in the early fall. The PSC newsletter was published during the fall and spring semesters, which listed upcoming projects and featured articles written by students about different public service efforts through the PSC. On-line access to listing s is available on the web through the VCC.

The PSC finished its final year of a three-year grant from The Germeshausen Foundation which was specifically donated for IAP and summer fellowships. This year the PSC reapplied for additional funding and was granted a two-year $100,000 gift. The Lord Foundation has granted additional funding of $50,000 for the same purpose again this year. The PSC was also written into a grant awarded to the Cambridge Public School Science Department by the National Science Foundation, and it is in its third year (of three) for receiving support for the facilitation of the LINKS program. Approximately $60,000 has also been donated to the Priscilla King Gray Endowment over the past year, and the PSC is in the process of seeking additional funding through Foundations and individual donors to support PSC activities.

STUDENT LIFE PROGRAMS

This year is particularly notable in that the Public Service Center and Student Activities staff worked together to create a vision for a new broad-based student program area, currently being referred to as "Student Life Programs." In addition to Public Service and Student Activities, this program would provide support for Multicultural Programs, Lesbian, Bisexual, Gay, and Transgendered Programs, and Leadership Development and would create a mechanism for communication regarding programming efforts across MIT's campus, including Orientation, Health Education, CAC, and Residential Life.

Included in the programs offered in the past year were the Infinite Buffet that brought together 6,000 members of the MIT community for music, entertainment, and food from all over the world, the Diversity of Thought Symposium with panels of MIT faculty and staff, and alumni who shared their thoughts on the philosophy behind multiculturalism and diversity, and Lesbian, Gay, Bisexual, Transgender gatherings that addressed resources available to LBGT students and the Institute's non-discrimination policies.

STAFF CHANGES

Edmund Jones was hired as Staff Associate for Student Activities Finances.
Rick Gresh served in the temporary full-time position of Program Coordinator for Student Activities shared jointly with the Campus Activities Complex

Phillip Bernard, Neal Dorow, Andrew Eisenmann, Rick Gresh, Monica Huggins, Katherine O'Dair, Carol Orme-Johnson, Emily Sandberg

RESERVE OFFICERS' TRAINING CORPS PROGRAMS

AIR FORCE ROTC

The Air Force Reserve Officers' Training Corps (AFROTC) program at MIT provides challenging and comprehensive leadership and academic training for students attending MIT, Harvard, Tufts and Wellesley. We continue to recruit and commission men and women as second lieutenants in the United States Air Force. Year-end enrollment in AFROTC as of June 1997 was as follows:

	Freshmen	Sophomores	Juniors	Seniors	Total
MIT	4	14	11	12	41
Harvard	4	1	4	4	13
Tufts	1	0	0	1	2
Wellesley	0	2	1	0	3
Total	9	17	16	17	**59**

Of the 59 students enrolled, 56 (95 percent) were on scholarship and 15 (25 percent) were minorities, including 21 women (36 percent).
An assortment of special cadet activities continued unchanged from previous years. These included a freshman orientation program emphasizing Air Force knowledge, physical fitness, and drill; an Air Force Dining-In, a formal dinner with guest speaker; and the Tri-Service Military Ball, parade, awards ceremony and commissioning ceremony at the USS Constitution.

Some of the highlights of the year include:

- The cadets held a 24 hour POW/MIA Day Vigil kicked off by a keynote lecture by Dr. Shelia Widnall.
- Fall term, Professor Meyer lectured and Colonel Rutley led the cadet recitations for 17.471, American National Security Policy.
- Spring term, Detachment 365 sponsored a field day at MIT for Air Force ROTC cadets from three other detachments in the surrounding area.
- AFROTC cadre continued to participate with members of the ROTC Oversight Committee in reviewing the AFROTC course material aimed at designing a "modified ROTC" program. The goal of the "modified ROTC" would be to have a military cadet track to commissioning and a civilian student track to enhance leadership knowledge and experience.
- One MIT cadet was commissioned this fall and thirteen MIT cadets received commissions as second lieutenants this spring. In addition, one Tufts cadet and three Harvard cadets were also commissioned this spring.

The cadre for the 1997-98 academic year included Colonel Rutley, Captain Brown, Captain Eherenman, Captain Liechty, Captain Rickert, TSgt Briggs, TSgt Marcaurelle, and Mrs Cronin. Captain Eherenman retired in the spring and Captain Brown arrived to take his position for spring term. Colonel Rutley will be retiring from the Air Force on July 31 and enjoyed his two years as visiting professor of aerospace studies here at MIT. Colonel Kuconis arrived here in June following an assignment as commander, 425th Air Base Squadron, Izmir Air Station, Turkey.
For more information about our program, please visit our detachment web page at the following URL:
http://web.mit.edu/afrotc/

John E. Kuconis

ARMY ROTC

The purpose of the Army Reserve Officers' Training Corps (ROTC) is to provide instruction and training in military science subjects, to include a focus on leadership development. When coupled with the completion of a bachelor's degree, this training qualifies selected students for commissions as officers in the Active Army, Army Reserves, or Army National Guard.

The 1997-98 Academic Year was successful in commissioning highly qualified graduates who promise to represent our program well in both the active army and the army reserves. In the spring, scholarships were awarded on campus for the first time. The Professor of Military Science chaired the review board and ultimately selected a maximum of 10 scholarships worth $21,900 per year. This campus-based scholarship program allows cadets to compete locally, greatly simplifying the nomination process that traditionally was a national selection board.

At the end of the academic year, 46 students were enrolled in our program. Of those 46 students 15 (33%) were minority, including 10 women.

	Freshmen	Sophomores	Juniors	Seniors	Total
MIT	3	0	7	6	16
Harvard	7	1	4	3	15
Wellesley	0	0	1	1	2
Tufts	1	3	7	2	13
Total	11	4	19	12	46

Of the 16 enrolled MIT students, all are currently on scholarship, and two were awarded 2-year scholarships this spring.

This year the Army ROTC Department commissioned nine new second lieutenants, three of whom were from MIT. Of the nine, two are entering the Reserves, and seven will be reporting to Active Duty.

Most faculty positions changed this year. Departing staff includes Major Long, Captain Filosa, Sergeant First Class Acton, Staff Sergeant Weir, and Sergeant Thrall. Replacements are Captain Brown, Sergeant First Class Anderson, Sergeant Hiett, and Staff Sergeant Sullivan.

Social highlights for this year included a formal Military Ball where cadre, cadets, and guests participated in dinner and dancing. Army ROTC sponsored the Annual Tri-Service Awards Banquet with 85 cadets and midshipmen receiving awards from 37 organizations. Army ROTC supported the MIT Community Service Fund by participating in the 4-mile Road Race around the Charles River Basin. Tri-service commissioning ceremonies at Tufts, Harvard, and for MIT, at the *USS Constitution* were memorable events marking the transition to officer.

On- and Off-campus learning opportunities continued to attract cadets who voluntarily trained at Fort Benning, GA (Airborne School); Schofield Barracks, HI (Air Assault School); Washington, D.C. (Pentagon Internship); and Ansbach, Germany (Troop Leadership). Participation continued strong in the MIT Pershing Rifles Company, a group of both ROTC and non-ROTC students dedicated to the pursuit of excellence in leadership and tactics.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/armyrotc/

Robert R. Rooney

NAVY ROTC

The Navy Reserve Officers Training Corps (NROTC) program at MIT provides challenging and comprehensive leadership and academic training for students attending MIT, Harvard, and Tufts. In the 1997-98 Academic Year, a total of 19 Graduates were commissioned. Program enrollment just prior to June commencement was as follows;

	Freshmen	Sophomores	Juniors	Seniors	Total
MIT	17	5	7	14	43
Harvard	10	8	7	6	31
Tufts	2	3	2	2	9
Total	29	16	16	22	83

The Navy's financial assistance for MIT students totaled approximately $1,039,500 for the year. We are expecting approximately 35 new freshmen entering the program this year.

Annual activities included Freshmen Orientation held in Newport, Rhode Island, and the Navy and Marine Corps Birthday Ball, where Col Alauria, USMC, was the honored speaker. The MIT NROTC Color Guard participated in the Boston's Veteran's Day parade, as well as in several MIT football games. The midshipman battalion was also active in community, working closely with the New England Shelter for Homeless Veterans, teaching computer skills to veterans.

The MIT NROTC sailing team competed successfully this year. The team participated at the Georgetown and Cornell regattas and hosted the Fourth Annual Beaver Sailing Regatta on the Charles River. The spring semester also included three military excellence competitions at Villanova, Cornell, and Holy Cross.

During the summer, all of the scholarship midshipmen participate in active duty training with deployed naval units. This summer, midshipmen are cruising aboard submarines, maritime patrol aircraft, aircraft carriers, amphibious assault ships, and other vessels.

Vice Admiral Richard Mies, Commander Submarine Force visited to discuss submarine warfare with the students at a leadership lab.

Rear Admiral John Padgett, Commander Submarine Group Two was the guest speaker at the MIT Commissioning ceremony held 5 June alongside the *USS Constitution.* The commissioning party consisted of 12 MIT students.

More information about this department can be found on the World Wide Web at the following URL: http://www.mit.edu:8001/activities/navyrotc/home.html

Randall D. Preston

STUDENT FINANCIAL AID

The mission of the Student Financial Aid Office is to develop and maintain fair and equitable financial aid policies and practices which assure equal access by all students qualified for admission to MIT. Activities that advance this mission include counseling students and parents in all financial aid matters, managing grant and loan funds from outside agencies, stewarding undergraduate scholarship endowment funds, managing g on- and off-campus student employment opportunities, and faculty and administrators on all matters pertaining to financial aid policies.

HIGHLIGHTS OF THE YEAR

The reorganization of the Bursar's office and the Office of Student Financial Aid was completed this year. A new organization was created called Student Financial Service and combined with Academic Services within the Office of Educational Services. The organizational structure of the new office is team-based and reflects the work done over the past year in the reengineering of student services.

As a result of the improved fiscal condition of the US economy and the scholarship endowment, the need for unrestricted funds decreased for the third year in a row. This improved aid situation allowed MIT to reduce the self-help component of the standard aid package by more than 11% from $8,600 to $7,600.

The year brought new financial aid competition into the aid picture. For the first time in decades a number of Ivy League schools as well as Stanford made significant changes in the formulas used for determining aid eligibility. These changes were Institution-specific and diverged from the national standards of need determination. The effect on MIT's enrollment picture for the year were negligible, partly as a result of MIT's lowered self-help. Future admissions and aid years will likely be characterized by increased price competition among these schools and others hoping to enroll MIT's admitted students.

During the year some significant achievements were made by the Office of Student Financial Aid. These included coordinated admissions and aid notifications for prospective freshmen, improved processes for application processing that eliminated paperwork and staff time, and an increase of 20% in the number of applications processed for the fall-term bill. A wider staff from the new Student Financial Services organization became involved in the evaluation of financial aid applications. In the area of systems design and analysis important work was done on the potential cost-effect to MIT of differing financial aid policies as schools created new institution-based aid formulas. Projects were also completed to improve the data matching of federal and institutional aid information assuring compliance with a myriad of federal regulations.

The office was successful in delivering aid more efficiently and in a more complex competitive market than ever before. Improved yield figures for the incoming class attest to the effective work done in coordinating financial information with admissions processes. This was done while significant time was spent on reorganizing the offices and planning for the physical move from Building 5 to Building 11.

Significant changes in the federal tax laws were made during the year. Two tax credits were established to aid families with college costs. These credits will be effective in the 1998 tax year. MIT and schools across the country are gearing up for the significant school reporting requirements that are part of these new laws. For the most part the

traditional aid programs associated with Title IV of the Higher Education Act have remained the same in terms of funding and delivery. Only modest changes in these programs are expected in the coming reauthorization of the Higher Education Act due this coming year.

SCHOLARSHIPS AND GRANTS
Awarded to undergraduates with need, in $000's

Source	1995-96	1996-97	1997-98
Pell Grants	1,183	1,159	1,153
SEO Grants	1,970	1,913	1,847
ROTC Scholarships	601	715	665
Scholarship Endowment	12,021	13,269	14,063
Current Gifts	773	986	894
Direct Grants	3,311	3,160	2,995
Unrestricted Funds	14,965	12,908	12,755
Total Grants Awarded	34,824	34,110	34,372

Fiscal year 1998 saw a continuation of the strong national economy and the moderating demand for grant support to needy students. The number of needy undergraduates decrease by 4% to 2,505 and the average need increased by 3% to 21,285. The total of endowment and current gifts used to fund grants increased in FY98 by 5%. The decreased number of needy students lowered the required draw down of unrestricted sources for grants and scholarships to $12.8 million which represents about 13% of total undergraduate tuition revenues.

LOANS
Received by needy and non-needy students, in $000's

Source	1995-96	1996-97	1997-98
Awarded to Undergraduates			
Technology Loan Fund	2,061	2,118	1,922
Perkins/Nation Direct Loans	4,411	4,315	4,009
Stafford Loans to Needy Students	8,642	8,818	8,358
Stafford Loans Beyond Need	475	517	662
Other Loans to Students	99	96	121
Sub-Total, Undergraduates	15,688	15,864	15,072
Awarded to Graduate Students			
Technology Loan Fund	4,577	4,631	4,986
Perkins/Nation Direct Loans	177	21	4
Stafford Loans to Needy Students	5,668	5,325	4,976
Stafford Loans Beyond Need	3,562	3,963	3,763
Other Loans to Students	97	184	0
Sub-Total, Graduates	14,081	14,124	13,729
Total Loans to Students	29,769	29,988	28,801

The reduced demand on aid funds was also reflected in the lower use of loans among undergraduate and graduate students. Total student loans decreased by 4%.

Parent Loans Source	1995-96	1996-97	1997-98
Federal Parent Loan	2,421	2,966	1,039
MIT Parent Loan Plan	1,515	1,550	1,766
Mass. Ed. Finance Authority (MEFA)	1,889	2,104	2,379
Other Parent Loans	113	51	0
Total Loans to Parents	5,938	6,671	5,184

Fiscal 98 also saw a reduced demand for parent loan assistance. The use of the Federal Plus loan declined significantly while the use of the Massachusetts Educational Financing plan continued its steady increase. MIT's Parent Loan Plan also saw a modest increase.

STUDENT EMPLOYMENT

Opportunities in the off campus job increased significantly in 1997-98. Students could be very selective in choosing employment. In fact, for the first time in many years some of the larger on-campus employers found it difficult to fill their positions. High end jobs were on the rise; employers were seeking more technical skills and language skills.

2,773 undergraduate students worked on campus earning $5,587,855 in 1997-98.

The MIT Student Minimum Wage was remained $7.25. (Does not include UROP) This minimum has been in effect for two years.

The Federal College Work- Study Program allocation increased by 8%. At least half of the extra funding was to be committed to community service, with emphasis on providing work study jobs for reading tutors. This tutoring program is known nationally as the America Reads Program.

The primary goal of the America Reads Program is to have children reading at grade level by the end of third grade. The Massachusetts Institute of Technology was an unlikely candidate to launch such a program. Although MIT has no school of education and no existing program that can train its students to tutor elementary school children in reading, the MIT ReachOut (Help Teach a Child to Read) Program attracted MIT students in large numbers. One hundred and thirty students joined the program last fall. (both work-study and volunteers) MIT students were tutoring in the Patrick O'Hearn, the Lucy Stone and the Neighborhood Charter House schools. This was the first time in many years that MIT had been able formally to support some of the Boston schools. Tutors also went to the Edward Devotion school in Brookline. The largest placement (60 students) was at the Cambridge Community Center. The goals for the upcoming year is to ensure a strong and sustainable program, to assess how the literacy training is being used by the tutors, and to provide books to those centers that do not have libraries.

A Federal Work Study Community Service computer system was developed in Power Builder. The system provides better integration with the student information system. The system monitors payroll, earnings ceilings and produces bills and reports.

PERSONNEL

Karen Wilcox resigned as Assistant Director to take a position in financial aid at Wellesley College.

FUTURE PLANS

The new Office of Student Financial Services will integrate the services provided by the Bursar and Financial Aid. The coming year will bring the integration of this change and the development of team-based service delivery for financial services.

More Information about the Office of Student Financial Aid can be found on the World Wide Web at the following URL:http://web.mit.edu/finaid/
More information about the Office of Student Employment can be found at this URL:http://web.mit.edu/seo/

Stanley Hudson

STUDENT SERVICES CENTER

The mission of the Student Services Center is to provide financial and academic services to all students, staff, faculty, parents, and alumni/ae in a friendly, accurate, and timely manner, and in a way that ideally will allow more time for pursuit of their educational and personal interests.

With this sense of mission the Student Services Center (SSC) opened its doors to the MIT community on the 18th of August 1997. As with all new organizations, the SSC spent this past year accomplishing two main tasks. First, the office had to organize and develop a staff while, at the same time, the work of serving students and the MIT community had to be met on a daily basis.

Staff development focused on learning to work together and to work in new ways. Staff had intensive training in the policies and procedures available at the SSC. This training resulted in a manual that will be useful for all Financial Services Staff as they assist with public contact during heavy traffic times. The other aspect of staff development involved working as a team. Staff developed the SSC mission statement, operating norms, tools to measure success, and other practices and protocols that allowed the staff to function as a team.

The other major task of the SSC was providing high quality service to the MIT community. Increased efficiency and convenience was the first achievement. At the SSC students could go to one place to handle a variety of administrative tasks -- from adding money to a meal plan, turning in an academic petition, and signing promissory notes for student loans. This one stop approach makes it easier for students to handle several types of administrative tasks in less time.

Also, representatives from the Bursar's Office, Student Financial Aid Office, and the Registrar's Office were available to work with students to resolve problems. This coordinated approach saved time as representatives of more than one office could work together in one location. Students also appreciated the fact that they could go to one location to handle complicated problems that in the past would have required trips across campus.

From the day that the SSC opened, it has been busy. During the month of September 1997, the SSC recorded almost 13,500 contacts with students. Over 95% of these contacts were walk-ins. While the entire year did not sustain the volume of September, the SSC did average over 5,800 student contacts per month for October through May.

The SSC provides a starting point for the new Student Financial Services organization. During the next few months, as construction is completed, additional student services will move into the Center. Ultimately, all four floors of the Student Services Center will be occupied and offering a broad array of services to students, parents, and others at MIT. Student Financial Services is organized into teams, a new experience for most, and we expect to reorganize staff and space as we learn to work in new ways and improve our processes.

More information about the Student Services Center can be found on the World Wide Web at the following URL:http://web.mit.edu/afs/athena.mit.edu/org/s/ssc/index.html

Carolyn Bunker

FALL TERM 1997-1998

OFFICE OF THE REGISTRAR

COURSE NAME	2	3	4	5	Total Undergrads	Master/ Eng.	Doctoral Reg.	Doctoral Non-Res.	Doctoral Spec'l.	Total Grads	Grand Total	Course Number
SCHOOL OF ARCHITECTURE AND PLANNING												
Architecture, IV	21	17	21	4	63	148	33	19	3	203	266	IV
Architecture, IV-B	-	1	-	-	1	-	-	-	-	-	1	IV-B
Urban Studies and Planning, XI	5	8	4	4	21	122	32	30	17	201	222	XI
Program in Media Arts and Sciences, MAS	-	-	-	-	-	78	53	-	-	131	131	MAS
Total	26	26	25	8	85	348	118	49	20	535	620	Total
SCHOOL OF ENGINEERING												
Aeronautics and Astronautics, XVI	41	25	21	-	87	138	69	1	3	211	298	XVI
Aeronautics and Astronautics, XVI-C (Internship)	-	4	1	-	5	-	-	-	-	-	5	XVI-C
Chemical Engineering, X	93	81	113	10	297	51	167	1	-	219	516	X
Chemical Engineering, X-C	4	4	3	1	12	-	-	-	-	-	12	X-C
Civil and Environmental Engineering, I	-	-	-	-	-	222	70	2	-	294	294	I
Civil and Environmental Engineering, I-A	-	-	1	-	1	-	-	-	-	-	1	I-A
Civil and Environmental Engineering, I-C	18	5	15	1	39	-	-	-	-	-	39	I-C
Civil and Environmental Engineering, I-E	17	19	22	4	62	-	-	-	-	-	62	I-E
Civil and Environmental Engineering, I-W (Woods Hole)	-	-	-	-	-	2	3	-	-	5	5	I-W
Electrical Engineering and Computer Science, VI	-	-	-	-	-	149	382	5	30	566	566	VI
Program 1-Electrical Science and Engineering	51	61	39	9	160	-	-	-	-	-	160	VI-1
Program 2-Electrical Engineering and Computer Science	167	100	104	12	383	-	-	-	-	-	383	VI-2
Program 3-Computer Science and Engineering	119	135	86	16	356	-	-	-	-	-	356	VI-3
Electrical Engineering and Computer Science, VI-P (M. Eng.)	-	-	-	-	-	191	-	-	-	191	191	VI-P
Electrical Eng and Computer Science, VI-PA (M. Eng., Internship)	-	-	-	-	-	55	-	-	-	55	55	VI-PA
Program 1-Electrical Science and Engineering	-	15	16	-	31	-	-	-	-	-	31	VI-1A
Program 2-Electrical Engineering and Computer Science	-	24	30	-	54	-	-	-	-	-	54	VI-2A
Program 3-Computer Science and Engineering	-	31	16	-	47	-	-	-	-	-	47	VI-3A
Electrical Engineering and Computer Science, VI-W (Woods Hole)	-	-	-	-	-	-	1	-	-	1	1	VI-W
Materials Science and Engineering, III	25	4	11	5	45	82	86	3	1	172	217	III
Materials Science and Engineering, III-A	-	2	3	-	5	-	-	-	-	-	5	III-A
Materials Science and Engineering, III-B (Internship)	15	29	22	1	67	-	-	-	-	-	67	III-B
Mechanical Engineering, II	107	103	96	13	319	212	165	3	4	384	703	II
Mechanical Engineering, II-A	9	6	3	-	18	-	-	-	-	-	18	II-A
Mechanical Engineering, II-B (Internship)	-	16	22	-	38	-	-	-	-	-	38	II-B
Mechanical Engineering, II-W (Woods Hole)	-	-	-	-	-	-	1	-	-	1	1	II-W
Nuclear Engineering, XXII	9	7	4	1	21	56	57	-	-	113	134	XXII
Nuclear Engineering, XXII-A (Internship)	-	2	1	-	3	-	-	-	-	-	3	XXII-A
Ocean Engineering, XIII	2	7	3	-	12	29	25	1	-	55	67	XIII
Ocean Engineering, XIII-W (Woods Hole)	-	-	-	-	-	11	5	-	-	16	16	XIII-W
Naval Construction and Engineering, XIII-A	-	-	-	-	-	24	-	-	-	24	24	XIII-A
Ocean Systems Management, XIII-B	-	-	-	-	-	8	-	-	-	8	8	XIII-B
Center for Advanced Educational Services, CAES	-	-	-	-	-	-	-	-	74	74	74	CAES
System Design and Management, SDM	-	-	-	-	-	35	-	-	-	35	35	SDM
Total	677	680	632	73	2,062	1,265	1,031	16	112	2,424	4,486	Total
SCHOOL OF HUMANITIES AND SOCIAL SCIENCE												
Economics, XIV	40	27	40	4	111	3	100	19	1	123	234	XIV

Anthropology, XXI-A			-	1	1	1	3	-	-	-	-	-	3	XXI-A
Foreign Languages and Literatures, XXI-F			-	-	1	-	1	-	-	-	-	-	1	XXI-F
Literature, XXI-L			-	4	3	1	8	-	-	-	-	-	8	XXI-L
Music and Theater Arts, XXI-M			2	2	1	1	6	-	-	-	-	-	6	XXI-M
Writing and Humanistic Studies, XXI-W			-	1	6	2	9	-	-	-	-	-	9	XXI-W
Linguistics and Philosophy, XXIV			-	2	3	1	6	-	58	7	-	65	71	XXIV
Political Science, XVII			3	6	7	1	17	7	82	27	2	118	135	XVII
Program in Science, Technology, and Society, STS			-	2	-	1	3	1	23	3	-	27	30	STS
Total			45	45	62	12	164	11	263	56	3	333	497	Total
SLOAN SCHOOL OF MANAGEMENT														
Management, XV			53	41	59	12	165	722	79	9	12	822	987	XV
Management Fellows, XV-A			-	-	-	-	-	57	-	-	7	64	64	XV-A
Operations Research, OR			-	-	-	-	-	8	35	-	-	43	43	OR
Total			53	41	59	12	165	787	114	9	19	929	1,094	Total
SCHOOL OF SCIENCE														
Biology, VII			104	142	104	3	353	1	179	7	5	192	545	VII
Biology, VII-A			2	1	1	-	4	-	-	-	-	-	4	VII-A
Biology, VII-W (Woods Hole)			-	-	-	-	-	3	30	-	-	33	33	VII-W
Brain and Cognitive Sciences, IX			24	24	14	3	65	-	52	-	2	54	119	IX
Chemistry, V			42	40	24	-	106	5	184	4	-	193	299	V
Earth, Atmospheric, and Planetary Sciences, XII			6	10	7	-	23	15	80	2	2	99	122	XII
Earth, Atmospheric, and Planetary Sciences, XII-W (Woods Hole)			-	-	-	-	-	7	64	-	-	71	71	XII-W
Mathematics, XVIII			29	29	29	5	92	1	86	2	5	94	186	XVIII
Mathematics with Computer Science, XVIII-C			14	9	10	1	34	-	-	-	-	-	34	XVIII-C
Physics, VIII			44	34	34	5	117	11	237	3	3	254	371	VIII
Physics, VIII-A			5	5	1	-	11	-	-	-	-	-	11	VIII-A
Total			270	294	224	17	805	43	912	18	17	990	1,795	Total
WHITAKER COLLEGE of Health Sciences and Technology														
Division of Toxicology, TOX			-	-	-	-	-	4	30	-	-	34	34	TOX
Harvard-MIT Division of Health Sciences and Technology, HST			-	-	-	-	-	7	246*	-	1	254	254	HST
Total			-	-	-	-	-	11	276	-	1	288	288	Total
Undesignated Sophomores			16	-	-	-	16	-	-	-	-	-	16	UND
First Year			-	-	-	-	1,066	-	-	-	-	-	1,066	First Year
Special Undergraduate -- No Course	18	1,066	-	-	-	-	18	-	-	-	-	-	18	Special-NC
Grand Total	18	1,066		1,086	1,002	122	4,381	2,465	2,714	148	172	5,499	9,880	Grand Total

Not included in above totals:

Foreign Study: 18 students in the third year, and 78 students in the fourth year.

Non-Institute Brandeis, NIR	-	-	-	-	-				1	1	NIR
Non-Institute Harvard, NIH	11	4	18	36	69				185	254	NIH
Non-Institute Tufts, NIT	2	5	8	3	-	18			-	18	NIT
Non-Institute Wellesley, NIW	-	21	26	30	-	77			-	77	NIW
Non-Institute Research Visitor, NIV	-	-	-	1	-	5			26	27	NIV
Non-Institute Exchange, NIE	-	-	-	7	-	7			6	13	NIE
Total	13	30	52	77		172			218	390	Total

*Number includes 149 students working on Harvard degrees only.

NUMBER OF DEGREES AWARDED IN SEPTEMBER 1997, FEBRUARY 1998, AND JUNE 1998

	S.B.			S.M.			M.ARCH M.C.P., M.ENG, MBA			ENGINEER			Ph.D.			Sc.D.			TOTAL		
	Sept	Feb	June	Sept	Feb	June	Sept	Feb	June	Sept	Feb	June	Sept	Feb	June	Sept	Feb	June	Sept	Feb	June
SCHOOL OF ARCHITECTURE																					
Architecture	-	-	-	-	-	-	1	20	3	-	-	-	-	-	2	-	-	-	1	20	5
Architecture Studies	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Art and Design	-	5	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	17
Building Technology	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Media Arts and Sciences	-	-	-	5	4	11	-	-	-	-	-	-	6	3	1	-	-	-	11	7	12
Media Technology	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Planning	-	1	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	9
Real Estate Development	-	-	-	30	1	-	-	-	-	-	-	-	-	-	-	-	-	-	30	1	-
Urban Studies and Planning	-	-	-	-	1	1	3	4	44	-	-	-	1	1	5	-	-	-	4	6	50
Visual Studies	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Total	-	6	26	36	6	42	4	24	47	-	-	-	7	4	8	-	-	-	47	40	123
SCHOOL OF ENGINEERING																					
Aeronautics and Astronautics	1	1	19	9	16	24	2	1	6	-	-	-	1	7	6	-	1	-	13	26	55
Chemical Engineering	2	8	113	-	3	5	-	-	-	-	-	-	7	13	21	-	1	-	9	25	139
Undesignated	-	1	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	10
Chemical Engineering Practice	-	-	-	18	6	11	-	-	-	-	-	-	-	-	-	-	-	-	18	6	11
Civil Engineering	-	1	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	12
Civil and Environmental Engineering	-	-	-	6	19	35	1	1	32	-	1	-	7	9	5	-	1	2	14	31	74
Undesignated	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Computer Science and Engineering	8	9	107	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	9	107
Electrical Science and Engineering	1	7	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	60
Electrical Engineering and Computer Science	2	6	118	14	22	53	27	23	162	-	-	4	17	21	25	-	1	3	60	73	365
Engineering and Management	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Environmental Engineering Science	-	3	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	21
Materials Science and Engineering	1	3	33	5	4	20	-	-	-	-	-	-	3	9	12	1	-	1	10	16	66
Undesignated	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Mechanical Engineering	3	9	103	8	20	79	-	-	-	-	-	2	7	12	12	-	-	5	18	41	201
Undesignated	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4
Naval Architecture and Marine Engineering	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Naval Engineer	-	-	-	-	-	-	-	-	-	1	-	7	-	-	-	-	-	-	1	-	7
Nuclear Engineering	-	1	5	4	5	20	-	-	1	-	-	2	3	6	4	-	1	-	7	13	32
Ocean Engineering	-	-	5	2	1	6	-	-	-	-	-	-	3	2	7	-	-	-	5	3	18
Ocean Systems Management	-	-	-	-	2	7	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7
Technology and Policy	-	-	-	9	4	35	-	-	-	-	-	-	-	-	-	-	-	-	9	4	35
Transportation	-	-	-	5	4	12	-	-	-	-	-	-	-	-	-	-	-	-	5	4	12
Total	18	50	619	80	110	311	30	25	201	1	1	15	48	79	92	1	5	11	178	270	1,249

SCHOOL OF HUMANITIES AND SOCIAL SCIENCE																			
Anthropology/Archaeology	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Economics	-	7	53	-	1	3	-	-	-	-	-	3	1	22	-	-	-	3	9	78
Foreign Languages and Literatures	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
History	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Humanities	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Humanities and Engineering	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Humanities and Science	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4
Linguistics	-	-	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	3	1	-
Literature	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Music	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Philosophy	1	1	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	1	4
Political Science	1	-	5	2	1	3	-	-	-	-	-	1	9	8	-	-	-	4	10	16
Science, Technology, and Society	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Writing	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Total	2	10	86	2	3	6	-	-	-	-	-	8	10	31	-	-	-	12	23	123
SLOAN SCHOOL OF MANAGEMENT																			
Management	-	-	-	-	1	47	1	12	359	-	-	-	6	13	-	-	-	1	19	419
Management Science	1	11	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	11	65
Management of Technology	-	-	-	-	-	56	-	-	-	-	-	-	-	-	-	-	-	-	-	56
Operations Research	-	-	-	-	5	7	-	-	-	-	-	1	3	7	-	-	-	1	8	14
Total	1	11	65	-	6	110	1	12	359	-	-	1	9	20	-	-	-	3	38	554
SCHOOL OF SCIENCE																			
Biology	-	8	93	3	-	2	-	-	-	-	-	4	9	17	-	-	-	7	17	112
Undesignated	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
Brain and Cognitive Sciences	-	5	14	-	-	2	-	-	-	-	-	-	1	2	-	-	-	-	6	18
Chemistry	-	2	29	5	4	-	-	-	-	-	-	11	10	23	-	-	-	16	16	52
Cognitive Science	-	2	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	23
Earth and Planetary Sciences	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	2	1	1
Earth, Atmospheric, and Planetary Sciences	-	1	7	-	-	-	-	-	-	-	-	2	4	4	1	-	-	3	5	11
Geosystems	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Mathematics	5	8	50	-	-	-	-	-	-	-	-	3	4	16	-	-	-	8	12	66
Mathematics with Computer Science	-	2	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	11
Meteorology	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Physics	1	5	35	1	2	3	-	-	-	-	-	7	14	14	-	-	-	9	21	52
Total	6	31	253	11	8	9	-	-	-	-	-	27	42	76	1	-	-	49	81	338
WHITAKER COLLEGE of Health Sciences and Technology																			
Health Sciences and Technology	-	-	-	-	1	-	-	-	-	-	-	1	3	9	-	-	-	1	4	9
Toxicology	-	-	-	-	-	1	-	-	-	-	-	1	1	4	-	-	-	1	1	5
Total	-	-	-	-	1	1	-	-	-	-	-	2	4	13	-	-	-	2	5	14

Without Course Specification	-	-	-	7	10	17	-	-	-	-	-	-	-	-	-	-	-	-	7	10	17
Awarded Jointly with Woods Hole Oceanographic Institution																					
Biology	-	-	-	-	-	-	-	-	-	-	-	-	1	4	3	-	-	-	1	4	3
Earth, Atmospheric, and Planetary Sciences	-	-	-	2	2	2	-	-	-	-	-	-	2	3	6	-	-	-	4	5	8
Electrical Engineering and Computer Science	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
Ocean Engineering	-	-	-	2	1	1	-	-	3	-	-	-	1	-	1	-	-	-	3	1	5
Grand Total	27	108	1,049	140	147	499	35	61	610	1	1	15	98	155	250	2	5	11	303	477	2,434

NUMBER OF WOMEN STUDENTS BY COURSE AND YEAR

FALL TERM 1997-1998

OFFICE OF THE REGISTRAR

COURSE NAME	Year 2	3	4	5	Total Under grads	Doctoral Master/ Eng.	Reg.	Non-Res.	Spec'l.	Total Grads	Grand Total	Course Number
SCHOOL OF ARCHITECTURE AND PLANNING												
Architecture, IV	15	11	14	3	43	60	14	13	-	87	130	IV
Urban Studies and Planning, XI	2	6	1	3	12	59	18	15	4	96	108	XI
Program in Media Arts and Sciences, MAS	-	-	-	-	-	16	11	-	-	27	27	MAS
Total	17	17	15	6	55	135	43	28	4	210	265	Total
SCHOOL OF ENGINEERING												
Aeronautics and Astronautics, XVI	13	9	4	-	26	26	6	-	-	32	58	XVI
Aeronautics and Astronautics, XVI-C (Internship)	-	1	1	-	2	-	-	-	-	-	2	XVI-C
Chemical Engineering, X	55	49	62	3	169	10	38	1	-	49	218	X
Chemical Engineering, X-C	-	2	-	-	2	-	-	-	-	-	2	X-C
Civil and Environmental Engineering, I	-	-	-	-	-	61	19	2	-	82	82	I
Civil and Environmental Engineering, I-A	-	-	1	-	1	-	-	-	-	-	1	I-A
Civil and Environmental Engineering, I-C	11	3	8	1	23	-	-	-	-	-	23	I-C
Civil and Environmental Engineering, I-E	10	17	15	2	44	-	-	-	-	-	44	I-E
Civil and Environmental Engineering, I-W (Woods Hole)	-	-	-	-	-	1	-	-	-	1	1	I-W
Electrical Engineering and Computer Science, VI	-	-	-	-	-	29	59	-	5	93	93	VI
Program 1-Electrical Science and Engineering	12	19	11	3	45	-	-	-	-	-	45	VI-1
Program 2-Electrical Engineering and Computer Science	38	23	28	2	91	-	-	-	-	-	91	VI-2
Program 3-Computer Science and Engineering	30	27	21	1	79	-	-	-	-	-	79	VI-3
Electrical Engineering and Computer Science, VI-P (M.Eng.)	-	-	-	-	-	34	-	-	-	34	34	VI-P
Electrical Eng and Computer Science, VI-PA (M.Eng., Internship)	-	-	-	-	-	9	-	-	-	9	9	VI-PA
Program 1-Electrical Science and Engineering	-	2	5	-	7	-	-	-	-	-	7	VI-1A
Program 2-Electrical Engineering and Computer Science	-	2	5	-	7	-	-	-	-	-	7	VI-2A
Program 3-Computer Science and Engineering	-	8	2	-	10	-	-	-	-	-	10	VI-3A
Materials Science and Engineering, III	16	2	3	1	22	15	24	1	-	40	62	III
Materials Science and Engineering, III-A	-	1	3	-	4	-	-	-	-	-	4	III-A
Materials Science and Engineering, III-B (Internship)	4	19	16	-	39	-	-	-	-	-	39	III-B
Mechanical Engineering, II	38	25	26	3	92	45	11	-	-	56	148	II
Mechanical Engineering, II-A	2	3	2	-	7	-	-	-	-	-	7	II-A
Mechanical Engineering, II-B (Internship)	-	5	8	-	13	-	-	-	-	-	13	II-B
Nuclear Engineering, XXII	7	4	1	1	13	9	9	-	-	18	31	XXII
Nuclear Engineering, XXII-A (Internship)	-	-	1	-	1	-	-	-	-	-	1	XXII-A
Ocean Engineering, XIII	2	3	2	-	7	5	1	-	-	6	13	XIII
Ocean Engineering, XIII-W (Woods Hole)	-	-	-	-	-	2	1	-	-	3	3	XIII-W
Ocean Systems Management, XIII-B	-	-	-	-	-	1	-	-	-	1	1	XIII-B
Center for Advanced Educational Services, CAES	-	-	-	-	-	-	-	-	3	3	3	CAES
System Design and Management, SDM	-	-	-	-	-	1	-	-	-	1	1	SDM
Total	238	224	225	17	704	248	168	4	8	428	1,132	Total
SCHOOL OF HUMANITIES AND SOCIAL SCIENCE												
Economics, XIV	17	16	13	3	49	2	25	7	-	34	83	XIV
Anthropology/Archaeology, XXI-A	-	1	1	-	2	-	-	-	-	-	2	XXI-A
Foreign Languages and Literatures, XXI-F	-	-	1	-	1	-	-	-	-	-	1	XXI-F
Literature, XXI-L	-	1	1	-	2	-	-	-	-	-	2	XXI-L
Music and Theater Arts, XXI-M	1	2	-	-	3	-	-	-	-	-	3	XXI-M
Writing and Humanistic Studies, XXI-W	-	1	4	-	5	-	-	-	-	-	5	XXI-W

Linguistics and Philosophy, XXIV				-	-	-	-	-	-	27	3	-	30	30	XXIV
Political Science, XVII				2	3	4	-	9	2	30	8	1	41	50	XVII
Program in Science, Technology, and Society, STS				-	1	-	-	1	1	7	2	-	10	11	STS
Total				20	25	24	3	72	5	89	20	1	115	187	Total
SLOAN SCHOOL OF MANAGEMENT															
Management, XV				20	24	24	2	70	188	21	3	4	216	286	XV
Management Fellows, XV-A				-	-	-	-	-	5	-	-	1	6	6	XV-A
Operations Research, OR				-	-	-	-	-	2	10	-	-	12	12	OR
Total				20	24	24	2	70	195	31	3	5	234	304	Total
SCHOOL OF SCIENCE															
Biology, VII				72	90	63	2	227	-	77	4	1	82	309	VII
Biology, VII-A				2	1	-	-	3	-	-	-	-	-	3	VII-A
Biology, VII-W (Woods Hole)				-	-	-	-	-	2	17	-	-	19	19	VII-W
Brain and Cognitive Sciences, IX				20	11	8	1	40	-	19	-	-	19	59	IX
Chemistry, V				24	26	18	-	68	1	56	-	-	57	125	V
Earth, Atmospheric, and Planetary Sciences, XII				4	5	6	-	15	4	31	1	1	37	52	XII
Earth, Atmospheric, and Planetary Sciences, XII-W (Woods Hole)				-	-	-	-	-	4	28	-	-	32	32	XII-W
Mathematics, XVIII				13	12	9	2	36	-	21	-	1	22	58	XVIII
Mathematics with Computer Science, XVIII-C				3	3	4	-	10	-	-	-	-	-	10	XVIII-C
Physics, VIII				14	5	7	-	26	1	23	-	-	24	50	VIII
Physics, VIII-A				1	1	-	-	2	-	-	-	-	-	2	VIII-A
Total				153	154	115	5	427	12	272	5	3	292	719	Total
WHITAKER COLLEGE of Health Sciences and Technology															
Division of Toxicology, TOX				-	-	-	-	-	2	15	-	-	17	17	TOX
Harvard-MIT Division of Health Sciences and Technology, HST				-	-	-	-	-	-	58	-	-	58	58	HST
Total				-	-	-	-	-	2	73	-	-	75	75	Total
Undesignated Sophomores				6	-	-	-	6	-	-	-	-	-	6	UND
First Year	451		406	-	-	-	-	406	-	-	-	-	-	406	First Year
Special Undergraduate -- No Course		7		-	-	-	-	7	-	-	-	-	-	7	Special-NC
Grand Total	451	7	406	454	444	403	33	1,747	597	676	60	21	1,354	3,101	Grand Total

VICE PRESIDENT FOR RESEARCH AND DEAN FOR GRADUATE EDUCATION

The areas that report to the Vice President for Research and Dean for Graduate Education include the Graduate Education Office, the Whitaker College, and the interdisciplinary laboratories, centers, and programs. At the end of this year, the Division of Toxicology will leave the Whitaker College to join the Division of Bioengineering in the School of Engineering.

During the year, the Center for Environmental Initiatives was established with Professor David H. Marks as Director. The Center's mission is to educate a new generation of leaders in business and public service who are knowledgeable about issues on the environment and sustainability that impact development and worldwide welfare. The Center aims to forge new relationships between industry, governments, academia and the public though an active communications and outreach program.

Since 1995, the Office of the Vice President for Research has sponsored annual seminars on research practice aimed at clarifying the range of acceptable practices in conducting research. These seminars bring together faculty, professional research staff, posdoctoral fellows and associates, and graduate students to discuss topics such as mentorship, authorship, and secrecy in science. They are moderated by Dr. Stephanie Bird, Special Assistant to the Provost and participation is Institute-wide.

Professor Mark Kastner stepped down as Director of the Center for Materials Science and Engineering (CMSE). Professor Robert Silbey has been appointed Director of the CMSE. Dr. John Bernard was appointed Acting Director of the Nuclear Reactor. Dr. Walter Jones retired as Chairman of the Committee on the Use of Humans as Experimental Subjects (COUHES). Dr. Leigh Firn has been appointed Chairman of COUHES. Professor James Orlin is serving as codirector of the Operations Research Center while Professor Robert Freund enjoys a well-deserved sabbatical. Professor Douglas Lauffenberger, director of the Center for Biomedical Engineering (CBE), has become the head of the Engineering School's new Division of Bioengineering, and Professor Alan Grodzinsky is serving as acting director of the CBE.

J. David Litster

GRADUATE EDUCATION OFFICE

The past year witnessed two significant staffing changes in the Graduate Education Office (GEO). Margaret D. Tyler, associate dean for graduate education, was granted a one-year leave of absence to serve as executive assistant to the new, and the first female, president of Norfolk State University in Virginia. This experience will further expand and strengthen the GEO's ties to historically black universities, while also providing a professional development opportunity for dean Tyler. The GEO warmly welcomed back Blanche E. Staton, formerly of the Pennsylvania State University's Philadelphia Recruitment Center, to serve as interim associate dean for the past year. Having served here with great distinction five years ago, Ms. Staton was the obvious choice to again replace dean Tyler; and we were grateful that she was both available and willing to return to MIT. The second significant change was the retirement of Daniel Langdale, assistant dean for recruiting. Over nearly three decades, Mr. Langdale served MIT in financial aid and admissions activities, with his final service in the GEO bringing additional focus and strength to our minority recruitment and programming efforts. He was replaced by another old friend of the office, Roy Charles, who returned to MIT after serving as associate director of the MassPEP Program.

MAJOR ISSUES

Graduate student housing re-emerged as a major and positive issue. During the past year, dean Colbert served on a Client Team that was invited by the dean for undergraduate education to develop functional requirements for a proposed new graduate residence hall. The team assembled early in the Summer Term 1997 and devoted several months to consideration of the primary spaces to be incorporated, some general guidelines for design of those spaces, initial parameters for the mix of residential units and dining options, and a preliminary vision of social and intellectual activities and programs for the residence. The overarching concern was that the residence hall and its activities build and support a sense of community among graduate students and faculty, which does not currently exist at the institutional level. Thus, the proposed construction promises to fulfill a long delayed dream of establishing a focal point for graduate life at MIT. When realized, the building will also achieve the long standing goal of providing housing for 50% of the graduate student population. The project is an exciting one that, when completed, promises to add a new spark to the developing northwest region of campus and provide our graduate departments with a wonderful recruitment tool to help draw talented graduate students to MIT.

A more minor focus of activity this past year was on revising and enhancing the orientation program that is organized each year by the Graduate Student Council (GSC) for all new incoming graduate students. The GEO provides funding support for the main activity, which has been a picnic lunch held in Killian Court. Stimulated by questions from Dr. Vest, the GSC established a committee to review and revise plans for fall 1998 activities. Plans were finalized during the spring term 1998 and anticipate a day-long suite of welcoming activities on Kresge Oval and the athletic fields, culminating in an early evening barbecue with music provided by a popular local band. As planned, this revised orientation promises an enthusiastic, hearty and informative welcome to the 1998 cohort of incoming graduate students.

COMMITTEE ON FOREIGN SCHOLARSHIPS

Chaired by dean Colbert and comprised of faculty, staff and students, the Committee on Foreign Scholarships seeks to encourage undergraduate and graduate students to apply for a variety of prestigious opportunities for study, research and cultural experiences abroad. While there are many such options available to pursue, the committee focuses on a number of the more visible programs. Most prominent among these are the Rhodes Scholarship, the British Marshall Scholarships, the Churchill Scholarship, and the Fulbright Year-Abroad Program. While MIT students continue to fare remarkably well in these annual competitions, the overall number of applicants each year remains small. Still, the past year witnessed a new level of success, with our students having won four British Marshall Scholarships, one Churchill Scholarship and three Fulbright Scholarships.

Near the end of the academic year, the GEO completed an historic agreement with the Fulbright Commission of Mexico (COMEXUS). By this agreement, the commission will raise an endowment fund, to be stewarded by the GEO, that will support two or three Mexican students who are admitted to graduate programs at MIT. The commission will nominate a number of top science and engineering students, who will be considered for admission in the normal manner and who will be eligible for three years of support via the endowment. In addition, those Mexican nationals who have formerly received direct, multi-year financial support via that nation's government and industrial consortium, CONACYT, will have those resources channeled through COMEXUS. In doing so, the

nature, source and amount of that support will become visible to MIT and will permit our faculty to better direct internal support resources to students who truly need funding.

COMMITTEE ON GRADUATE SCHOOL POLICY

The CGSP conducted its traditional reviews of degree candidates and end-of-term grades. While no significant policy changes were voted this past year, the committee recognized the need for a thorough review of graduate education policies and practices in the coming year. The review is prompted by anticipated changes in how sponsored research projects will be administered beginning with fiscal year 1999. In particular, tuition charges for graduate research assistants will no longer be recovered from federal research sponsors through the employee benefit rate, as has been allowed for the past thirteen years. A number of graduate policy and practice changes appear to ensue from this fundamental shift. Dean Litster agreed to appoint a select committee to undertake that review beginning in the fall term 1998 and return recommendations to the entire body for consideration.

The CGSP endorsed and forwarded to the Faculty Policy Committee (FPC) a proposal by the Department of Materials Science and Engineering to establish an Interdisciplinary Doctoral Program in Archaeological Materials. The program was endorsed with the understanding that it will be reviewed in five years. The proposed program was subsequently approved by vote of the faculty.

The CGSP reviewed and endorsed a proposal by the Department of Earth, Atmospheric and Planetary Sciences to establish a new doctoral program in Climate Physics and Chemistry. The new program was sent forward to the FPC and was subsequently approved by vote of the faculty.

The CGSP endorsed a proposal from the Department of Humanities to establish a new Master's Degree Program in Comparative Media Studies. This program represents the first graduate level program within the department. The CGSP endorsement was sent forward to the FPC and was subsequently approved by vote of the faculty.

The CGSP discussed a proposal by the Sloan School of Management to establish a Technology Enhanced Evening MBA Program. Following extensive discussion, the proposal was tabled for further consideration in fall term.

My colleagues in the Graduate Education Office express our sincere appreciation to the CGSP members for their service during the past year. We especially thank those long-term members who left the committee and will be replaced. Also, we take special note of all the graduate administrators who work so closely with the CGSP faculty members and who occasionally stand in for them. The monthly luncheon meetings of the graduate administrators, organized this past year by Renee Caso (Cse 4) and Jo-Ann Muray (Cse 7), continue to strengthen the links between the departments and the GEO and enhance the effectiveness of this office.

RECRUITMENT AND OUTREACH

SPONSORED PROGRAMS

The Minority Summer Research Program was recast as the MIT Summer Research Program, in order to appeal to a broader group of interested and talented students from across the nation. In the past summer, thirty-one minority students and one majority student participated in research projects sponsored by MIT faculty members. To date, this is the largest group of research interns ever hosted by the program.

Faculty continue to embrace the program and to offer research opportunities to interns. At the end of the summer, two interns, one from the University of Puerto Rico and one from the University of Texas at Austin, were invited to return to their research groups to continue with their work. Both elected to return, one for the fall term and the other for the spring term. The MSPR's current base of foundation grants (from the A. P. Sloan Foundation, the Camille and Henry Dreyfus Foundation, and the Howard Hughes Medical Institute) will be expiring, and a new round of funding proposals is under development. We remain grateful for the ongoing commitment of these foundations to the MSRP and are very pleased that new funding proposals are being entertained. Our next step for this program will be to develop a stronger base of endowment support.

Finally, we acknowledge and thank all those members of the faculty who open their research groups to welcome and mentor the summer interns. Many have worked with the MSRP for years, which is the strongest statement of encouragement and support for this successful program.

The Sloan Minority Bridge Program, funded by the Alfred P. Sloan Foundation, completed its third year of operation. Within the participating departments (Physics, Chemistry, Toxicology, and the Parson Laboratory in Civil and Environmental Engineering) the program has provided full or partial financial support for eleven students. The purpose of the program is to provide fellowship funding for incoming minority students who need additional course preparation. The funds replace teaching and research assistantships, thereby temporarily relieving the students of the work requirements and allowing more time for coursework. In allowing the students to strengthen their background coursework, the program seeks to enhance to probability that each student will be achieve the degree objective. Of the eleven students supported to date, only one has discontinued graduate studies; and all the remaining students are performing well in their research and their graduate level courses. Thus, it would appear that the objective of the bridge program is being achieved.

RECRUITMENT AND OUTREACH

While we remain gravely concerned about legislative and legal assaults on university based affirmative action programs, the GEO remains committed to helping departments achieve and maintain diversity within their graduate student populations. In our interactions with colleagues at other colleges and universities, we are heartened by their collective determination to develop new approaches to pursuing diversity that will pass court scrutiny or that will be beyond the reach of reasonable litigation. Still, most acknowledge the equal determination of certain conservative and reactionary elements to dismantle and discourage existing programs that use race in any way as a factor in providing access to opportunities. The GEO holds tightly to the view that MIT, as a national resource, must make every reasonable attempt to provide graduate education opportunities to every segment of the population, and that doing so requires aggressive, structured and targeted outreach efforts especially to those who have traditionally been under-represented in our graduate ranks. During the past year, many departments seemed to signal their agreement with this notion by stepping up efforts to locate and attract a diverse pool of applicants, with some reasonable success. We gratefully acknowledge the additional funds provided for these and other recruitment efforts by the provost this past year. The increased resources permitted broader involvement of current graduate students, more participation by faculty and additional travel by our recruitment staff.

While we had hoped for some increase in applicants from California and Texas, based on anticipated fallout from Proposition 209 and from the Hopwood case, there was no discernible impact on applications or admissions. Rather, it appears that many minority students from these areas chose employment rather than advanced education. Should this become a trend, the implications for maintaining the rather shallow advances in diversity made in the past few years, both nationally and at schools like MIT, are not positive. Still, the staff of the GEO will move forward, in close cooperation with the departments, in its outreach activities.

INDIVIDUAL ACTIVITIES

Dean Colbert was appointed by the Acting Governor of Massachusetts to a second five-year term on the board of directors of the Corporation for Business, Work and Learning, a quasi-public state organization that seeks to maintain a manufacturing base in Massachusetts. In addition, he continues to serve on the steering committee of the Mathematics, Science and Engineering Network of the Quality Education for Minorities (QEM) Network. During the past year, dean Colbert also continued as a member of the executive committee of the GEM Fellowship Program, assisting Dr. Vest in his third and final year as president of the organization; as a member of the board of governors of Endicott House; and a stockholder of the Harvard/MIT COOP.

Dean Roy Charles served as advisor and technical consultant to the MassPEP program.

Isaac M. Colbert

WOMEN, FOREIGN NATIONAL AND MINORITY GRADUATE ENROLLMENT, AY 1974 TO AY 1998

Academic Year	Number of Women	Percent Women	Number of Foreign National	Percent Foreign National	Number of Minorities	Percent Minorities	Total Enrollment
1974	318	9.5%	954	28.4%	121	3.6%	3,358
1975	405	11.7%	970	28.0%	151	4.4%	3,468
1976	487	13.5%	1,037	28.8%	155	4.3%	3,603
1977	546	14.5%	1,059	28.1%	178	4.7%	3,774
1978	559	14.6%	1,151	30.1%	157	4.1%	3,824
1979	606	15.4%	1,145	29.0%	147	3.7%	3,944
1980	684	16.5%	1,219	29.4%	150	3.6%	4,146
1981	779	17.8%	1,283	29.3%	174	4.0%	4,384
1982	828	18.2%	1,347	29.7%	140	3.1%	4,541
1983	856	19.1%	1,418	31.6%	145	3.2%	4,489
1984	914	19.7%	1,439	31.1%	143	3.1%	4,631
1985	981	20.6%	1,449	30.5%	141	3.0%	4,757
1986	981	19.9%	1,658	33.7%	139	2.8%	4,920
1987	987	19.8%	1,497	30.1%	144	2.9%	4,979
1988	929	19.2%	1,441	29.8%	154	3.2%	4,832
1989	963	20.0%	1,498	31.1%	159	3.3%	4,822
1990	1,064	21.7%	1,628	33.2%	168	3.4%	4,909
1991	1,092	22.0%	1,674	33.7%	155	3.1%	4,967
1992	1,155	23.0%	1,711	34.1%	190	3.8%	5,019
1993	1,177	23.4%	1,755	34.9%	215	4.3%	5,024
1994	1,154	22.7%	1,744	34.3%	193	3.8%	5,090
1995	1,308	23.9%	1,798	32.9%	229	4.2%	5,465
1996	1,313	23.8%	1,745	31.6%	285	5.2%	5,518
1997	1,354	24.6%	1,842	33.5%	268	4.9%	5,499
1998	1,394	25.3%	1,857	33.7%	266	4.8%	5,513
TOTALS	**22,834**	**19.9%**	**36,319**	**31.5%**	**4,367**	**3.8%**	**115,476**

GRADUATE ENROLLMENT FALL 1998

	Internationals	Women	*Minority	**Non-Resident	Total MIT Enrollment
School of Architecture & Planning	192	232	34	47	**545**
Architecture	87	97	11	23	202
Media Arts & Sciences	34	33	3	0	129
Urban Studies Planning	71	102	20	24	214
School of Engineering	824	484	111	17	**2,431**
Aeronautics & Astronautics	88	33	10	1	199
Chemical Engineering	62	48	12	1	199
Civil & Environmental Engineering	124	63	20	3	248
Electrical Engineering & Computer Science	179	156	27	7	796
Materials Science & Engineering	61	41	3	2	170
Mechanical Engineering	161	55	27	0	389
Nuclear Engineering	44	17	5	1	102
Ocean Engineering	44	11	0	0	104
TPP. SDM, BEH	61	60	7	2	224
School of Humanities and Social Science	143	115	14	50	**329**
Economics	64	32	1	18	124
Linguistics & Philosophy	41	34	1	9	69
Political Science	30	38	9	18	109
Science, Technology & Society	8	11	3	5	27
School of Management (w/Operations Rsch)	378	236	52	2	**926**
School of Science	311	282	58	19	**1,005**
Biology	19	105	11	4	272
Brain & Cognitive Science	22	14	2	1	50
Chemistry	57	53	18	5	175
Earth, Atmospheric & Planetary Sciences	52	63	7	0	160
Mathematics	57	21	1	6	94
Physics	104	26	19	3	254
Whitaker College	38	70	7	1	**274**
Total Graduate Enrollment	**1,886**	**1,419**	**276**	**136**	**5,510**
Category as % of Total	34%	26%	5%	2%	
* "Minority" refers to underrepresented groups: African Americans, Mexican Americans, Native Americans, Other Hispanics and Puerto Ricans.					
** "Non-resident" refers to students who are in non-resident doctoral dissertation status.					

INTERNATIONAL STUDENTS OFFICE

The mission of the International Student's Office is to help students fulfill their academic goals by providing services and support programs that facilitate their adjustment to a new academic and cultural environment, mediate their interactions with US government agencies, provide support to their dependents, and promote interaction and understanding with the MIT community at large.

ADMISSIONS

Although, technically the ISO does not admit students, the Office plays a pivotal role in enabling the international students admitted to MIT, to secure their visas and arrive at MIT on time, before Registration Day. During this past year the number of international students seeking a degree at MIT has remained the same, but the number of Special, Exchange and Visiting Students has increased. Maria Brennan has played an essential role in enabling the Office to meet the needs of these students. The ISO has also provided INS forms and other clerical support to me twenty seven international students who were chosen to participate in the Research Science Institute project supported by the Provost's Office. This program brings to MIT promising high school students from the US and from abroad for a six week Summer program in science and research. The ISO has also continued to be involved in providing support to degree and non-degree programs for mid-level executives and professionals. Excluding students who came to MIT only for a short period during the Summer, a total of 2,174 international students from 107 countries registered for the academic year 1997-98.

PROGRAMS

All international students, regardless of their age or degree program, undergo a period of cultural adjustment. They need information on their new surroundings and community. To meet this need, the ISO has provided orientation sessions for individual students and small groups to help overcome these barriers. These sessions, held daily from the middle of August to the middle of September, were complemented by social events open to the international community where the new students could meet other new students and current students. These events included Coffee Hours, presentations by the Medical Department, the Libraries, the Campus Police, and culminated with the Student Panel, the Faculty Panel, and the International Open House, which is co-sponsored by the International Scholars Office.

HOSTS TO INTERNATIONAL STUDENTS PROGRAM

The HISP has remained vital in providing new students with very supportive new emotional and social ties. Kate Baty, the Coordinator of the Program, now a professional staff member within ISO, has provided invaluable insights on the needs of the students. She has also generously contributed time and effort to the development and implementation of new programs and events. Besides the tradition Welcome Picnic for new students and their host families, held at the end of September, Kate and other ISO staff organizes a pot-luck dinner for freshmen, when she felt that the students had begun missing their families, their friends and home cooked meals. Another pot-luck dinner for students and their hosts were held in February.

IAP ACTIVITIES

International students, like their American counterparts, are very much concerned about their future and the options they will have career-wise. Immigration regulations and procedures on the employment of foreigners are quite complex. In order to clarify the rules, and to allow students to make informed decisions, the ISO has sponsored a number of workshops covering the various regulations as they relate to possible careers after graduation. All three advisors and guest immigration attorneys have given presentations on topics ranging from "How to get a Summer job" to "How to start a company in the US."

Another confusing subject for international students is that of taxes. International students are taxed differently than US students, and all of them, regardless of whether or not they have a US income, are required to file certain federal forms. To help students deal with this issue, the Office invited Fred Crowley, the MIT Assistant Controller to give two presentations - one for graduate and one for undergraduate students - on this topic. The Office also made available to students all the tax forms they required.

ADVISING

As in the past, the ISO staff has advised thousands of students on immigration procedures and regulations for traveling, employment, change of visa status, etc. However, immigration regulations affect so many different aspects of the students lives, that the Advisors must intervene on behalf of the students in circumstances that one would not associate with the functions of an International Students Office. During the past year, Danielle Guichard-Ashbrook has twice accompanied students to Court hearings. In both cases, the students requested her presence, as a friend and mentor. They were scared and frightened over rules they could not understand. Staff members have visited students who were hospitalized, comforted students grieving the loss of a loved one, and pleaded with immigration and consular officers on their behalf. During the past year, the Advisors have spent countless hours with distraught Chinese students who wished to have their spouses, children, or parents join them in the US, but saw Consular Officers deny their visas because of a peculiar interpretation of the new Immigration Act. As the Office is greatly affected by international events, the financial crisis of South-East Asia has also had an impact on the Advisors' work load, since new regulations were introduced to meet the needs of affected students.

PERSONNEL

As the Immigration Service proposes a transformation from paper to electronic communication, the ISO has been preparing itself for the change. Last October, Brima Wurie became a full-time member of the staff of the Dean for Graduate Education Office. Chris LaCava was hired in his place with the new title of Technical Support Specialist. The ISO Web site has been redesigned and expanded, an ISO intranet system has been developed and implemented, SAP applications have been installed (all ISO staff members have received SAP training) and electronic communication with students has been increased. The position of Sr. Office Assistant, currently covered by a temporary worker, will be filed as of August first. However, another temporary worker still acts as the Office receptionist. Given the high number of students who visit the Office daily, this position should be allocated to the Office on a permanent basis. We hope that this will be accomplished when the office moves to its new location.

PROFESSIONAL ACTIVITIES AND AWARDS

The ISO staff members have been very active within NAFSA: National Association of International Educators, at the local, regional, and national level. Danielle has been chosen to be one of the trainers for national workshops that will be required for certification as an International Student Advisor. She has also given presentations at the Regional and National Conferences. Kate has also made presentations at both conferences. She has also continued to be the sustaining force behind "COMSEC Open Forum," an informal organization that brings together people from New England who do programming for international students. Milena Levak had also been involved with NAFSA at the regional and national level. Milena and Danielle were recognized with an award at the Regional Conference for their commitment in running the Third Thursday meetings. These meetings held at MIT since 1978 provide a forum where International Student Advisors new to the field, or form small colleges, can discuss issues related to student advising with more experienced colleagues and can also learn about the most recent regulations published by INS. Kate's extraordinary work on behalf of international students was acknowledged by the Institute with the James N. Murphy Award.

Milena was honored with an invitation from ACTR-ACCELS to travel to Kazakhastan to provide orientation sessions for fifty Kazakh students who received the Presidential "Bolashak" scholarship to study in the US.

FUTURE PLANS

The Office will be moving to a new location in the near future. We hope that this move, accompanied by the transformation of temporary office positions into permanent staff, will allow the Office to work more efficiently and to continue to provide improved services for the students.

More information about this Office can be found on the World Wide Web at the following URL:
http://web.mit.edu/afs/athena.mit.edu/org/i/iso/www

Milena M. Levek

WHITAKER COLLEGE

The Whitaker College of Health Sciences and Technology (Whitaker College) is a major interdisciplinary academic and research entity at MIT. Several areas of research and teaching that are pertinent to health, both fundamental and applied, have been developed and been incorporated into Whitaker College.

Current activities in the Whitaker College include the Harvard/MIT Division of Health Sciences and Technology, the Clinical Research Center, the Division of Toxicology, the Center for Environmental Health Sciences, Biomedical Imaging and Computation, and the Center for Biomedical Engineering.

J. David Litster

CENTER FOR BIOMEDICAL ENGINEERING

The mission of the Center for Biomedical Engineering (CBE) is to intimately combine engineering with molecular and cell biology, for the purpose of developing innovative approaches to biomedical technology. In the past year, it continued initiating new multi-disciplinary, multi-investigator research projects.

In one mode of new project initiation, CBE established the Engineering/Biology Catalytic Research Seed Grant Fund, founded in conjunction with the CBE Industrial Advisory Board, to provide small starting grant awards for teams combining investigators from engineering and the biological sciences. This Fund resulted in 3 Seed Grant awards, to: (1) Linda Griffith (Chemical Engineering/Bioengineering & Environmental Health) and Frank Gertler (Biology), on synthetic extracellular matrices for tissue engineering; (2) Ram Sasisekharan (Bioengineering & Environmental Health) and Peter Seeberger (Chemistry), on a new technology for designing and synthesizing oligosaccharide-based drugs and materials; and (3) Peter So (Mechanical Engineering) and Richard Lee (Harvard Medical School), on a new methodology for studying gene expression responses to mechanical stresses on cells. In another mode of new project initiation, under CBE auspices a number of MIT/Industry research collaborations were organized. These include collaborations with Johnson & Johnson Professional on bone tissue engineering, with 3M on diagnosis and monitoring of bacterial infection, and with Amgen on innovative strategies for therapeutic protein formulation and delivery.

Multi-user core laboratory facilities continued to be maintained and developed, emphasizing instrumentation for quantitative measurement of molecular and cellular properties. These facilities are used by undergraduate students, graduate students, and postdoctoral research associates from various Departments and Divisions in the Schools of Engineering and Science, as well as by investigators from other academic institutions and industrial companies. Finally, Professor Alan Grodzinsky has succeeded Professor Douglas Lauffenburger as CBE Director.

Douglas Lauffenberger

CENTER FOR ENVIRONMENTAL HEALTH SCIENCES

For the last twenty years the Center for Environmental Health Sciences has tried to discover if the chemicals or radiation in our environment are responsible for causing the genetic changes which cause human diseases. This report formally acknowledges that the preponderance of the available evidence now favors an interpretation that human genetic changes are not caused by reactions with environmental agents but may arise primarily from errors in DNA replication.

It must also be acknowledged that only a small fraction of professional scientists and a minority of toxicology faculty at MIT are of this opinion.

Toxicology at MIT has developed as a distinct faculty using the hypothesis of environmentally induced mutations in humans as a *Central Premise.* Research and education have used a common paradigm of human exposure, metabolism of environmental compounds to reactive intermediates, reaction with cellular macromolecules especially DNA and, failing repair of this damage, genetic change. CEHS coupled this toxicological paradigm with environmental engineering studies aiming at understanding sources of chemicals and their chemical changes as they are transported through the environment in air, water or food to humans.

The available evidence, which requires us to rethink our scientific positions, has two parts. The first is that the mutations inherited via germ cells in humans are chiefly G->A transitions (>70%) and small deletions at locally repetitive sequences(20%). A similar pattern is observed in mutations in cells in tissues as human's age or within tumors. These kinds of changes are associated with patterns of mutations caused by DNA polymerases and not with induction by any known exogenous chemical in bacteria, yeast, rodent or human cells. A single exception to this finding is that the mutations reported in human skin are consistent with mutations induced in human cells by ultraviolet light. The second is that the rate of mutation as observed by determining mutant fractions in white blood cells in humans from youth to old age indicate a constant rate of mutation at a rate per stem cell division equal to or somewhat less than observed for mutations in human cells grown in the absence of added chemicals in the laboratory.

There is, however, only one published direct test of the *Central Premise* in humans and that is in the mitochondrial DNA, not the nuclear DNA which carries tumor suppressor genes in which mutations required for human cancer occur. In this case, careful examination of a 100 base pair sequence revealed that the mutations were >90% G->A or A->G transitions distributed over some 17 base pairs as *hotspots*. It is now known that this distribution of transition mutations is found among humans in the mitochondrial DNA inherited in maternal lineage indicating that our studies have revealed a pattern of mutation common to the entire mitochondrial genome. In direct studies of the lung epithelium of twins discordant for cigarette smoking it was found that cigarette smoking had no effect on the number or kind of mitochondrial mutations. A study in progress with human mitochondrial DNA polymerase has shown that the same quantitative pattern of G->A transitions observed in the organs of humans are produced when the mitochondrial sequence is copied by the polymerase in the laboratory.

However, after dissection of lungs from smokers and nonsmokers and assay of two different point mutations in the K-ras and P53 nuclear genes, we find that the number of mutant colonies in smokers and nonsmokers are identical. While more lungs and assays are required prior to offering for publication it seems that cigarette smoking probably does not induce point mutations in human lung cells.

These findings may be considered in terms of the natural progress of science inexorably discovering former error but they have also created a great deal of discomfort among MIT toxicology faculty and among scientific reviewers of CEHS proposals.

One reason is that when some scientists hear the arguments for a spontaneous source of human mutations and they interpret them to be arguments against a role for environmental chemicals in human disease, especially cancer. This is not logically implied by CEHS proposals in which it is argued that the historical record of rising fractions of Americans at risk for lung cancer, leukemia, lymphoma, and cancers of the central nervous system and kidneys is prima facie evidence of the importance of environmental factors. What is logically inferred is that in addition to

press for direct testing of the Central Premise in human nuclear genes, CEHS must invest in basic research, which examines biological phenomena in addition to mutations, which could be affected by environmental factors?

To this end CEHS has created a network of collaborating physicians interested in the pathology of lung and colon and in its new Building 16 facilities established core laboratories to receive, dissect and study tissues, organs and blood samples as autopsy or surgical discards. These samples may be studied for indications of exposure to environmental and endogenous chemicals, genetic changes at the DNA sequence or chromosome structural level, changes in gene expression or local morphology. Younger faculty in toxicology such as Professors David Schauer, Bevin Engelward and James Sherley are paying close attention to the role of cell kinetics, death and division rates, in human tissues as factors, which could be affected by the presence of environmental pollutants.

In the area of human exposure to chemicals, chaos reigns. Our senior faculty laboratory leaders are expressing strong reservations about the accuracy of results from their own and othersí laboratories which indicated that cells in the human body carried thousands of DNA adducts derived from food, air and water.

Since March 1998, the Center has undergone three NIH site visits and one more is scheduled for 15 October. For the program grants, Mutagenic Effects of Airborne Toxicants (W.G. Thilly, P.I.), Nitrite Carcinogenesis (S.R. Tannenbaum, P.I.) and the Center for Environmental Health Sciences center grant we have been informed of high ratings and funding over the next five years of some 19 million dollars. New initiatives abound in the areas of human genomics, exposures to radiation emanating from DOE sites, and the health effects of materials used or created in computer chip manufacture.

Key to the success of the CEHS renewal for five years of additional core funding was the MIT investment in the new facilities and the fact that eleven junior faculty joined the Center in the past seven years and three have already been awarded tenure through their Departments and Schools. The Center received a rating of *Outstanding with enthusiasm*, despite a recognition by the reviewers that observations were discordant with generally held beliefs. This is the highest rating the Center has received since its founding in 1978.

The Center Director, W.G. Thilly, was elected in the past year to the presidency of two organizations representing university environmental health and engineering researchers across the U.S.: Association of University Environmental Health Science Centers and the Superfund Basic Research Universitiesí Association. In these positions he continues 12 years work organizing some two hundred annual explanatory sessions in states and congressional districts regarding progress and limits of knowledge in the environmental health field as well as the research needs and opportunities.

William G. Thilly

CLINICAL RESEARCH CENTER

The Clinical Research Center (CRC) was established in 1964, with grant support from the National Institutes of Health (NIH), to provide a facility in which Massachusetts Institute of Technology (MIT) investigators and their collaborators could apply the Institute's expertise in basic biochemical and biophysical mechanisms to the analysis of normal and pathologic processes in humans. MIT's CRC was the first federally supported clinical research center located in a university and not within a hospital. It was anticipated that in spite of its university venue, a large enough number of qualified physicians and clinical scientists from MIT's faculty and staff would utilize the CRC to study normal volunteers, or patients with chronic diseases.

Scientists and physicians authorized to carry out research protocols using the CRC's facilities include: professors; research scientists who work exclusively at MIT; and those with primary appointments in local medical institutions whose research interests overlap extensively with those of MIT investigators. Research protocols must be approved by the MIT Committee on the Use of Humans as Experimental Subjects and the CRC Advisory Committee before they can be implemented. The CRC Advisory Committee, chaired by Dr. John Burke, Professor of Surgery at the Harvard Medical School, consists of eleven voting members plus nine non-voting members of the CRC's program staff. The Committee reports to the Principal Investigator, Martha Gray, Associate Professor and Co-director of Harvard/MIT Division of Health Sciences and Technology (HST), and meets bimonthly to evaluate protocols for their scientific quality, experimental design, statistical analysis and potential risk to human subjects. The Committee also sets general policies and reviews the operations of the CRC.

ADMINISTRATION

The CRC presently has a dual administrative locus within MIT. As a research unit, the CRC reports through the Harvard-MIT Division of HST to the Vice President and Dean for Research, Professor David Litster. However, as a patient-care unit, the CRC is a part of the MIT Medical Department and reports to Dr. Arnold Weinberg, the Director of the Medical Department. Members of the CRC participate in the Medical Department activities; i.e., Quality Assurance, Pharmacy and Therapeutics, Medical Records, and Safety Committees.

Based on discussions with the Program Directors at the Massachusetts General Hospital (MGH) and the Beth Israel Deaconess Medical Center (BI/DMC) and the NIH staff, the MIT CRC has been designated a "network" facility, which encourages a closer collaboration with these and other CRC's. For example, MGH investigators are implementing relevant outpatient protocols at MIT; and conversely MIT CRC Investigators will be initiating studies on inpatients at MGH. Similarly, the MIT CRC uses the biostatistical services of the BI/DMC and together they direct the Clinical Research Training Program under the auspices of the Center for Experimental Pharmacology and Therapeutics (CEPT).

EDUCATION

The CRC provides postdoctoral training for physicians who are participating in fellowship programs at MIT. These physicians utilize the CRC's facilities to initiate research protocols and to participate in ongoing projects supervised by senior investigators and faculty. During the current fiscal year, six postdoctoral fellows and four graduate students participated in such research projects. At the undergraduate level, nine Undergraduate Research Opportunities Program students participated in clinical research projects with physician preceptors and faculty supervisors.

On June 9, 1998, the CRC organized a major symposium on Neuroprotection in Stroke for the benefit of both the MIT and the broader Boston biomedical community. The program consisted of eight presentations by academic clinical neuroscientists on the development of clinically useful neuroprotective strategies in acute ischemic stroke. This was followed by a panel discussion including representatives of five pharmaceutical companies involved in neuroprotective drug research and development.

AFFIRMATIVE ACTION

The hiring of women and minorities continues to be a high priority at the CRC; our continuing problem in meeting affirmative action objectives is attracting qualified minority candidates. The traditional means of advertising and posting positions in local colleges, universities, medical institutions, and minority organizations have not resulted in a significant response from qualified minorities.

This past year two research staff positions became available. One male and one female were hired. Eight Visiting Scienists were appointed, two female and six males, two of whom were members of minority groups. The Center will continue its efforts to increase the pool of qualified minority applicants as positions become available.

RESEARCH ACTIVITIES

During the past year, most of the research activities of the CRC continued to be associated with three clinical areas, and to involve three groups of scientists, each led by a senior professor. These areas are: *Nutrition/ Metabolism* (Vernon R. Young, professor, MIT School of Science), an area in which the CRC constitutes the major locus of MIT's activity, and one that is a traditional component of clinical research centers; *Neurochemistry/Neuropsychopharmacology* (Richard J. Wurtman, Cecil H. Green Distinguished Professor and Program Director, MIT CRC), studies on the effects of drugs, foods and hormones on brain composition and behavior; studies on melatonin and sleep, and on biologic rhythms in sleep and hormone secretion; studies on a set of diseases characterized by affective and appetitive symptoms (i.e., depression, premenstrual syndrome, smoking withdrawal, carbohydrate craving, obesity), which seem to relate to brain serotonin; and *Behavioral Neuroscience* (Suzanne Corkin, Professor of Brain and Cognitive Sciences), focusing on the effects of diseases on cognitive and related brain functions and on genetic and other mechanisms causing neurodegenerative disorders (e.g., Alzheimer's disease). Groups collaborate on multi disciplinary projects, e.g., obesity; depression; Alzheimer's disease. Moreover, numerous CRC research collaborators involve both an MIT professor and investigators at an outside hospital or research laboratory.

This year the CRC patient census totaled 307 inpatient days and 2,985 outpatient visits. The CRC branch of the NIH provided support for up to 295 inpatients and 3906 outpatient visits.

CENTER FOR EXPERIMENTAL PHARMACOLOGY AND THERAPEUTICS

Research efforts have been centered in the application of quantitative measurements to the process of drug development with such forms of technology as positron emission tomography, magnetic resonance imaging, and ultrasound. This Center is directed by Dr. Robert Rubin (HST), a member of the HST Academic Faculty.

COMPUTER FACILITY

The computer area continued the development of the CRC Operations System. It is being developed using the ORACLE relational database, and supports the day-to-day operations of the Center.

Researchers continue to make use of the SAS statistical software available on the CRC computer system. They also use the resources available on the Internet.

The computer facility provides administrative report support and statistical assistance to all researchers. Design of the system fully integrates web services with the local database.

CORE LABORATORY/MASS SPECTROMETRY FACILITY

The Core Laboratory specializes in assays that directly support the research efforts of CRC investigators. The most important and complex assays are undertaken by the Mass Spectrometry Facility, where stable isotope tracer analyses are performed. The Mass Spectrometry Facility is a shared instrument facility that allows CRC investigators to conduct human metabolic studies using stable nuclide tracers. Principal areas of investigation concern the regulation of energy substrate metabolism in health and disease, and the regulation of whole body amino acid metabolism, with particular reference to the nutritional requirements for indispensable and conditionally indispensable amino acids. Research at the MIT CRC has made important contributions to the further development of national and international dietary standards and the establishment of sound food and nutrition policies and programs. Studies continue to examine the role of dietary arginine as a precursor of signal transducer nitric oxide. The novel doubly labeled water ($^2H_2{}^{18}O$) method is being used to define the energy requirements for adolescent and elderly subjects, and the factors which affect these needs. These various investigations offer new basic knowledge about the physiology of human energy substrate and amino acid metabolism and, additionally, make practical contributions to problems in human nutrition.

High performance liquid chromatography (HPLC) techniques are also utilized by the Core Laboratory. A Beckman System Gold Amino Acid Analyzer HPLC provides resolution of up to 42 physiologic amino acids. Other HPLC assays include tests for choline, tryptophan, the catecholamines, cytidine and melatonin.

RESEARCH HIGHLIGHTS

Suzanne Corkin, Ph.D. and her colleagues conducted studies designed to identify brain regions involved in somatosensory perception and to determine whether they are similar to those of non-human primates, in which somatosensory maps have been identified with the post central gyrus.

Several distinct somatosensory maps exist within the nonhuman primate postcentral gyrus (PCG). Brodmann area 3a, located in the depth of the central sulcus, contains a map of proprioceptive and deep receptor input. Areas 3b and 1, located on the crest of the PCG, each possess separate maps of predominantly tactile information. These maps have been shown to have distinct anatomical connectivity and dissociable perceptual functions. Given their importance in the nonhuman primate for somatosensory perception, we have used fMRI and inflated brain analysis techniques to define areas 3a and 3b/1 functionally in human subjects.

Subjects (N = 6, 27-32 yr) were scanned in either a 1.5 T scanner with a 5" circular surface coil, or in a 3 T scanner with a GE birdcage head coil. In both scanners, 16 coronal oblique slices (4x3x3mm voxel size) were taken during 4:16min scans (TR = 2.0s). To activate the 3b/1 and 3a maps, subjects were scanned while they performed a tactile and a proprioceptive/motor task. In the tactile task, subjects received 3 Hz stimulation of the right palm, administered with a 5.88 log10mg von Frey filament. In the proprioceptive/motor task, subjects opened and closed the fingers of the right hand at 3 Hz without touching the digits to the palm (to avoid additional tactile input). Both tasks consisted of 16s epochs of stimulation alternated with 16s epochs of no stimulation. Data were analyzed using a Fourier transform with a Bonferroni correction for multiple tests. Data were displayed on an inflated brain to visualize distinct maps within the PCG.

The tactile and proprioceptive/motor tasks activated distinct maps around the central sulcus. In both the tactile and the proprioceptive/motor task, the precentral gyrus (area 4, the locus of primary motor cortex) was activated. In the tactile task, the crest of the PCG (areas 3b and 1) was also activated, but the depth of the central sulcus (area 3a) was not (N=5/6). Conversely, in the proprioceptive/motor task, the depth of the central sulcus (area 3a) was activated (N=6/6) in addition to area 4.

Their results demonstrate multiple maps within the human PCG that code for separate submodalities of somatosensory perception. The segregation of these neighboring maps suggest parallel processing streams for somatosensory perception. They are currently investigating the activation of area 2, located on the posterior bank of the PCG, which integrates these two types of information in nonhuman primates.

Linda Bandini and William Dietz continue to follow girls annually to examine the relationship of energy expenditure to growth and development. Girls are being studied annually until four years post menarche. They have completed four years of follow-up data in the entire cohort, and some girls gave completed five and six years of follow-up. At each annual visit anthropometric measures, and bioelectrical impedance are done. Girls are also asked to fill out questionnaires regarding diet and activity, and bloods are drawn for the measurement of insulin, and sex hormones. At the subjects last visit (four years post menarche) body composition is measured by isotopic dilution of O^{18} water and basal metabolic rate is measured by indirect calorimetry.

Forty six girls (approximately twenty-five percent of the original cohort) have now completed the study. In a subset of girls daily energy expenditure was repeated at age twelve and again at age fifteen to examine the changes in activity level with age and development. Twenty-eight girls were studied at age twelve, and twenty-three have been studied at age fifteen. In another subset of girls body composition and visceral fat are measured at menarche and four years post menarche. The first phase of this analysis has been completed. Forty-four girls are enrolled in this part of the study. They will examine the relationship of several factors including diet, activity, and hormone levels to the distribution of body fat at puberty and four years post menarche.

In a cross-sectional analysis they examined the validity of anthropometry and bioelectrical impedance to predict fat-free mass and body fatness in pre-menarcheal girls. Their findings suggest that bioelectrical impedance was a reliable measure of fat-free mass but is no better than triceps skin-fold thickness in the predication of body fat in pre-menarchael girls. Preliminary analysis of the change in activity level from age ten to fifteen years suggests a decrease with age, however the findings were not statistically significant. Although the decrease in activity level was not significant, it was lower than in previously published data for thirteen to seventeen year olds.

Paul A. Spiers, Ph.D., and Gail S. Hochanadel, Ph.D., continued their study on the effects of Citicoline in patients treated a month after an ischemic stroke. The results from a pilot group of patients suggested that there is a positive effect of the drug in this population as well as in the normal elderly. This pilot research was presented at the 1998 joint meeting of the American Neuropsychiatric Association and Behavioral Neurology Society.

Additional research projects examined the effects of Citicoline on memory in elderly patients with Age-Associated Memory Impairment, a condition which is widely considered to be a precursor of dementia.

William Thilly, Ph.D. and his coworkers detected mutations at the level seen in normal healthy humans. They have developed the means to measure point mutations in certain DNA sequences at mutant fractions as low as 10-6 without reference to phenotypic changes. The specificity of mutations allowed researchers to construct a mutational spectrum which is characterized by a reproducible set of predominant point mutations.

Mutational spectra show what mutates DNA in humans. Specifically, they have examined mitochondrial sequences as the source of mutations. In the development of constant denaturant capillary gel electrophoresis (CDCE) it was necessary to discover an appropriate mtDNA sequence. In this process they had to characterize human mtDNA for polymorphisms (1). An appropriate mtDNA sequence was discovered, which now allows examination of mutations in human organ tissue samples. From these studies they have determined that there is a similarity of hotspot sets in vivo and in vitro for mtDNA (2). Thus, they have concluded that human mitochondrial point mutations in the sequence studied are primarily spontaneous in origin and arise either from DNA replication error or reactions of DNA with endogenous metabolites.

Richard J. Wurtman, M.D. and his coworkers demonstrated for the first time, that very low melatonin doses (0.1 or 0.3 mg), which raise daytime blood melatonin levels only to those which occur normally at night, make people sleepy and facilitate sleep initiation. The results obtained in twenty healthy people also suggest that the *normal* secretion of melatonin, each evening and night, is partly responsible for physiological sleep. In subsequent studies using low melatonin doses given later in the evening, using standard polysomnography, demonstrated that low melatonin doses at *all* of the time points tested cause sleep onset without disturbing the normal sleep structure. They additionally showed that melatonin administration causes no differences in mood and performance of people tested on the morning after melatonin or placebo. These preliminary results suggest that induction of melatonin concentrations close to normal physiological levels does not negatively affect humans' performance and mood the morning following treatment.

Vernon R. Young, Ph.D., D.Sc., recently received the first Danone International Prize for Nutrition (France) and he has been made recipient of the 1998 International Award for Modern Nutrition (Switzerland).

Dr. Young and his colleagues earlier demonstrated the feasibility of using a whole body amino acid balance technique using ^{13}C-labeled amino acid tracers to estimate human amino acid requirements. This novel approach opened the way for a reappraisal of the requirements for the nutritionally essential amino acids in human nutrition. Studies have been concerned with leucine, phenylalanine and lysine as the test amino acids. These studies by Young and coworkers have received international acclaim and have resulted in a profound change in concepts regarding the quantitative significance of the dietary amino acid intake level on human well-being. He has initiated a collaborative study in Bangalore, India to assess the relevance of their findings from his MIT studies to healthy populations in the Third world. Their early observations confirm the applicability of the MIT findings to populations worldwide.

Richard J. Wurtman

DIVISION OF COMPARATIVE MEDICINE

The Division of Comparative Medicine (DCM) provides animal husbandry and clinical care for all research animals on the MIT campus. From its inception in 1974, the Division has evolved into a comprehensive laboratory animal program that provides a full range of veterinary and surgical support. Additionally, the Division has a National Institutes of Health (NIH) funded training program for veterinarians specializing in laboratory animal/comparative medicine and conducts externally funded research focusing on comparative medicine. Total personnel in the Division now comprises 90 individuals. In March 1998 the Division moved its administrative, diagnostic and research laboratories to the newly renovated eighth floor of Building 16. This space is contiguous to the eighth floor of the newly renovated Building 56, which also houses quarantine, diagnostic and research space for DCM.

The final phase of major renovations in the animal facilities was completed during FY98. Buildings E20 and 45 have been vacated. The eighth floor of Building 56 has been renovated and this space now accommodates quarantine animals. The state-of-the-art animal facilities now include 30,000 gross square feet in Building 68, which has been occupied since November, 1994, and a fully renovated E17/E18 facility (13,200 gsf), which has been occupied since March, 1995. Also, a new addition of 11,300 net square feet to the Whitehead facility along with renovations to the existing animal area were completed in 1997. These facilities support transgenic and gene "knockout" *in vivo* experiments. The average daily census of laboratory animals was approximately 8 percent higher during FY98 than in FY97. Mice remain the primary species used by MIT investigators and represent more than 98 percent of the animal population.

Current NIH-funded grants support *in vivo* study of nitrite carcinogenesis, *in vivo* study of *Helicobacter hepaticus* carcinogenesis, *in vivo* study of the pathogenesis of inflammatory bowel disease, *in vivo* study of the etiology of lymphoma in ferrets, *in vivo* studies of *H. pylori* pathogenesis and the role of *Helicobacter felis* and *H. mustelae* in inducing gastric cancer. Private pharmaceutical firms have provided funding for research on the efficacy of anti-*Helicobacter* agents and *H. pylori* pathogenesis studies. FY98 was the tenth year of the Division's NIH postdoctoral training grant and a competing renewal was funded for the next five years. There are currently six postdoctoral trainees, one of whom is enrolled in the graduate programs in the Division of Toxicology. Two postdoctoral fellows completed the program this year. One was recruited by the University of Oregon and the other joined the staff of a pharmaceutical firm. Seventeen of 18 eligible postdoctoral fellows have now passed the board examination of the American College of Laboratory Animal Medicine.
DCM faculty and staff published two chapters, 18 papers and 28 abstracts in FY98 and presented numerous research papers at national and international meetings.

Dr. Susan Erdman, an ACLAM boarded veterinarian was promoted to the Clinical Veterinarian position that was vacated by Dr. Charmaine Foltz. Dr. Erdman had been a Research Scientist in DCM for the past five years. Dr. Zhongming Ge, a Molecular Biologist, joined the Division last autumn. Dr. Marisa Esteves, a former DCM postdoctoral fellow, returned to the Division as a Research Scientist. She is supported by a NIH research supplement for underrepresented minorities. DCM faculty and staff taught the graduate courses Toxicology 201 and 214.

The Committee on Animal Care moved to new quarters on the fourth floor of Building 16 in March 1998. Didactic training sessions were conducted throughout the year by DCM staff in conjunction with the Committee on Animal Care to train Institute personnel on topics pertaining to the care and use of laboratory animals. The Committee continued to distribute to other institutions in the United States and abroad two instructional videos, one focusing on the role and responsibilities of Institutional Committees for the Care and Use of Animals and the other focusing on the use of anesthesia in laboratory animals. Both are available to MIT researchers at the Division or in the Schering-Plough Library.

James G. Fox

DIVISION OF TOXICOLOGY

This is the final Report to the President concerning an independent Division of Toxicology. Earlier this year the Division moved administratively from Whitaker College of Health Sciences and Technology to the School of Engineering, and as of July 1, 1998 we merged with faculty in the School of Engineering and the Whitehead Institute into a new Division of Bioengineering and Environmental Health. It is anticipated that these moves will strengthen an already outstanding program through the development of new resources and new educational and research opportunities. The Ph.D./S.M. degree programs in toxicology will be conserved, and an important new role will be opened for introduction of toxicological principles into the undergraduate curriculum. This will be accomplished both through the introduction of "modules" into existing courses, and through the development of an undergraduate minor in Environmental Health.

MISSION

The Division of Toxicology's major educational activity is the operation of a graduate degree program leading to S.M./Ph.D. degrees in toxicology. Teaching as well as research programs emphasize mechanisms through which chemical and physical agents in the environment induce toxicity and pathogenesis.

The objective of the programs of the Division is to train scientists who will be professionally qualified to make research contributions to improve understanding of the impacts of hazardous chemicals and other environmental agents on human health, and to educate future generations of scientists with similar interests and qualifications. Special emphasis is placed on development and application of *in vivo* and *in vitro* experimental models and approaches designed ultimately to elucidate, in cellular and molecular terms, mechanisms through which such agents induce their adverse effects. Strong emphasis is placed on the development, validation and application of methodology for detection and characterization of adverse effects that will improve assessment of hazards to humans resulting from environmental exposures. Utilizing biochemical, chemical and biological approaches, the training of pre- and post-doctoral trainees is concerned with: characterization of effects of toxic, carcinogenic and mutagenic chemicals at intact animal, tissue, cellular and molecular levels; development of methods for the detection and quantification of such effects in humans, experimental animals, and other experimental systems; studies of metabolic activation, macromolecular binding and genetic effects; and elucidation of modes of action at cellular and molecular levels.

Faculty members whose primary academic affiliations are in the Division include Professors Peter C. Dedon, Bevin Engelward, John M. Essigmann, James G. Fox, Ram Sasisekharan, David B. Schauer, James Sherley, Steven R. Tannenbaum, William G. Thilly, and Gerald N. Wogan. James G. Fox is also Director of the Division of Comparative Medicine. Professors Essigmann, Tannenbaum and Wogan hold joint appointments in the Department of Chemistry; Professor Thilly also serves as Director of the Center for Environmental Health Sciences. Professor Dedon was promoted to Associate Professor with Tenure.

The curriculum is designed to provide rigorous training in basic sciences, with particular emphasis on graduate subjects in biochemistry, molecular biology and genetics as well as toxicology. Graduates of the doctoral program follow career paths in academic, industrial or governmental organizations requiring applications of modern methods of chemical, molecular biological and genetic analysis to research related to the evaluation of risks associated with chemical exposures. The scope of both educational and research programs encompasses subject matter pertinent to activities of chemical, biotechnology, pharmaceutical, and food industries, as well as to governmental regulatory and research agencies.

In 1997-8 there were 3 students enrolled in the S.M. program and 31 in the Ph.D. program. Degrees awarded included 1 S.M. and 6 Ph.D.'s

AFFIRMATIVE ACTION

Specific efforts to recruit members of underrepresented minority groups are made at several levels. In the context of general recruiting efforts, all notices and other documents clearly state the M.I.T. and program commitment to recruitment of minority candidates. Additional recruiting efforts include internships, faculty visits, conferences, mailings and informal networking by current minority trainees.

An important and most fruitful avenue of contact with prospective minority students has been through the M.I.T. Minority Summer Science Research Program (MITSSRP). This program was initiated in 1986 as an institutional effort to address the issue of under-representation of African Americans, Hispanics, and Native Americans in mathematics and the physical and biological sciences in the United States. The Summer Science Program is designed to provide opportunities for talented minority sophomores and juniors to spend a summer on the M.I.T. campus working in an active research program under the guidance of faculty, postdoctoral fellows, and graduate students. The Toxicology faculty have consistently been active participants in the MITSSRP since its inception. This has proven to be an effective recruitment path, as approximately one-half of our current and formerly enrolled minority doctoral candidates were Summer Program interns before joining the Division. This year two interns are in our Division, one with Professor Dedon and one with Professor Schauer.

Two new minority students joined the Division in Fall, 1997. Cecilia Fernandez earned the B.A. Degree in biology from Boston University and Jose Marquez was an undergraduate in Civil & Environmental Engineering at M.I.T. In addition, there are three continuing students. Pablo Herrero was an undergraduate in Chemical Engineering at M.I.T. before joining the Division. Curtis Glover earned his B.S. degree in chemistry and biology at Cheney University of Pennsylvania. Jacquin Niles earned the S.B. degree in Chemistry at M.I.T. and is enrolled in the Toxicology Ph.D. program which he will complete in conjunction with the M.D./Ph.D. program at Harvard Medical School.

Efforts to recruit members of underrepresented minorities into the Toxicology program are being conducted in coordination with institutional programs with similar objectives within M.I.T. For example, the Division is one of four academic units at M.I.T. participating in the Sloan Foundation Fellowship program which provides financial assistance to support the recruitment and funding of new minority graduate students. Both of our incoming new students, Ms. Fernandez and Mr. Marquez, were supported as Sloan Foundation Fellows during their first year of graduate study. These efforts have been developed with the support of and in consultation with Isaac M. Colbert, Senior Associate Dean of the Graduate School.

HONORS AND AWARDS

The following honors and awards were accorded to faculty and students of the Division during the current academic year.

Ms. Sophie Currier was awarded an Ida Green Fellowship. Ms Currier is an S.M. candidate in Prof. John M. Essigmann's lab.

Professor Bevin Engelward was appointed to the Samuel A. Goldblith Development Professorship.

Professor John M. Essigmann won the Arthur C. Smith Award which was established in 1996 on the occasion of Dean Smith's retirement from the position of Dean for Undergraduate Education and Student Affairs. The award honors the service of Dean Smith and is presented to a member of the MIT faculty for meaningful contributions and devotion to undergraduate student life at MIT.

Ms. Cecilia Fernandez, a doctoral candidate in Toxicology who is conducting her thesis research with Prof. Bevin Engelward and Mr. Jose Marquez, a Master's candidate with Prof. William G. Thilly, were awarded Sloan Fellowships for the 1997-1998 academic year. Ms Fernandez has been awarded the three-year Ford Foundation fellowship for Minorities beginning September, 1998.

Professor James G. Fox received the Merit Award for Research in Comparative Medicine from the Massachusetts Veterinary Medical Association, and was appointed to the Editorial Board of the new journal *Helicobacter.*

Ms. Maria Kartalou of the Essigmann lab has been selected by the Graduate Education office for the Henry Bromfield Rogers Fellowship which provides tuition and stipend for the Fall '98 term.

Ms. Carrie Pesce, who completed her first year of graduate work in Prof. Bevin Engelward's lab, has been awarded a five year D.O.D. National Defense Science and Engineering Fellowship which begins September of 1998.

Mr. Zachary Shriver, a student in Prof. Sasisekharan's group, has been awarded the prestigious Whitaker Health Sciences Fund Fellowship for 1998-99.

Professor William G. Thilly was elected to the presidency of two national organizations representing environmental health scientists: the Association of University Environmental Health Sciences Centers and the Association of Superfund Universities. In these capacities he continues to organize presentations in many states and districts regarding the needs of university researchers trying to provide a scientific basis for decision making in environmental, food and drug regulatory practice.

Ms. Aoy Tomita was one of two recipients honored with the Poitras Fellowship for graduate students conducting research in the biomedical sciences.

Professor Gerald N. Wogan received a Fogarty Scholar-in-Residence Award from the National Institutes of Health, which extends over the 1997-1999 period. It is an award supporting scholars from all over the world to work at NIH in order to stimulate development of new research initiatives for the NIH and also to foster collaborative research endeavors among and with NIH scientists.

Mr. Jinghai Xu, a doctoral candidate in Toxicology working with Prof. Peter C. Dedon was awarded the Whitaker Health Sciences Fellowship.

TEACHING AND RESEARCH

Professor Peter C. Dedon has made important advances in both teaching and research in the past year. With regard to teaching, he spearheaded the development of an undergraudate minor in environmental health and Toxicology, which has been designed to appeal to a braod spectrum of science and engineering majors. Two new courses have been developed as part of this minor: Introduction to Physiological Modeling, taught by Profs. Sasiskharan and Lauffenberger; and Infectious Agents and the environment, taught by Prof. Schauer. Following the first offering of these new courses, we will petition for approval of the Minor for the Fall of 1999.

Professor Dedon has also made several important research discoveries in the past year. One addresses the biologically important phenomenon of DNA supercoiling and how supercoiling determines the location of DNA damage in the genome. Using a technique developed in his laboratory to prepare positively supercoiled DNA, his research group discovered that positive supercoiling caused heretofore undescribed changes in DNA structure and dynamics that significantly affect the interaction of the DNA with even the most reactive genotoxins. On a second front, Prof. Dedon discovered that products derived from oxidation of deoxyribose in DNA, namely base propenal, react with DNA bases to produce mutagenic lesions. Prof. Dedon is now extending these studies to several other electrophilic products of DNA oxidation as well as an abundance of potentially reactive intermediates of cellular metabolism. These results have opened up a new area of genetic toxicology that may account for a significant portion of so-called "spontaneous" DNA damage and mutation.

Professor Bevin Engelward's research is on the recombination of DNA and how it is known to contribute to tumorigenesis, since recombination events can results in loss of genetic information. Somatic recombination in human cells is known to be stimulated by DNA damage. Whilst it is clear that double strand breaks are highly recombinogenic, it is less clear how lesions that affect only one strand of duplex DNA stimulate recombination. Her group has recently shown that removal of alkylation damage by base excision repair enzymes prevents mutagenic recombination in *S. cerevisiae*. These are the first studies show that repair of alkylation damage by this repair pathway suppresses mutagenic recombination. They now directing their efforts toward understanding the molecular basis for the ability of alkylation lesions to stimulate recombination. In addition, they are developing tools for studying the role of various DNA repair processes in preventing somatic recombination events that may lead to cancer. They expect the work that is underway to help us understand why some people are more susceptible to cancer than others. In addition, many cancer chemotherapeutics induce recombination, and these recombination events may contribute to secondary tumors induced by exposure to the anticancer drug itself. By understanding the basis chemotherapy induced recombination, it may become possible to design better anticancer drugs with reduced side effects.

Professor David Schauer's research accomplishments have to do with the etiology of inflammatory bowel disease. Human inflammatory bowel disease has no known cause. He has now shown in three distinct mouse models of inflammatory bowel disease that infection with pathogenic bacteria of the genus *Helicobacter* cause disease expression. He has also successfully performed genetic manipulation of these murine *Helicobacter* species. This had not been accomplished previously, and will allow his group to define the molecular basis of disease induction by these pathogens.

In the Thilly laboratory, the technical ability to measure point mutations in human mitochondrial or nuclear DNA has achieved its long term goal of measuring mutations directly in human organs. The first published papers reveal that mitochondrial mutations arise from endogenous processes such as reaction with chemicals manufactured by cells themselves or errors in DNA replication. The study of nuclear sequences, technically more challenging, is underway. These data represent a significant challenge to the widely held belief that environmental conditions associated with cancer, such as cigarette smoking, act via direct induction of mutations through chemical reaction products in DNA.

More information about the Division of Toxicology can be found on the World Wide Web at the following URL: http://web.mit.edu/tox/www/

Steven R. Tannenbaum

HARVARD-MIT DIVISION OF HEALTH SCIENCES AND TECHNOLOGY

The mission of the Harvard-MIT Division of Health Sciences and Technology (HST), established in 1970, is to develop and conduct research and educational programs across disciplinary lines within MIT and Harvard University, and the teaching hospitals in order to combine the sciences and engineering in the solution of problems in biology and medicine. By uniting the great strengths of the two universities, HST trains students for research and leadership roles in medicine, biomedical sciences and biomedical engineering. The program seeks to improve human health through its multi-disciplinary, multi-institutional research and educational activities.

Recognizing that the future requires leaders who can effectively bridge the cultures represented by medicine, science, and engineering, the Division accomplishes its mission by providing truly multi-disciplinary training in these three areas to both M.D. and Ph.D. candidates. Accordingly, the HST student body and faculty have backgrounds and interests spanning the continuum represented by these areas, and have career and research objectives that depend on a substantial integration of these areas. The HST M.D. curriculum trains physicians who have a deep understanding of the underlying quantitative and molecular science of medicine and biomedical research. The Ph.D. programs combine rigorous scientific or engineering graduate training with an in-depth exposure to the biomedical sciences and clinical medicine.

The research programs for students and faculty similarly reflect the mixing of cultures in applying the appropriate tools of medicine, engineering and science to address problems in human health and clinical medicine. They are focused on five main thematic areas:

- medical sciences and molecular medicine,
- biomedical engineering/biological physics,
- imaging sciences and technology,
- medical informatics, and
- clinical therapeutic discovery, delivery and assessment.

Through these programs, HST seeks to explore the fundamental principles underlying diseases, discover new pharmaceuticals and devices to ameliorate human suffering, and train the next generation of physicians, scientists, and engineers to do the same.

Because of its inter-disciplinary and inter-institutional nature, HST's administrative home at MIT is the Whitaker College of Health Sciences and Technology. The Division is headed by two Co-directors who report to J. David Litster, Professor of Physics, Vice President for Research, and Dean For Graduate Education, along with Dennis Kasper, William Ellery Channing Professor of Medicine and Executive Dean for Academic Programs at Harvard Medical School (HMS). Professor Martha L. Gray, Kieckhefer Professor of Electrical Engineering is the M.I.T. Co-director, while Dr. Joseph Bonventre Professor of Medicine, is the Harvard Co-director. Dr. Richard Mitchell, Assistant Professor of Pathology at Harvard Medical School, serves as Associate Director of HST and Director of Student Affairs for HST-M.D. students.

HIGHLIGHTS OF THE YEAR

The second group of recipients of the John F. and Virginia B. Taplin Awards was announced June 5th at commencement ceremonies for the Harvard-MIT Division of Health Sciences and Technology. The four recipients of the $50,000 awards are George Daley, M.D., Ph.D., HST '91, Frederick Schoen, M.D., Ph.D., Professor of Pathology, Deborah Burstein, Ph.D., HST '86 and Associate Professor of Radiology, and Steve Massaquoi, HST '83, incoming assistant professor of Electrical Engineering and Health Sciences/Technology. The Taplin Awards were established by Mr. John Taplin, an MIT '35 alumnus, and his wife Virginia to advance research, study, and training in HST. The fund recognizes and supports the work of HST faculty and students in building HST's infrastructure in the areas of biomedical engineering, physics, and chemistry.

M.I.T.'s Commencement speakers were President Bill Clinton and Dr. David Ho, a 1978 HST graduate who was also the 1996 TIME magazine Man of the Year. Joseph Martin, M.D. Ph.D., Dean of the Harvard Medical School, was the keynote speaker at the HST commencement ceremonies on June 3rd.

The eleventh annual HST research day, The HST Forum, was held on March 12, 1998. The topic of the 1998 forum was "Neuroengineering", and Dr. Dennis Choi, M.D. Ph.D. (HST '78) the Andrew and Gretchen P. Lones Professor and Head of Neurology at Washington University School of Medicine in St. Louis, was the featured speaker. Fifty-three HST students presented their research at the Forum.

On June 3rd, HST and the MIT international Science and Technology Initiative jointly sponsored a special seminar, "Healthcare, East and West" by Dr. Wu Jie Ping, China's best-known physician and Dr. Huang Jie Fu, Vice President of the Chinese Medical Association.

Mr. Thanassis Martinos and his family have established the $1 million dollar Athina Martinos Research Scholarship fund to enable HST students to perform research under the mentorship of faculty at Harvard, M.I.T., and the Harvard-affiliated teaching hospitals.

Funding from the Whitaker Foundation allowed HST to launch an industrial internship program in biomedical engineering.

HONORS AND AWARDS

Robert S. Langer, Sc. D., the Germeshausen Professor of Chemical and Biomedical Engineering at MIT and member of the HST faculty, was awarded the $500,000 Lemelson-MIT Prize, the world's largest cash prize for American invention and innovation. Professor Langer is a world leader in developing polymeric drug delivery systems.

Jeffrey Drazen, M.D., was honored at the HST commencement as the recipient of the 1998 Irving M. London Teaching award.

Joseph Bonventre, M.D., Ph.D., HST '76, HST co-director, has been elected President of the National Kidney Foundation of Massachusetts and Rhode Island.

PROGRAM HIGHLIGHTS

HST offers approximately 70 courses in the biomedical sciences and biomedical engineering, a number of which have been developed jointly with other MIT departments. More than 150 faculty members at MIT and at Harvard Medical School contribute significantly to the academic programs of HST. The Division has a "core" faculty numbering ten individuals (including the directors).

A total of 302 graduate students was registered in HST degree programs during the academic year. There were 189 M.D. candidates of whom 88 were simultaneously pursuing Ph.D. degrees. HST doctoral programs registered 112 students: 67 in the Medical Engineering and Medical Physics (MEMP) track, 40 in the Speech and Hearing Sciences (SHS) track, 4 in the Medical Informatics M.S. program, and 4 in the Radiological Sciences Joint Program which is sponsored jointly by HST and the Nuclear Engineering Department.

The M.D. degree was awarded by Harvard Medical School to 29 HST students this year, of whom 6 received honors in a special field and 17 received the combined M.D.-Ph.D. degree. Nine students received MEMP doctoral degrees from MIT, and 1 student received a doctoral degree from the Radiological Sciences Joint Program. The inaugural degrees for several new graduate programs in HST were awarded this year: One student received a Master of Science degree in Medical Informatics; 3 students received the Ph.D. degree in the Speech and Hearing Sciences program, and 1 student received a Ph.D. from the Biological Physics/Biological Engineering program.

Eric Liao '99 and Maureen Su '00 presented platform lectures at the 58th annual Soma Weiss Research Day at Harvard Medical School. An additional 26 HST students presented research posters.

A new educational track in the Medical Engineering and Medical Physics program was launched. This new Ph.D. track in Cellular and Molecular Medicine enhances the training of engineers and physicists by emphasizing recent advances in molecular biology.

RESEARCH ACHIEVEMENTS

An objective of HST from its inception has been to foster development of interdisciplinary, inter-institutional collaborative research between the faculties of MIT and Harvard. The research of the HST core faculty and research staff covers a wide spectrum of biomedical areas including: auditory physiology (including therapeutics); pathophysiology, epidemiology, and therapy of atherosclerosis (including diagnostic instrumentation); biological response of tissue such as cartilage to mechanical, chemical and electrical factors; regulation of gene expression; gene therapy; virus replication and assembly; hyperthermia for cancer therapy; biomedical instrumentation; tissue engineering; systems physiology and modeling; physiological signal processing; vascular biology and pathophysiology; and fundamental pathophysiology of bone. Their research links include a number of Harvard Medical School teaching hospitals (MGH, BWH, BIH, NEDH) and the Harvard Medical School quadrangle.

BIOMEDICAL ENGINEERING/BIOLOGICAL PHYSICS

Elazer R. Edelman, M.D., Ph.D., HST '83, uses elements of continuum mechanics, digital signal processing, and polymeric controlled release technology to examine the cellular and molecular mechanisms that transform stable coronary-artery disease to unstable coronary syndromes. Tissue-engineered cells, for example, deliver growth factors and growth inhibitors for the study and potential treatment of accelerated arterial disease following angioplasty and bypass surgery. Edelman is motivated by a tough clinical problem: more than half of blocked blood vessels that are cleared by a procedure called balloon angioplasty become blocked again. His discoveries have lead to patents for endovascular stents, drug-delivery devices, tissue-engineered implants and new drug formulations.

Frederick J. Schoen, M.D., Ph.D., has made major investigative contributions in identifying, elucidating the mechanisms of, and solving the critical problems associated with the biomaterials and devices used clinically to replace diseased heart valves. His approaches have used basic biology, evaluations of clinical implants that have failed, and industrial developmental studies.

Richard J. Cohen, M.D., Ph.D., HST '76, is studying the electrical and mechanical regulation and stability of the cardiovascular system. Dr. Cohen's laboratory has developed a noninvasive means of identifying individuals at risk for dying of sudden cardiac death – which accounts for 400,000 deaths in adults each year in the US. For those at risk, there is an effective preventive therapy – an implantable cardioverter/defibrillator. Cohen's group at MIT analyzes tiny, microvolt level fluctuations in the electrocardiogram to identify individuals at risk. However, the pattern is so subtle that it can be detected only with sophisticated computer-based analysis. The technology developed in Dr. Cohen's laboratory has been licensed by Cambridge Heart, a company founded by Dr. Cohen, that is commercializing this technology for routine clinical use.

Robert S. Lees, M.D., and his colleagues, have recently been awarded a key patent for imaging the arterial tree with radiolabelled oligopeptides (short polymers of amino acids which resemble a small portion of a protein). This work was the first to show that short peptides could have the defined structure required to function in a way similar to the proteins after which they were fashioned to serve as diagnostic agents. The techniques developed in Dr. Lees's laboratory have been successfully incorporated into multiple diagnostic pharmaceuticals which are in clinical trial for imaging not only cardiovascular disease but also cancer and infection.

Roger G. Mark, M.D., Ph.D., is devising intelligent patient monitoring systems. He also analyzes cardiac arrhythmias, or the rhythmic disturbances in the heartbeat often associated with heart ailments such as coronary heart disease. Other studies include physiological signal processing, cardiovascular system modeling, geographically distributed health-care systems, and elder care.

Michael S. Feld, Ph.D. heads the MIT Laser Biomedical Research Center, an NIH Biotechnology Resource Center housed in the MIT Spectroscopy Laboratory, which develops basic scientific understanding, new techniques and technology for advanced biomedical applications of lasers. In one area of interest, he and his colleagues have developed spectroscopic techniques for biochemical analysis of tissues and blood, and early diagnosis of cancer, atherosclerosis and other diseases. The techniques are implemented clinically by introducing a fiber-optic probe or catheter into the body, delivering excitation light, collecting spectroscopic signals remotely, and analyzing the data outside the body as the test is being done. One new and exciting result is HST Ph.D. student Vadim Backman's development of a light-scattering technique for measuring the size distribution of enlarged epithelial cell nuclei, an

indication of pre-cancer (dysplasia) which is not visible to the eye. The first application studied a condition known as Barrett's esophagus, which is very difficult to diagnose.

George B. Benedek, Ph.D., and colleagues have found the molecular factors that produce lens opacification in cataracts. They have developed instrumentation for the early detection of cataract formation and are developing agents designed to inhibit cataract formation. Also, he and colleagues at MIT and Harvard Medical School have developed methods to assay and control the growth of fibrils of the protein beta amyloid. Plaques made up of these fibrils are believed responsible for neuronal damage in the brains of patients suffering from Alzheimers's disease.

Kenneth N. Stevens, Sc.D., has made several contributions in the area of speech and speech perception, integrating the thinking from linguistics, acoustics, and signal processing. The research in the laboratory of Dr. Stevens includes the development of models of the segmental and prosodic aspects of human speech production and models for the accessing of words from continuous speech. Dr. Stevens and his students have also been examining the acoustic and articulatory manifestations of certain neuromotor and laryngeal speech disorders, with the goal of developing quantitative approaches to the assessment and understanding of these disorders.

Dennis M. Freeman, Ph.D., focuses on hearing – the process of receiving and translating the sounds of speech, etc. Via a bundle of microscopic hairs, sensory cells in the inner ear sense sound-induced motions of inner-ear structures and trigger neural messages that relay information about sound to the brain. Dr. Freeman and colleagues have devised video methods to measure the submicrometer motion of these sensory cells, which show for the first time how the microscopic hairs move in relation to other inner-ear structures. The studies should lead to a better understanding of our incredibly sensitive sense of hearing.

James C. Weaver, Ph.D., and colleagues at MIT are investigating electrochemical methods for creating enlarged pathways across skin, with the goal of providing rapid, controlled transdermal drug delivery of large molecules such as peptides, proteins and DNA.

Dr. Stephen Burns has a long-term interest in the fate of medical instruments in the developing world. Specific issues include maintenance and repair and mechanisms for providing local technical expertise. In collaboration with the American Medical Resources Foundation, we have proposed a Center in the University of Hanoi to repair and up-grade medical instruments using modern computer technology. This involves understanding the instrumentation problem and replacing its original electronic control and display function with something ranging from a single-chip microcomputer to a locally procured personal computer. Mr. Neil Ghiso, HST-98, has upgraded a BEAR-3 respirator with a single-chip processor and traveled to Hanoi to design and initiate a study of current medical technology in Viet Nam. The respirator is an important technology, widely used, and dominated by air-handling hardware. The addition of a personal computer allows much more complex data-dependent control as well as providing quantitative measurement and data storage and retrieval; in summary--an upgraded instrument.

H. Frederick Bowman, Senior Academic Administrator in HST and Director of the MIT Hyperthermia Program, reported the development of a needle embedded with microchips that can measure a variety of parameters, including temperature and oxygen levels, using a single device. The needle is 30% smaller in diameter than current probes and can be used for characterizing both normal and tumor tissues.

Lisa Freed, Principal Research Scientist in HST and Gordana Vunjak-Novakovic, Principal Research Scientist in HST and Adjunct Professor of Chemical Engineering at Tufts University are studying tissue formation using isolated cells, 3-dimensional polymer scaffolds, and bioreactor vessels. Ongoing research includes in vitro cultivation of skeletal and cardiovascular tissues, a recently competed 4 month microgravity experiment aboard the Mir Space Station, and the development and scientific testing of the cell culture facility for the International Space Station. These studies have significance for designing tissue engineering bioreactors and the production of functional tissue equivalents for clinical use.

Chi-Sang Poon, Ph.D., has developed a patented one of the world's smallest mechanical respirator for use with newborn mice that are genetically engineered for various research purposes. He has also developed and patented a novel computational technique that allowed investigators to discern the presence of significant chaotic dynamics in the normal heart beat and a decrease of such cardiac chaos in patients with congestive heart failure. Another major

invention is a new artificial neural network architecture that can be trained must faster than ordinary neural networks and is amenable to implementation with analog very-large-scale-integrated circuits. In basic research, he found the first evidence of synaptic plasticity (the kernel of certain cognitive functions such as learning and memory) in the region of the mammalian brainstem which is important for the control of respiration and circulation - vital physiological functions that are generally thought to be non-cognitive.

IMAGING SCIENCES AND TECHNOLOGY

Medical and biological imaging have grown explosively during the century since Roentgen's discovery of x-rays. The contribution of imaging technology to medical science promises to be even greater in the next century as imaging expands to demonstrate function as well as anatomy. The advance of structural and functional imaging includes imaging technology for disease, brain function, auditory and speech process, gene expression, and cardiac imaging. Revolutionary research has propelled imaging technology for active treatment planning and monitoring. HST is launching the Harvard/MIT Imaging Center to house new faculty and their imaging and image processing teaching and research facilities, and to create a critical link devoted to developing imaging technology.

Martha L. Gray, Ph.D. HST '86, co-director of HST, and collaborator Deborah Burstein, Ph.D., HST '86 use magnetic resonance for measuring composition and functional integrity of cartilage. Over the last century, clinicians and researchers have had to struggle to understand and treat diseases they couldn't "see" until significant cartilage destruction had occurred. This situation has the potential to improve dramatically with the method that Gray and Burstein have pioneered.

W. Eric L. Grimson, Ph.D., has conducted research in computer vision for more than 20 years. He is internationally known for his seminal work in stereo vision, object recognition, formal models of visual processes, image indexing and visual surveillance. His current research interests include applications of computer vision to medical image analysis, especially the topics of image guided surgery, construction of anatomical and functional models of tissue from medical imagery, and surgical simulators. Grimson and colleagues are developing three-dimensional visualization and navigation tools that allow a surgeon to see hidden internal structures (such as vessels, tumors, eloquent cortex), thus minimizing damage to surrounding structures during surgery. A system based on these tools is currently being used at Brigham and Women's Hospital in Boston.

Bruce Rosen, Ph.D., HST '84, Director of the NMR Imaging Center at Mass. General Hospital. He is well known for his contributions in the area of "functional" imaging – that is, magnetic resonance images of the brain in which areas having some functional activity (e.g., visual cortex) are highlighted by receiving increased blood flow. The techniques Rosen and colleagues have developed are now being used by hospitals throughout the world in evaluating patients with acute stroke, and by neurosurgeons to non-invasively provide a "road map" of the functioning brain prior to surgery. Functional imaging tools are also being used by cognitive scientists and psychiatrists to study normal brain functions such as language and memory, and a host of mental illnesses including Alzheimer's disease, schizophrenia, and drug abuse.

Robert S. Lees, M.D., focuses on atherosclerosis, its causes, prevention, diagnosis and treatment. His broad range of contributions include the design and implementation of an ultrasound system for accurate noninvasive assessment of progression and regression of atherosclerosis, and the discovery of key oligopeptides (short polymers of amino acids which resemble a small portion of a protein) that functioned in a manner analogous to the full length protein and so, when radiolabeled, served as a diagnostic probe visualized by a special imaging procedure. These patented techniques developed in Dr. Lees's laboratory have been successfully incorporated into multiple diagnostic drugs which are in clinical trial for imaging not only cardiovascular disease but also cancer and infection.

James G. Fujimoto Ph.D., research group investigate laser diagnostic and therapeutic applications in medicine. A central theme of their research is the development and application of optical coherence tomography (OCT). OCT is a new medical imaging technology which can perform high-resolution, cross-sectional imaging of tissue microstructure in situ. This technology can function as a type of optical biopsy and has widespread applications ranging from the diagnosis of early neoplasia to guiding surgical intervention. The group performs vertically integrated research spanning physics, lasers and optics, biomedical studies in vitro and in vivo, and clinical studies. The group maintains collaborations with investigators at the Massachusetts General Hospital, the

Harvard Medical School, the New England Eye Center, several Boston Area teaching hospitals as well as international collaborations.

EXPERIMENTAL DIAGNOSTICS/THERAPEUTICS

One of the most visible and obvious arenas in which the bench-to-bedside transfer is a two-way bridge is with regard to therapeutics. Drugs and therapies not only may treat disease by serving as probes, they can provide important insights into disease mechanisms and offer diagnostic opportunities. Most faculty in HST are involved at some point in clinical human studies. The support of a clinical research center at MIT and the teaching hospitals, and the recently launched Clinical Investigator Training program have significantly enhanced the infrastructure, further enabling translational efforts.

It's well recognized now that melatonin, the hormone secreted by the pineal gland, has the important role of telling us when to fall asleep, and helping us to remain asleep. This recognition, as well as the knowledge that giving people low doses of melatonin can be used to treat insomnia, have their origins in research done during the past two decades by Richard Wurtman, M.D. and his associates. Wurtman showed that melatonin is a true hormone, that it is normally produced at night, and that the reason for this daily rhythm is that environmental light, acting via the eyes, inhibits melatonin synthesis. Wurtman's studies in HST's MIT Clinical Research Center showed humans, like animal subjects, also produce the hormone at night, but not during the day. Moreover, in humans, night-time melatonin production was found to decrease markedly with age.

John A. Parrish, M.D., developed a novel treatment of psoriasis (oral psoralen photochemotherapy, or PUVA) which is now used worldwide. His research group at MGH introduced laser lithotripsy of kidney stones, selective laser therapy of vascular birthmarks and lesions, and novel laser-based diagnosis and treatments of selective cardiovascular disorders and malignancies. Dr. Parrish organized the first, and now the world's largest, multi-disciplinary research group to systematically study the basic nature of laser effects on tissue, the Wellman Laboratories of Photomedicine at MGH of which he is Director. Dr. Parrish is also Director of the MGH-Harvard Cutaneous Biology Research Center (CBRC), a research center committed to fundamental research in cutaneous biology as broadly defined. Dr. Parrish is also Director of Partners-MIT-Draper Center for Innovative Minimally Invasive Therapy (CIMIT), a multidisciplinary research and clinical effort to introduce new therapeutic and diagnostic procedures to improve health care.

Robert H. Rubin, M.D., has spent much of his clinical career studying and caring for transplant patients. Among his accomplishments are the development of new strategies for preventing the most important infections, particularly those due to viruses and fungi; the establishment of the link between certain viral infections and allograft injury and the development of certain malignancies; and the development of novel antimicrobial approaches that are effective not only in transplant patients, but also in such other immunocompromised patient populations as those with AIDS and cancer. As director of the HST Center for Experimental Pharmacology and Therapeutics, Dr. Rubin has pioneered in the application of positron emission tomography, magnetic resonance imaging and spectroscopy and other measurement technologies to the development of new drugs, including those designed for the transplant patient. With Alan C. Moses, M.D., Dr. Rubin heads a two-year Clinical Investigator Training Program, a joint effort of the Beth Israel Deaconess Hospital, HST, and Pfizer, Inc. Trainees gain direct experience in clinical investigation and a strong foundation in the statistical and computational sciences, biomedical ethics, principles of clinical pharmacology, in vitro and in vivo measurement techniques, and aspects of the drug development process.

Daniel Shannon, M.D., is a founder of the field of pediatric intensive care and pulmonology. For more than two decades, Dr. Shannon has been furthering his breakthrough studies into the rare condition of congenital central hypoventilation syndrome (CCHS). Shannon and his colleagues have added incrementally to their framework of knowledge about the problem, using whatever new tool they could find to test specific hypotheses. Still, the clinical problems – like a child's failure to breathe adequately when asleep – continue to stump clinicians and researchers alike. Shannon's latest research reflects his concern to use technology in the service of patients.

Robert S. Langer, Jr. Sc.D., a pioneer in biomedical and chemical engineering, is studying new ways to deliver drugs, including a skin patch/ultrasound treatment that allows large-molecule biotechnology drugs such as gamma-interferon (an immune system booster for cancer patients) and (erythropoetin (for severe anemia) to be absorbed

easily into the body through the skin. Langer is also researching tissue engineering. He has developed biomaterials for medicine, including plastic that slowly dissolves and releases therapeutic drugs directly to tumors. In 1996, this led to the first new treatment for brain cancer approved by the FDA in more than 20 years.

Robert Kit Lee, Ph.D., conducts research aimed at finding treatments for neurologic diseases, particularly for Alzheimer disease. Specifically, he is investigating the use of neurotransmitter-type drugs (e.g, beta-blockers, Prozac-type drugs) to prevent neurodegeration and the formation of amyloid plaques in Alzheimer's disease. Recently, he briefed the Prime Minister and cabinet ministers of Malaysia on the development of a biotechnology/pharmaceutical center to discover new drugs from indigenous plants found in the Malaysian tropical forests.

MEDICAL SCIENCES AND MOLECULAR MEDICINE

Lee Gehrke, Ph.D., studies the replication and assembly of viruses that use RNA as their genetic material. Key biochemical processes that allow viruses to replicate depend on docking interactions between RNA and protein molecules. Gehrke's laboratory is focused on identifying these docking signals, an effort that will facilitate therapeutic approaches for blocking virus replication and assembly. The research has led to the molecular identification of amino acids and nucleotide sequences that are crucial for forming the RNA-protein interactions; moreover, the work also suggests the shape or conformation of the molecules changes upon binding. Another aspect of Gehrke's work is understanding how viruses are able to gain an advantage over the infected host cell in expressing their own genetic information. Nucleotide signals in a viral messenger RNA have been identified that give the virus a competitive advantage, and the lab is now working to elucidate the detailed mechanism.

Irving M. London, M.D., Founding Director of Health Sciences and Technology and Professor of Biology, Emeritus, is studying the regulation of hemoglobin synthesis at both transcriptional and translational levels. His laboratory has discovered and characterized the main enhancer elements that control the transcription of the human ß-globin. In collaboration with Dr. Philippe Leboulch, he is also focusing on novel gene transfer strategies for the gene therapy of human diseases.

George Daley, M.D., Ph.D., HST '91, a Whitehead Fellow, is looking into how the bcr/abl gene product stimulates blood cell growth, and has begun work toward a possible new therapy for leukemia. He has made great progress in the search for genes involved in other blood cell disorders.

Richard Mitchell, M.D., Ph.D., researches the mechanisms underlying acute and chronic rejection in solid organ allografts, and more specifically in heart transplants. The work spans from mouse heart transplant models up to human hearts, and is focused on understanding the specific immunologic mediators that drive the rejection and failure of these allografts. His lab is particularly interested in the mechanisms that induce the process of "chronic vascular rejection" whereby the vessels in transplanted hearts become progressively more occluded until the grafts get starved for blood and die. The research may have much broader applicability, since the inflammatory mediators that drive the occlusive process in transplanted hearts may also be involved in mediating the vascular wall thickening that characterizes more "typical" atherosclerosis. Mitchell's lab uses a number of genetically-engineered mice (so-called "knock-out" mice) that are either deficient in particular mediators (called "cytokines") or deficient in the receptors for those cytokines. In collaboration with other members of the HST community (such as Dr. Elazer Edelman), Mitchell has been trying new interventions to prevent the chronic vascular pathology. They have also developed collaborations with a number of pharmaceutical firms (Schering-Plough and Bristol Myers-Squibb) to evaluate new drugs that may reduce the vascular narrowing.

Jane-Jane Chen, Ph.D., studies the regulation of hemoglobin synthesis by the heme-regulated eIF-2 alpha kinase (HRI) that is responsible for the translational regulation by heme of globin synthesis. Dr. Chen's group has demonstrated that HRI is a hemoprotein with two distinct types of heme binding sites. These data have significance for further understanding of the role of HRI in the production of hemoglobin, a vital oxygen carrying protein.

BIOINFORMATICS AND MEDICAL INFORMATICS

Knowledge discovery and its dissemination in health care have been deeply influenced by recent advances in computer science and engineering. Medical and Biological Informatics (MBI) is the use of computer technology to extract, transport, and manage information from medical and biological data, and to model and support human

decision-making in clinical and biological domains. The field is a scientific and engineering activity which is inherently multidisciplinary. Research challenges include: deducing and mapping genomic structure, predicting structure and function of proteins, representing medical knowledge for modeling diagnostic and prognostic decision-making processes, extracting new information from large clinical and biological datasets, building comprehensive electronic medical records (EMR) and clinical information systems, interfacing monitoring devices and the EMR, assuring privacy and confidentiality in medical transactions, analyzing and manipulating images, recognizing patterns of disease progression, analyzing costs and benefits related to medical use of information technology, computer-aided instruction, and utilizing the Internet for providing education and health care services.

Robert Greenes, M.D., Ph.D., Director of the Medical Informatics Training Program, established the Decision Systems Group (DSG) in 1978, to pursue methodologies for physician education and decision support. Dr. Greenes has had a 34-year history of work in the area of medical informatics. The DSG lab includes physicians, computer scientists, database experts, graphics and multimedia specialists, with primary focus on development of means for enhancing decision support and education in medicine, and for integrating these capabilities into clinical practice. For the past ten years, emphasis has been on the development of component-based approaches to implementing applications that provide a framework for integration of diverse information resources in a cohesive manner.

Peter Szolovits, Ph.D., and colleagues study the intellectual processes in medical decision making and build systems that help improve them. One example is Guardian Angel, a lifelong personal health-information system which, among other things, collects all health-relevant information about its subject, communicates with health-care providers, payers, etc., and helps the patient manage ongoing medical problems. He is also developing a World Wide Web-based electronic medical-record system that permits sharing of clinical information among health-care providers while assuring confidentiality of patient data. Another tool in development, Geninfer, computes the risk of genetic disorders based on analysis of an individual's pedigree and results of genetic tests. Geninfer is to be used by genetic counselors. Szolovits is also developing and testing a program that diagnoses and evaluates possible therapeutic interventions in heart disease.

Lucila Ohno-Machado, M.D., Ph.D., investigates machine learning techniques to extract information from clinical databases, especially in the form of predictive models for prognosis. She has used special methods to predict survival for patients with AIDS, to assess the probability of myocardial infarction in certain populations, to predict ambulation for patients with specific kinds of spinal cord injuries, and to predict outcomes in other clinical domains. Her research is focused on the development and evaluation of models involving binary outcomes. She is also interested in deploying practical models for direct use by patients, physicians, and health care managers, so that they can make more informed decisions. An example in this area is a project that uses artificial intelligence techniques for dealing with uncertainty to select suitable clinical trials for patients with certain types of breast cancer.

PERSONNEL

Elazer Edelman, M.D., Ph.D. was appointed Thomas D. and Virginia W. Cabot Associate Professor of Health Sciences and Technology at M.I.T., with tenure. Dr. Edelman is an expert in the area of cardiovascular biology. Martha Gray, Ph.D. HST co-director, was appointed J.W. Kieckhefer Professor of Electrical and Medical Engineering. Dr. Gray is an expert in cartilage physiology and imaging. Joseph Bonventre, M.D., Ph.D., was appointed HST co-director and Professor of Medicine. Dr. Bonventre's expertise is in renal physiology.

FUTURE PLANS

The Division is poised to move ahead with a strategic plan that was reviewed recently with the Whitaker College/HST Visiting Committee. The plan calls for future growth in our educational and research programs through emphasis on our five focus areas: biomedical engineering/biological physics; medical sciences and molecular medicine; imaging sciences and technology; bioinformatics and medical informatics; and experimental therapeutics, clinical therapeutic discovery, delivery and assessment. Guided by student interests, new and enhanced course offerings are under development in every focus area. Two examples of these initiatives include novel programs that emphasize biomaterials and neuroengineering. These activities complement the new MEMP Ph.D. track in Cellular and Molecular Medicine that was launched in the Spring of 1998. HST's medical imaging initiative, stimulated by funding from John and Virginia Taplin, is recruiting a new faculty member and is moving ahead with plans for a new Biomedical Imaging facility. These coupled, ongoing activities involve many of our students and faculty, and each offers the opportunity for participation by individuals from many departments in the

MIT and Harvard communities. Career development of existing faculty and hiring new faculty are critical areas that will continue to receive priority as we move ahead. New faculty appointments are essential for meeting our objectives in each focus area, as well as in creating a critical mass of faculty, meeting adequate student-faculty ratios in instruction, and emphasizing strong and stable links with other departments at MIT and HMS.

Martha L. Gray

CENTER FOR ENVIRONMENTAL INITIATIVES

The Center conducts research, curriculum development, outreach and public service on the emerging set of environmental and sustainability issues that impact development and welfare worldwide. The work of the Center is aimed at providing knowledge, demonstration and collaboration in the development of scientifically and economically sound strategies for industry and government to respond to global environmental challenges. It is aimed at forging new relationships between industry, governments, academia and the public to strengthen industry's role as an agent of change in the protection of the environment and sustainability . It is also aimed at developing better synergy between existing MIT efforts in these areas, encouraging new MIT initiatives that complement and broaden them and helping to translate them into MIT educational programs. It works to build better understanding of the many issues between and among developed and developing nations that arise in the context of meeting global environmental challenges (including questions of eco efficiency, equity, futurity and security). It will examine the role of science and technology in forming better environmental policy both from a technical and institutional point of view. It has a strong commitment to educating a set of emerging environmental and sustainability leaders worldwide via joint projects, distance education and special educational programs.

Professor David H. Marks of Civil and Environmental Engineering is Director, Professor Lawrence Bacow of DUSP is Associate Director, and Dr. Joanne Kauffman, Lecturer in Political Science, is Assistant Director. The MIT Council on the Environment serves as the Steering Committee for the Center. The Center was established in late 1997 and this is the first report to the President.

MAJOR ACCOMPLISHMENTS

Through the MIT Council on the Environment, a major reorganization of the booklet *Environmental Studies@MIT* was undertaken under Ms. Cordelia Foell of the Office of Corporate Development. It is available as a substantial booklet, or through the official World Wide Web page for the Center.

COMPONENT PROGRAMS

The Center for Environmental Initiatives, which was formed during the past year, has assimilated many of the programs and functions previously included in the Program for Environmental Engineering and Research (PEEER). As a part of this reorganization, the Program for Environmental Education and Research (PEER) has been reconstituted as the education and outreach arm of the Center for Environmental Initiatives. PEER is headed by three Co-directors: Jeffrey I. Steinfeld, Professor of Chemistry, John Ehrenfeld, Technology Business and Environment Program, Vicki Norberg-Bohm, Professor of Urban Studies and Planning. The objectives of PEER are to encourage multi-disciplinary educational initiatives, to strengthen existing efforts, to promote communication among faculty, students, and staff with interests in these topics, and to integrate the findings of leading-edge research into the education of every student at MIT -- not just the relatively small percentage who identify themselves as environmental professionals.

PEER's major emphasis is to infuse environmental thinking, analytic tools, and management approaches into existing subjects and curricula. PEER stimulates and supports interdisciplinary activities, especially in areas of newly evolving research such as industrial ecology and the influence of science and technology on environmental policy. PEER seeks to involve faculty and students from all of the schools at MIT in examining a wide range of technology related environmental problems. PEER offers support to faculty members interested in strengthening the environmental awareness and problem-solving capabilities of their students. PEER also encourages the development of new subjects to address emerging fields such as industrial ecology and sustainability.

In addition, PEER functions as a clearinghouse for information about environmental subjects and programs, fellowships, and events taking place throughout the Institute. PEER is also assisting with coordinating MIT's own environmental practices in areas such as chemical waste disposal, energy conservation, and recycling. In addition to its coordinating functions within the Institute, PEER helps to develop MIT's alliances with other universities funding sources, industrial and public interest groups, and regulatory agencies sharing responsibility for a sustainable future. An important part of this effort is the development of structures for dialogue between industry, regulators, and public interest groups. In order to improve problem definition, share research findings, and identify emerging issues of interest to MIT, PEER communicates with these sectors through meetings, invited speakers, and publications.

Each semester, PEER publishes a listing of subjects and seminars having significant environmental and sustainability content. These guides will be published before the start of each term (and Independent Activities Period) in order to promote awareness of the range of environmental studies available at MIT. PEER will also organize a display at the Fall 1998 R/O "Academic Expo" in order to introduce newly arrived students to these opportunities.

During the past year, PEER arranged meetings with the student environmental group SAVE and the newly appointed environmental coordinator in the MIT safety office. The purpose of these meetings was to develop student perspectives on how effectively environmental and sustainability topics are addressed in MIT's curriculum, engage undergraduates in research and educational activities in these areas, and provide a focus for MIT's own efforts to achieve eco-efficient operations and compliance with environmental regulations.

During this past year, the Knut and Alice Wallenberg Foundation agreed to establish a fellowship program in which selected postdoctoral students from Sweden would be supported for up to two years to work in research groups at MIT focusing on environmental and sustainability issues, such as building technology, life-cycle analysis, chemical ecology, climate change, and environmental negotiations. The first group of six fellows has been selected and will arrive at MIT during the coming year. An inaugural event for the program is being planned for the Fall. While the number of Fellows is small, the impact on MIT's research and education programs is expected to be substantial, because these individuals include some of the most outstanding young scientists, engineers, and planners in Sweden and their presence on campus will provide a strong focus for environmental problems of interest to Sweden and to Europe in general.

EDUCATIONAL AND CURRICULUM INITIATIVES

PEER is coordinating a curriculum development proposal to the National Science Foundation's Course, Curriculum, and Laboratory Improvement Program which is intended to support the development of new courses, curricula, and materials that will more effectively integrate the concepts of sustainability and environmental constraints into core subjects at MIT and elsewhere. The proposed program brings together an interdisciplinary, multi-institutional group including the new Division of Biological Engineering and Environmental Health within MIT's School of Engineering, the Advanced Technology for Environmental Education Center, which is an N.S.F.-funded consortium of community colleges based in the Eastern Iowa Community College district, and minority institutions through the MIT Summer Research Program and Second Nature.

The Martin Family Graduate Fellowship Program in Sustainability has been established to honor graduate students across the institute working in issues of environment and sustainability. The students are nominated by the faculty and participate in various environmental meetings as well as their own meetings for exchange of information and network building. A generous gift from the Martin Family Foundation through Lee '42 and Geraldine Martin' has led to the eventual full funding of ten of the Fellows. For 1998-99 four students will receive Martin funding.

Created in October 1997, the Consortium on Environmental Challenges Research to Focus on Environmental Decision-Making (CEC) recently completed its startup phase and is developing the agenda for its first full program year. Efforts are currently underway to form the Consortium Advisory Committee of sponsors and participants, including other university partners in the United States and abroad.

During the startup phase, the Consortium management team organized research modules, established the Strategic Faculty Workshop with faculty and research associate participants from across the Institute, and sponsored the Center for International Studies' research on the use of science in environmental decision-making. The Consortium is managed by faculty leaders Larry Bacow, David Marks, Mario Molina and Dr. Joanne Kauffman.

CEC was created to improve the environmental decision-making process through the better use of scientific, technical, and socio-economic understanding. In order to achieve this aim, the Consortium defined the following goals:

- Assess global environmental challenges and their impact on ecosystems, economic development and health.
- Identify and contribute to the knowledge needed to meet those challenges.

- Improve policy making through use of unbiased knowledge--scientific, technological and socio economic.

CEC scholars from across the Institute are assessing the state of knowledge needed to effectively meet global environmental challenges by focusing on specific issue areas.

Current linkages focus on energy choices for the future; chemicals and society; mobility, with an emphasis on options for congested mega-cities; water for a sustainable future, and global climate change. Working papers on the "state of the knowledge" and inventories and analyses of case studies on the use of science in environmental decision-making will identify constraints on the use of scientific and technical knowledge in environmental decision-making.

In addition to assessments of the state of knowledge in specific areas, the Center for International Studies is spearheading a Consortium project on the use of scientific and technical knowledge in environmental decision-making. Through this project, researchers are looking to understand how to increase the role scientific evidence and technological knowledge play in meeting the challenges posed by environmental risks to economic development and social welfare.

The MIT Consortium on Environmental Challenges was created in October 1997, when MIT and Ford Motor Company announced a collaboration focusing on education and research. As a component of this partnership, Ford has pledged $6 million over five years to initiate and support the Consortium.

Energy Venture Fund: Energy Choices

A generous gift of $1,350,000 over two years from the V. Kann Rasmussen Foundation has allowed MIT to launch broad research initiatives focusing on innovative energy solutions. These funds will be used in conjunction with funds raised from corporate and other sponsors to pursue important research in strategic areas of opportunity. To help focus the research agenda it will work through a new MIT collaborative research initiative, the MIT Energy Choices Program, run by Professor Jefferson Tester and Dr. Elisabeth Drake of the MIT Energy Laboratory. The Energy Choices Program's initial planning meeting in November 1997 was attended by 66 people, including 21 industrial experts from 15 major companies, two senior representatives from the U.S. Department of Energy, three representatives from foundations supporting environmental activities at MIT, the project director from the International Energy Agency's Greenhouse Gas R&D Program, an expert from Central Research Institute of Electric Power Industry (Japan), and a representative from the Global Environmental Facility (under the United Nations Development Program). The November workshop fostered partnerships among industry, academic, and policy-making colleagues to begin a focused collaborative research and outreach program. From this meeting, the Venture Fund and other sources has been used to launch three new projects: Energy-Efficient Buildings in Developing Countries; China Nuclear Power Reliability and Safety; and Future Transportation Fuels. The program's initial research agenda is aimed at building a credible, knowledge-based framework for assessing promising energy technology options. In the Energy-Efficient Buildings project, MIT faculty in the Department of Architecture, in conjunction with faculty in the Department of Thermal Engineering at Tsinghua University in Beijing, plan to identify the most promising technologies for a generic residential building in a developing country. Focusing on a single climatic zone and urban area within China, the researchers will develop several prototype designs of energy efficient systems and buildings. The emphasis of the work will be to develop simple generic solutions that are appropriate to the local area, are cost effective, and will be accepted by the local people.

The China Nuclear Power Reliability and Safety project addresses the evolution of safety guidelines for nuclear power plants based on lessons learned from countries with long experience in nuclear technology. It is interesting to note that safety standards are still evolving in many parts of the world, including the US.. MIT will work closely with Tsinghua University to develop a better understanding of appropriate ways to formulate safety standards and to ensure a high level of reliability in the plants.

The oil industry initiative, Future Transportation Fuels, has two objectives: The first is a comprehensive assessment of the role of technology in emission reduction in the future supply of transportation energy. This assessment would be used to advise ongoing international assessments, to provide a basis for the petroleum industry to make positive changes to address climate change concerns, and to inform the policy process. The second objective is development

of a research program to identify and assess the feasibility of "leap-frog" technologies for transportation that might improve the longer term response to emission reduction goals for oil refineries.

Alliance for Global Sustainability

AGS-supported research brings together scholars from the three founding partner universities (MIT, the Swiss Federal Institutes of Technology, and the University of Tokyo) to address complex environmental problems that transcend geographical and disciplinary boundaries. At the annual meeting of the Alliance for Global Sustainability International Advisory Board in Zurich in January, the AGS Governing Board awarded $1.8 million in funding for 14 new projects over the next two years. This new funding brings the current AGS environmental research commitment to $3.7 million for 29 projects. These projects fall within the five thematic areas, or pathways to sustainability, previously established by the AGS to provide a coherent framework for research and outreach:

global environmental change,
natural resource depletion,
future cities,
energy and mobility,
cleaner technologies and industrial processes,
and policy choices.

AGS project leaders have raised more than $18 million to supplement these projects and related sustainability research at the partner universities.

Cooperation with developing countries was the focus of the Alliance for Global Sustainability's annual meeting, January 21-24 in Zurich. MIT President Charles M. Vest led an MIT delegation of 47 faculty and visiting scholars and 31 students to this international meeting. In his opening remarks, President Vest noted that the AGS is still a young organization, but its growing influence and value are amply illustrated at this year's meeting by the participation of so many distinguished scholars and business leaders from around the globe."

In looking at building relationships with developing countries, the AGS focused on the rapidly developing "megacities" of the southern hemisphere. In his talk, Rajandra Pachauri, Director of the Tata Energy Research Institute, New Delhi, warned that the transfer of knowledge, not simply the formulation of models based on the North's ideals for the South, will be the key to successful interaction. Professor Akin L. Mabogunje, Executive Chairman of the Development Policy Centre, Ibadan, Nigeria opened discussions on Africa. "Institutional reforms are...critical if 'sustainability' is to become an aspect of urban development in these countries. The empowerment of urban authorities and all that this entails in institutional capacity-building are a critical prerequisite for promoting sustainable development of municipalities in developing countries." His comments on urbanization explained that over-centralization has bred alienation and indifference on the part of the majority of city residents to environmental conditions in cities.

Nearly 300 people attended the meeting, exceeding the previous year's attendance by over 100 people. Professor David H. Marks, MIT AGS Coordinator, noted that the enthusiastic response of the faculty and students at the three-partner universities is a clear indication of progress the group has made and the intellectual importance of the challenge of sustainability. The 1999 annual meeting will be hosted by the University of Tokyo.

MIT Forum on Chemicals and Society

Persistent public concerns about chemical risk in day-to-day living was the topic for the June 11-12 conference *Chemicals and Society: A New Look at Persistent Concerns* sponsored by the MIT Center for Environmental Initiatives.

Conference attendees explored questions about managing chemicals in a socially and environmentally acceptable way. Topics dealt with the trend toward a diminished role for science in decision-making, and moderators will pose questions about the appropriate role for science, government and advocacy groups. A diverse audience from the chemical industry, government, environmental advocacy groups, and academia has been invited.

In the United States and Europe, large sectors of the public are continuing to demand that the chemical risks present in day-to-day living be reduced, despite significant environmental improvements on the part of the chemical industry: reduction of toxic releases, improvement of regulatory compliance, and a new openness to community concerns. The forum looked at the relationship between scientifically-based risk assessment and the growing societal concerns regarding sustainability, quality of life, and corporate responsibility.

In addition to these programs, a new initiative in water and depletable resources is being organized.

More information about the Center for Environmental Initiatives can be found on the World Wide Web at the following URL: http://environment.mit.edu/.

More information about PEER can be found on the World Wide Web at the following URL: http://curricula.mit.edu/CEI/Education.peer.html

David H. Marks

CENTER FOR MATERIALS SCIENCE AND ENGINEERING

The Center for Materials Science and Engineering (CMSE), an interdepartmental center at MIT, is an innovative and dynamic program in interdisciplinary materials research and education. Funded since 1994, CMSE is the largest of a nation-wide network of twenty-four Materials Research Science and Engineering Centers (MRSEC) sponsored by the National Science Foundation (NSF).

MIT has an extraordinarily strong and broad effort in materials science and engineering involving approximately 110 faculty members in 11 departments in the schools of science and engineering. Much of the research addresses intermediate-term engineering problems, often with the participation and support of industry. However, the longer-range problems, especially those that require a multi-investigator approach, are often overlooked. In this environment CMSE has a special mission: to encourage research and education in the fundamental science of materials and in the engineering of materials for long range applications that will meet the needs of society. CMSE promotes collaboration among MIT faculty and between MIT researchers and the researchers of other universities, industry, and government and nonprofit laboratories.

Collaborative research is encouraged through several mechanisms: interdisciplinary research groups (IRGs), shared experimental facilities (SEFs) and outreach programs. The IRGs, described below, are composed of MIT faculty who, with their students and postdoctoral associates, wish to investigate fundamental scientific questions and pathways to reach significant technological goals that can only be properly explored in a collaborative, multidisciplinary mode. These problems are too large in scope to be addressed by individual faculty members and their students. Collaboration is essential for materials-related science and engineering, even for individual investigators, because such research requires very sophisticated equipment. CMSE provides a mechanism for the purchase and supervision of such equipment in its SEFs. The equipment is made available to the members of the IRGs, individual MIT investigators, and researchers from other university, industrial, government, and nonprofit laboratories.

CMSE also provides seed and initiative funds. While preference is given to young faculty, CMSE uses seed funds to support research that has the potential of redefining the direction of an existing IRG or leading to the creation of a completely new IRG. Seed funding provides CMSE with the flexibility necessary to initiate high-risk research.

RESEARCH

The past year has been a year of challenge and transition for CMSE. First, I became Director in April 1998 succeeding Professor Marc Kastner who went on to become the Head of the MIT Physics Department. Second, we have been involved in a highly competitive process to continue core funding for the next five years. An internal competition was held during the spring and summer of 1997. We received nine proposals for IRGs. The five best of which were chosen for inclusion in a renewal proposal. The proposal was submitted in January 1998, and we have received positive feedback from the mail reviews and from our NSF Panel Review Presentation in May. We are confident that this process elicited the best research groups and we are hopeful that we will receive the funding we have requested.

INTERDISCIPLINARY RESEARCH GROUPS

Microphotonic Materials and Structures

The purpose of this program is to explore the fundamental nature, synthesis, and properties of Photonic Band Gap (PBG) materials and to exploit these properties for the creation and control of electromagnetic radiation. These materials are a composite of a periodic array of macroscopic dielectric scatterers in a homogeneous dielectric matrix. A PBG material affects the properties of traveling electromagnetic waves in much the same way that a crystal of atoms affects the properties of electron waves. Consequently, photons in PBG materials can have band structures, gaps, localized defect modes, and surface modes. By allowing the trapping, localization, and channeling of light with very low loss, these new materials have the potential of completely revolutionizing the basic elements of photonic and optoelectronic integrated circuits. The bending radius of a conventional planar waveguide is limited to 1 cm by scattering losses; this geometry is incompatible with integrated photon distribution on a chip. A PBG material will allow a 10 μm radius bend, and provide a gateway to microphotonics. The research addresses a broad range of fundamental issues in novel synthesis pathways for inhomogeneous microstructures, new photonic characterized a one-dimensional PBG material consisting of a set of collinear air holes in Si.

Participating faculty and departmental affiliations: H. A. Haus, E. P. Ippen, L. A. Kolodziejski, and H. I. Smith (Electrical Engineering and Computer Science); L. C. Kimerling (Materials Science and Engineering); and J. D. Joannopoulos (Physics).

Molecular and Supermolecular Engineering of Polymeric Systems with Novel Electronic and Optical Properties

The objective of this group is to develop the chemistry and molecular-level processing needed to control and manipulate the molecular and supermolecular organizations of macromolecular systems with novel electrical and optical properties. The development and utilization of combined molecular/supermolecular engineering schemes will make it possible to design and fabricate complex, multiphase or multicomponent systems with controllable molecular architectures and well-defined morphological arrangements. Thus, it will be possible to create multi-component systems in which each component serves a well-defined function and is molecularly positioned to achieve a specific and tunable electrical, optical, or chemical response. The juxtaposition of different components, such as semiconductor nanocrystallites and conjugated polymers, may result in new and useful electronic and optical behavior. Applications of interest include highly anisotropic electrically conducting films, photonic devices, periodic dielectrics, and thin film electroluminescent and energy storage devices. This group has recently discovered a new way of making light-emitting polymer films and super-paramagnetic films that may be useful in security applications.

Participating faculty and departmental affiliations: R. E. Cohen (Chemical Engineering); M. Bawendi, R. R. Schrock, and R. J. Silbey (Chemistry); and A. Mayes, M. F. Rubner, and E. L. Thomas (Materials Science and Engineering).

Phase Behavior in the Presence of Quenched Randomness and Frustration

Cooperative behavior in the presence of frozen-in randomness, i.e. ordering in the presence of quenched disorder, permeates all of materials science. Whereas phase changes in perfect systems are well-understood, the disorder challenges our ability to understand even qualitative effects and to make precise predictions and measurements. Cooperative phenomena in the presence of quenched randomness may also underlie fundamental mechanisms of life sciences and have applications to information sciences in, for example, neural networks or coding-decoding processes. The chief focus of this group is the study of gels with random distributions of positive and negative charges.

Participating faculty and departmental affiliations: A. N. Berker, R. J. Birgeneau, M. Kardar, and T. Tanaka (Physics).

Structure, Chemistry, and Transport Properties of Intercrystalline Interfaces

The properties of polycrystalline materials are largely dominated by their surfaces and grain boundaries. For example, TiO_2 is the primary component in paint that makes it opaque, and the yellowing of paint in the presence of sunlight is an example of an interface effect that costs society great sums. However, these same photochemical reactions make TiO_2 useful for degradation of sewage. The goal of this IRG is to develop a unified and comprehensive understanding of the role of atomic level structure, chemistry, and local electronic structure in determining the physical properties of crystal interfaces. This group has recently demonstrated a correlation between the chemistry and electrical properties of interfaces in ZnO varistor material.

Participating faculty and departmental affiliations: G. Ceder, Y.-M. Chiang, H. L. Tuller, and J. B. Vander Sande (Materials Science and Engineering); and J. Ying (Chemical Engineering).

Transition Metal Oxides

The discovery of high-temperature superconductivity in copper oxides has renewed interest in the more general problem of transition metal oxides, where strong correlations between the electrons are known to play a key role. For example, the parent compound La_2CuO_4 is an antiferromagnetic insulator, contrary to the prediction of band theory, and becomes metallic and superconducting when doped. Many believe that the superconductivity is a new manifestation of the correlated behavior of the electrons in the two-dimensional copper oxide layers. It follows that the physics of strong correlations must be better understood before the superconductivity can be explained. The goal of this group is, therefore, to study the properties of transition metal oxides in order to guide the development of a theory of correlated systems and ultimately explain the mechanism of high-T_c superconductivity. The group's strategy for reaching its goal has three parts: detailed studies of the magnetic, electronic, and optical properties of single crystals, development of a theoretical framework for the analysis of the data, and a search for new compounds. The growth of large single crystals for neutron scattering experiments is a unique strength of this effort. Using these crystals the group recently discovered the spatial ordering of oxygen in doped La_2CuO_4.

Participating faculty and departmental affiliations: R. J. Birgeneau, M. A. Kastner, T. Imai, and P. A. Lee (Physics).

INITIATIVES

The focus of the research on Microstructure and Mechanical Performance of Polymeric Materials is on identifying the mechanistic connections between structure, morphology, and macroscopic properties of polymers. The project aims at establishing the fundamental connections between polymer microstructure and mechanical performance, and the design of new forms of heterogeneous polymer systems. This group has made a breakthrough in the toughening of polyethylene.
Participating faculty and departmental affiliations: A. S. Argon, M. C. Boyce, and D. M. Parks (Mechanical Engineering); G. C. Rutledge and R. E. Cohen (Chemical Engineering).

This initiative on Electronic Transport in Mesoscopic Systems exploits new capabilities for processing of mesoscopic systems, including self-assembled arrays of semiconductor quantum dots and the fabrication of mesoscopic structures in Ge/Si. The group will study electronic transport in these systems to better understand the fundamental physics of these systems. In addition, the effects of GHz to THz radiation on the conductance of mesoscopic structures will be studied with an eye to possible applications.

Participating faculty and departmental affiliations: R. Ashoori, M. A. Kastner, P. Lee, L. Levitov, X.-G. Wen (Physics); M. G. Bawendi (Chemistry); E. A. Fitzgerald (Materials Science and Engineering); and Q. Hu (Electrical Engineering and Computer Science).

SEED PROJECTS

During the past year CMSE has supported the following seed projects:

- Multiscale materials modeling from the electronic structure-atomistic levels T.A. Arias (Physics) and S. Yip (Nuclear Engineering)
- Investigations of spin diffusion and local ordering by high resolution scattering D. G. Cory (Nuclear Engineering)
- Investigation into nonwetting phase entrapment during fluid transport in porous media P. J. Culligan-Hensley (Civil and Environmental Engineering)
- Design and synthesis of thermoplastic elastomers with side chain liquid crystalline soft segments p. t. hammond (Chemical Engineering)
- Polymer gel actuators and sensors s. b. leeb (Electrical Engineering and Computer Science)
- Gels for molecular recognition, accumulation, and release s. masamune (Chemistry)
- Conductive ladder polymers: pre-assembly in the synthesis of complex supramolecular materials T. M. Swager (Chemistry)

COLLABORATION WITH INDUSTRY AND OTHER SECTORS

CMSE collaborates with other laboratories and centers at MIT that carry out materials-related research and engineering with direct involvement of industry and other sectors, and CMSE facilities are modified in coordination with these organizations to assure that the overall spectrum of facilities offered by MIT is as broad as possible without unnecessary redundancy.

The SEFs are a critical feature of CMSE's collaborations with non-MIT personnel. The facilities are made available to any researcher from a nonprofit institution and to industrial researchers when equivalent facilities are not available commercially. During the past year, CMSE facilities have been utilized by 21 commercial organizations and 15 outside academic institutions. The current CMSE/IBM X-ray participating research team (PRT) at the National Synchrotron Light Source (NSLS) at Brookhaven, the CMSE/IBM/McGill PRT under construction at the Argonne Advanced Photon Source (APS), and the Brookhaven/CMSE/AT&T/Exxon neutron scattering PRT at the Brookhaven High Flux Beam Reactor are very special facilities constructed and operated with direct industrial and government laboratory collaboration. These PRTs and the neutron diffraction PRT at the National Institute of Standards and Technology (NIST) provide time for use of facilities to users from all sectors. A new grant from the DoE has made possible the purchase of magnets to carry out neutron and X-ray measurements at fields that had been previously inaccessible. Finally, several of the IRGs participate in direct research collaboration with industry and other sectors. This is important for exchange of knowledge and the education of graduate students, for it provides them with direct experience of industrial research.

EDUCATION, HUMAN RESOURCES, AND OUTREACH

CMSE's programs contribute to the education of both undergraduate and graduate students in a variety of ways. The CMSE colloquium series has provided an opportunity for graduate students from many departments to learn about the broad range of research activities at MIT. A joint program with the Materials Processing Center (MPC) brings students from all across the nation to MIT in the summer to become involved in materials research. The SEFs are also important in undergraduate education. Courses, such as those in X-ray scattering and electron microscopy, teach the students to use processing and characterization facilities and to carry out research projects using the equipment. A course entitled Materials Synthesis and Processing, taught by the Department of Materials Science and Engineering and initiated with partial NSF support, uses the SEFs extensively. In addition, short courses are taught using the facilities during the Independent Activities Period. At the graduate level, CMSE plays a critical role in the education of almost all the students at MIT who do materials-related research. In addition to those involved in the IRGs, the shared facilities are used by graduate students from 11 academic departments.

AFFIRMATIVE ACTION

CMSE is committed to providing opportunities to women and minorities through hiring and educational and research programs. During the past year, two female support staff members were promoted to sponsored research staff.

Of the fourteen students participating in the CMSE Undergraduate Research Opportunities Program, funded by the National Science Foundation as part of the MRSEC Program, seven were women and seven were men. For the fifth summer, CMSE is collaborating with the MPC in sponsoring a joint ten-week summer internship program. Ten interns were selected from applications submitted by over 200 undergraduates from both MIT and other universities around the country. Three of these scholars are women. The interns include Daniel Aubertine (Case Western Reserve University), Eric Cochran (Iowa State University), Brian D'Andrade (Pennsylvania State University), Jessica Hurt (Haverford College), Wendy McCullough (Pennsylvania State University), Jill Nolde (Purdue University), Isaac Rutenberg (Colorado School of Mines), Kuangshin Tai (University of California at Berkeley), Jason Vogel (University of Texas at Austin), and Brian Yen (University of North Carolina at Chapel Hill).

As part of its outreach program, CMSE participates in the cooperative employment in its shared experimental facilities of students from Northeastern University and Wentworth Institute. Four students were employed this year. One is a woman and three are men. One of the students is African-American. Suzanne Nicol, Patrick Boisvert, Kenneth Suprin, and Scott Lundin have worked as co-op students in two of the Center's SEFs over the course of the past year.

The Center continued its very successful science and engineering summer day camp for seventh- and eighth-grade students who are members of underrepresented minority groups. During the summer of 1997, the program doubled in size to include students from two Cambridge public schools. The students included eleven African-Americans, six Hispanic-Americans, and one Native American, of which eleven were male and seven were female. The students were supervised by volunteer faculty and staff, as well as MIT undergraduates Savita Dandapani, Mon-Fen Hong, Amro Farid, Melissa Kanemasu, Neil Jenkins, Ayr Muir-Harmony, John Reese, and Katherine Shih.
We continued the CMSE graduate minority research assistant (RA) program to fill the need for support for minority students in their last two years of graduate study. During the 1997-98 academic year, the Center provided RA support to an Hispanic male in the Department of Chemistry. In addition, seed funding was granted to one female faculty member working in the field of materials science and engineering who is a member of an under-represented minority group.

More information about the Center for Materials Science and Engineering can be found on the World Wide Web at the following URL: http://web.mit.edu/cmse/www/.

Robert J. Silbey

ENERGY LABORATORY

The Energy Laboratory and its associated Center for Energy and Environmental Policy Research (CEEPR) are multi-disciplinary organizations bringing together sectors of the MIT community with research interests related to energy supply, conversion, and utilization technology, as well as associated environmental, political, economic, geographical, and societal impacts. Professor Jefferson Tester is the Director of the Energy Laboratory and is supported by Associate Director Dr. Elisabeth Drake, Associate Director Dr. William Peters, and Administrative Officer John O'Brien. The CEEPR is directed by Professor Richard Schmalensee, with Dr. A. Denny Ellerman, Executive Director, and Joan E. Bubluski, Administrative Assistant.

For more than 20 years, the Energy Laboratory has sustained a unique organizational structure to develop and implement strong single- and multi-disciplinary energy-related work at MIT. It provides a variety of research opportunities for students at all levels - from the Undergraduate Research Opportunities Program to postdoctoral studies. Our research programs in FY98 involved about 40 undergraduates and 105 graduate students, along with about 100 associated faculty members from twelve Academic Departments representing all five of MIT's Schools.

HIGHLIGHTS

- A new graduate elective, *Sustainable Energy* (22.811J/10.391J/TPP66), was offered for the second time in the Spring term. The course was taught collaboratively by members of the Energy Laboratory and the Nuclear Engineering Department, with participation of other experts from within and without MIT. In addition to about ten listeners, eighteen students from MIT and Harvard completed the course which included topical papers and oral reports. The level of student participation, the richness of international viewpoints, and the interactive learning, have provided a springboard for future improvements in an exciting course on an important global topic. We are preparing a new textbook for the course which will be tested in draft next Spring.
- The Energy Laboratory research volume for FY98 was $11.4 million. The University Research Consortium (URC - on behalf of the Lockheed Martin Idaho Technologies Company) accounted for $2.6 million of the volume, with 14 research projects being supported at 10 different universities. URC management and the 5 URC research projects at MIT amounted to $1.1 million.
- In the fall of 1997, the CEEPR published a special report on *Emissions Trading under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance*. This report summarized, in non-technical language, the results of two years of research concerning this innovative approach to environmental regulation by Professors Schmalensee and Paul Joskow and Dr. Ellerman. This report is the first thorough, empirical analysis of the U.S. experience with SO_2 emissions trading, and it will likely stand as the definitive study of this public policy experiment. It also formed the basis for the cost assessment contained in the Quadrennial Report of the National Acid Precipitation Assessment Program to the U.S. Congress on the implementation of Title IV of the 1990 Clean Air Act Amendments. The authors have recently signed a book contract for the publication of the entire corpus of research underlying the Special Report, which consists of about a dozen working papers and articles.
- We are continuing as a world leader in our work relating to technologies for carbon dioxide mitigation through carbon sequestration. In January 1997, we completed a widely-read white paper on *CO_2 Capture, Reuse, and Storage Technologies for Mitigating Global Climate Change*. In June 1998, we organized and hosted a two day *Stakeholders' Workshop on Carbon Sequestration.*

SELECTED CURRENT ACTIVITIES

Many of the Laboratory's projects involve quantitative and cross-disciplinary study of complex energy and environmental systems. The *Sloan Automotive Laboratory*, directed by Professor John Heywood and managed by Dr. Victor Wong, continues promising research to improve fuel economy and utilization within the engine and reduce adverse emissions. Focusing on new engine and fuel technologies, the Engine and Fuels Research Consortium continues to explore critical fuel-air mixture preparation and emission formation mechanisms in developing engine concepts, with potential application to both gasoline and diesel direct-injection engines. Complementing the engine and fuels studies, the Consortium on Lubrication in Internal Combustion Engines, involves major engine component and lubricant manufacturers, in addressing issues in oil consumption and engine friction reduction. Some members in these consortia also sponsor separate research projects on related topics of specific application to the individual sponsors. The Sloan Laboratory also engages actively in basic combustion

research in advanced engine systems with US DOE support, and in engine emission research with support from the EPA Research Center on Airborne Organics.

The Energy Laboratory interacts closely with the *Center for Environmental Initiatives* (CEI - directed by Professor David Marks) through several major sustainable energy initiatives described later in this section. Administrative duties are also provided to the CEI by the Energy Laboratory staff. Other interactions include the *Building Technology* program (led by Professor Leon Glicksman) in research on energy efficient, "healthy" buildings. Another collaboration with the *Center for Environmental Health Sciences* (CEHS - directed by Professor William Thilly) seeks to determine how combustion emissions and effluents from treatment of hazardous wastes may lead to adverse human health impacts. The Energy Laboratory is an active member of the *Program for Environmental Education and Research* (PEER) under the leadership of Professors Vicki Norberg-Bohm and Jeffrey Steinfeld.

Under the leadership of Dr. Drake, the Energy Laboratory launched a new initiative, *Energy Choices in a Greenhouse Gas (GHG) Constrained World,* with a planning workshop held at Endicott House in November 1997. This initiative is an outgrowth of collaboration with the *Joint Program on the Science and Policy of Global Change* (co-directed by Professors Henry Jacoby and Ronald Prinn) to improve the technology characterizations in their Integrated Global Systems Model, as well as from growing concerns about the role of present and future energy choices on the local, regional, and global environment. Under the leadership of the CEI and its role in the *Alliance for Global Sustainability* (AGS), a collaboration between MIT, Eidgenössische Technische Hochschule (ETH - Switzerland), and the University of Tokyo, the *Energy Choices Program* will interface with the Joint Program and other AGS activities. The November workshop was attended by 66 participants, including 21 industrial experts from 15 companies, as well as experts from the US DOE, the International Energy Agency, the Central Research Institute of the Electric Power Industry (Japan), and the United Nations Development Programme. The attendees agreed with the need to bring improved and factual energy technology forecasting and assessment to initiatives seeking practical options for cleaner and more environmentally-friendly energy supply and use in the future. Along with the assessment activity, innovative ideas for new energy technologies will also be explored. During its initial year, the program has received funding from the AGS, four industrial sponsors, and a foundation, and is seeking additional funding from corporations and government. The foundation funding of $1.35 million over two years was used to establish the *MIT Venture Fund for Energy Choices*, which facilitated the development of the larger program.

Several *Energy Choices* research activities have been started. In the energy supply sector, Professor Mujid Kazimi is leading a collaboration with other faculty at MIT and at Tsinghua University which aims toward providing China's growing nuclear power establishment with information to facilitate the development of national standards for nuclear reactor safety and performance. A building sector initiative is led by Professor Glicksman, again involving Tsinghua University, to identify efficient, economic, lower GHG urban building design techniques and technologies for southern China. These two projects, and a third project relating to transportation options (being developed by Professor Heywood) are part of the *MIT Venture Fund* portfolio. Finally, the petroleum industry sponsors have strong interests in the future of their industry under GHG constraints. The *Energy Choices Program* has run two initial exploratory workshops with small groups of faculty and industry participants to generate new research ideas in the broad areas of advanced separations technology (led by Professor Alan Hatton) and bioprocessing (led by Professor Charles Cooney). During the next year, these ideas will be screened to identify areas worthy of research investment.

Professor Jack Howard directs the *EPA Center on Airborne Organics*. The goal of this Center is to better understand pollution of ambient airsheds by energy and other industrial sources and to use that understanding to prescribe new means of detecting and tracing organic pollutants and new methodologies for preventing pollutant emissions altogether. Specific projects focus on sources, atmospheric transport and transformation, monitoring, and engineering controls for organic pollutant vapors and aerosols. To provide a strong group of experts to address these issues, the Center operates as a consortium of MIT, the California Institute of Technology, and the New Jersey Institute of Technology. Professor John Seinfeld (Caltech) and Professor Richard Magee (NJIT) are associate directors. MIT scientists participating in Center research projects include Professors János Beér, John Heywood, Simone Hochgreb, Jack Howard, Gregory McRae, Mario Molina, Adel Sarofim, John Vander Sande, and Dr. Arthur LaFleur. The Center hosts an annual Summer Symposium on high visibility topics in ambient air pollution. In 1997, the focus of this meeting was on fine particles in the atmosphere, with special interest in issues surrounding the

EPA-proposed standard regulating aerosols smaller than 2.5 μm. This symposium was co-chaired by Dr. Praveen Amar of Northeast States for Coordinated Air Use Management, Professor Glen Cass of Caltech. and Dr. Jane Warren of the Health Effects Institute.

Our continuing work on carbon sequestration technologies focuses on three areas: assessment, education/outreach, and basic research on ocean sequestration. This effort is led by Howard Herzog in collaboration with Dr. Drake in the first two areas, and with Dr. Eric Adams of the Parsons Laboratory in ocean sequestration. Highlights of this effort include the January 1997 white paper and the January 1998 stockholders' workshop, attended by over 100 delegates, described earlier in the "highlights" section. We have been quoted in *The Wall Street Journal, Scientific American, Chemical and Engineering News, Discover,* and other publications. This work is supported by the Federal Energy Technology Center (FETC) of the DOE.

The MIT Energy Laboratory has been phasing out its responsibility for administering the *University Research Consortium* (URC) on behalf of the Lockheed Martin Idaho Technologies Company (LMITCO), the operations and management contractor for the DOE Idaho National Engineering and Environmental Laboratory (INEEL). The phaseout will be completed on September 30, 1998. During the past year, the URC has overseen 14 research projects at 10 universities (subcontracts totaling $1.55 million), including 5 projects at MIT ($829K in FY98 funding). INEEL is assuming the administration duties for the URC, and two additional research projects at MIT, funded at $456K, have been initiated under the INEEL management structure. Professors Tester and Mujid Kazimi are the co-Principal Investigators for the URC, which is directed by Dr. Malcolm Weiss. Other URC leadership is provided by Dr. Drake, the program co-director, and by Technical Focus Area Leaders who are: Professors Merton Flemings (Materials), Kazimi (Nuclear Technologies), and Kenneth Smith (Environmental Engineering).

The *Electric Utility Program* (EUP), directed by Mr. Stephen Connors, has been jointly sponsored by roughly twenty-five electric utility companies, equipment manufacturers, fuel suppliers, and the U.S. Dept. of Energy over the past several years. EUP facilitates the development of collaboratively funded electric industry-related research projects by bringing together MIT faculty and researchers with EUP members through an annual series of workshops and meetings. In the fall of 1997 the EUP began a reorganization, which will be completed in FY1999, which recognizes the realities of an increasingly competitive and global electric industry. As part of this transformation the EUP will assume a new name *The Electric Industry Program* and focus on several, more focused research tracks. The first such track focuses on research topics related to electric power transmission under open access. Led by Dr. Marija Ilic, this research activity is comprised of the consortium funded project Transmissions Provision and Pricing Under Open Access. Using research from the project, Dr. Ilic and Mr. Connors led a short course in June 1998 entitled ISO Operations, Planning and Design, attended by eleven companies, the Dept. of Energy, and several academic colleagues. In addition to this transmission related work, the EUP's research efforts related to heath effects of electromagnetic fields (EMF), led by Dr. James Weaver, also continues. Electric industry responses to climate change under competition is another large area of interest where the EUP is involved, and is being pursed in conjunction with the *Energy Choices Program.* Mr. Connors represents the Energy Laboratory on the Technical Program Committee for the World Energy Council's 17th World Congress in Houston, in September 1998. Heavily involved in the sustainability division, Mr. Connors is one of four industry rapportuers for the topic.

The *Analysis Group for Regional Electricity Alternatives* (AGREA), also directed by Mr. Connors, employs multi-attribute power systems planning tools to identify environmentally-responsible and cost-effective electric development strategies. Over the past year, these techniques have been extended throughout the Energy Lab, forming the core assessment and outreach approach being employed by the *Energy Choices Program,* and several Alliance for Global Sustainability projects. Under the auspices of the AGS, AGREA is applying its experience in strategic planning via the multi-year SESAMS project (Strategic Electric Sector Assessment Methodology under Sustainability Conditions) in Switzerland, in collaboration with the Swiss Federal Institutes of Technology (Zürich and Lausanne) and the Paul Scherrer Institut. Another AGS project is exploring electric development strategies for China involving distributed generation and other customer-based technologies. This effort is being coordinated with Prof. Glicksman's Sustainable Buildings for China Program supported by the *MIT Venture Fund.* AGREA continues to be active in the assessment of environmentally proactive emissions reductions strategies for New England via activities with the Massachusetts Division of Energy Resources, the Massachusetts Photovoltaics Group, and the New England Solar Energy Industries Association, all connected with provisions in regional restructuring legislation tied to the development of renewable energy sources.

The Energy Laboratory is coordinating a national program aimed at developing new technologies for rapid drilling, tunneling, and cavity creation in rock formations. Important applications include drilling for exploitation of deep petroleum, gas, and geothermal energy; mining; and tunneling for infrastructure expansion and revitalization. Professors Carl Peterson and Tester direct the National Advanced Drilling and Excavation Technologies (NADET) Institute which was established at MIT in 1996 with initial funding from the DOE. MIT contributions include expertise in engineering (Professors Kim Vandiver, Herbert Einstein, Peterson, and Tester) and earth sciences (Professor Nafi Toksoz and Dr. Roger Turpening). The major function of the Institute is to be carrying out industry-guided and co-funded RD&D on proposed new technologies. We expect to continue our project management, research, and technology transfer roles as the NADET continues on a national scale with U.S. universities as well as government and industrial laboratories encouraged to participate.

A major collaborative program between MIT and the INEEL, with funding from DOE Basic Energy Sciences, seeks new engineering understanding to improve efficiency and materials conservation in energy-intensive processes. This program, with one project led by Professor David Parks and another by Professor Thomas Eagar, is directed by Dr. Drake. An initiative to broaden this program and bring in additional projects is under development with the goal of organizing a synergistic research activity focused on providing improved lifetime integrity for welded structures.

The Energy Laboratory continues a program of scientific and engineering research to support technologies for destroying military and other hazardous wastes by oxidation in supercritical water. Specific projects focus on the kinetics of waste destruction, understanding and prevention of corrosion in process equipment, phase equilibria, and the transport and deposition of salt particles that can foul and corrode reactor vessels. Historically, much of this research was supported by an University Research Initiative Grant and supplemental student fellowship awards from the US Army Research Office (ARO). More recent ARO funding under an university-small business collaboration has supported development of mathematical models for reactors and process flowsheets. This project recently received Army approval for a 24-month, Phase 2 initiative. Other related projects are focusing on chemical synthesis in supercritical carbon dioxide and on the possible role of supercritical water oxidation in recycling components of automobiles. The supercritical fluids project team is led by Professor Tester and involves Professors Tomas Arias, David Cory, Rick Danheiser, Peter Griffith, Jack Howard, Ronald Latanision, Kenneth Smith and Jeffrey Steinfeld, Dr. Michael Modell, Dr. Peters, and Mr. Herzog, as well as visiting faculty from Merrimac College, Professors Angelike Rigos and Katherine Swallow, working with sixteen graduate students and visiting scientists.

CEEPR AND JOINT PROGRAM

The CEEPR is an activity, jointly hosted at MIT by the Energy Laboratory, the Department of Economics, and the Alfred P. Sloan School of Management, that funds policy-related research in energy and environmental economics. The Center and the Joint Program receive financial support from corporate sponsors, government agencies in the U.S. and Norway, and one foundation. In addition, affiliate relations are maintained with several environmental groups and other policy-oriented research groups in other countries.

For the past several years, CEEPR's principal research activity has been conducted under the auspices of the *Joint Program on the Science and Policy of Global Change,* sponsored in collaboration with MIT's Center for Global Change Science. This program, led by Professors Henry Jacoby and Ronald Prinn, draws on MIT's traditional strengths in science and economics to conduct the serious interdisciplinary work needed to provide a basis for global climate policy. The Joint Program is now in its fifth year of existence during which time it has become established as one of the world's leading centers for the Integrated Assessment of Climate Change. The Integrated Global Systems Model is now operational and has provided the basis for a number of reports, articles, and presentations on the science and policy of global warming. The principal faculty and researchers are frequently requested to attend scientific and expert group meetings related to climate change. Contributions to the Joint Program continue to grow with annual funding now exceeding $3.0 million. The work of the Joint Program is supported financially by a number of corporate sponsors in North America, Europe and Japan, the US and Norwegian governments, and the Vetlesen Foundation.

CEEPR research outside of the Joint Program has focused on three areas: emissions trading, productivity improvements in the supply of energy, and energy futures, forwards and arbitrage. By merit of its research on the Title IV SO_2 emissions trading program, the Center has become an authority on the actual functioning and

implementation of emissions trading as an instrument for the more efficient achievement of environmental goals. The work on productivity is concerned with determining the sources and causes of the remarkable improvements that have occurred over the past 10-15 years in the supply of conventional hydrocarbon energy supplies. Most of the current work has been concerned with coal; however, with the cooperation of the Norwegian government, this research is being extended to cover oil and gas, using the North Sea as a case study. Finally, research on energy futures, forwards and arbitrage applies an area of expertise at the Sloan School to the emergence of highly liquid spot, futures and forward markets for crude oil and natural gas and to the current development of such markets for coal and electricity.

NEW INITIATIVES

MIT, under the leadership of Mr. Herzog and Dr. Adams, is playing a leading role in an international collaborative effort between Japan, Norway, and the United States on CO_2 sequestration in the ocean. The objective of this project is to investigate the technical feasibility and improve understanding of the environmental impacts of CO_2 ocean sequestration. These results will be needed to develop ocean sequestration technologies that minimize ocean impacts while reducing greenhouse gas concentrations in the atmosphere. A field experiment will take place in the summer of 2000 off the Kona Coast of Hawaii. In addition to the US DOE, other implementing organizations are the Research Institute of Innovative Technology (Japan) and the Norwegian Institute for Water Research.

We are attempting to strengthen the links between our carbon sequestration program and the Joint Program on the Science and Policy of Global Change. A graduate student will be sponsored by the *Energy Choices* program to develop representations of sequestration technologies in their energy sector impact models. We also responded to a solicitation from the DOE Office of Energy Research on the same topic, with final awards to be announced later this summer.

In the area of supercritical fluids, we are expanding our emphasis from research in support of waste destruction/decontamination to chemical synthesis and other applications that capitalize upon the remarkable solubilizing power, phase relationships, and species transport behavior of fluids near and above their critical point.

In the area of electrothermal (plasma) processing, we plan to pursue applications to problems in soil decontamination, materials science, and fuel conversion.

More information about the Energy Laboratory can be found on the World Wide Web at the following URL: http://web.mit.edu/energylab/www/energylb.htm

Jefferson W. Tester

FRANCIS BITTER MAGNET LABORATORY

The Francis Bitter Magnet Laboratory (FBML) has continued to make notable advances in several areas of science and engineering involving high magnetic fields. The research program in Magnetic Resonance (nuclear magnetic resonance (NMR) and electron paramagnetic resonance (EPR)) has continued to grow and remains the largest effort at the FBML. The program is funded primarily by the NIH and DOE, and involves ~20 NMR and EPR magnets and spectrometers.

A few of this year's highlights:

- Prof. David G. Cory received tenure.
- Prof. Robert G. Griffin, together with Prof. Gerhard Wagner of Harvard University, announced The MIT/Harvard Center for Magnetic Resonance, a collaborative research effort between MIT and Harvard University.
- Dr. Yukikazu Iwasa received funding from the NIH to construct a very high field, wide bore 750 MHz NMR system. The Technology Group will begin work on this project immediately.
- Dr. Jagadeesh Moodera has continued to strengthen his research efforts through collaboration with various industrial sources as well as the NSF. In addition, he has continued his mentoring of undergraduate and high school students by providing research opportunities within his lab.

RESEARCH ACTIVITIES

During the past year, Prof. Cory's research group continued to develop novel NMR methods, instrumentation and applications. These included:

NMR microscopy—We completed the construction of a high field NMR microscope with resolution of a few microns. We are currently using this to explore questions in developmental biology.

2-D diffusive scattering—We completed a set of studies to demonstrate that correlated, multi-vector scattering measurements are not only feasible by NMR, but that they provide information that is unavailable by other means. As a first example, we used these methods to measure the eccentricity of the average pore volume in a pore glass.

MAS gradient studies—We continue to explore applications of the combination of magic angle sample spinning and magnetic field gradients. We have shown that this is an excellent means of investigating compartmentation in biological samples. Some initial solid state studies have also been completed.

NMR investigations of quantum information processing—A large part of our efforts has been directed towards exploring quantum information processing by NMR. These studies include the implementation of quantum computers, studies of decoherence via quantum error correction, exploration of quantum coherence and entangled states, and the first demonstration of fully coherent quantum feedback control. This work includes strong collaborations with Dr. T. Havel (Harvard Medical School), Prof. Seth Lloyd (Mechanical Engineering), and a group at Los Alamos headed by Dr. Raymond LaFlamme.

We have completed the construction of a modest scale MRI setup for environmental transport studies. This is now being used by Professors P. Culligan (Civil and Environmental Engineering), K. Czerwinski (Nuclear Engineering) and their students.

HIGH FREQUENCY ELECTRON PARAMAGNETIC RESONANCE (EPR)

The capabilities of the 140 GHz EPR spectrometer have been dramatically extended by incorporating a four-phase microwave pulse forming network and amplifier. The greater microwave power and phase switching capability now allow us to perform more sophisticated pulsed EPR techniques. In particular, we are working on developing new pulsed multiquantum EPR experiments for measuring long-range distances (10-30 Å) in spin labeled proteins and peptides. We have also added a 140 GHz pulsed Electron-Nuclear Double Resonance (ENDOR) capability. The

increased sensitivity, resolution and orientation selection available in the ENDOR experiment at this high frequency/field has enabled us to determine in detail the electronic structure of the tyrosyl radical of ribonucleotide reductase. ENDOR studies of the Fe-S cluster active site of the protein putidaredoxin have also been initiated. The paramagnetic Fe-S cluster precludes the characterization of the active site structure by NMR techniques due to the very large paramagnetic shifts and broadenings of the NMR resonances. High frequency ENDOR spectroscopy, however, is uniquely suited to study the active sites of such paramagnetic enzymes and proteins.

STRUCTURAL STUDIES OF ALZHEIMER'S DISEASE β-AMYLOID

Amyloidoses are a group of peptide or protein misfolding disorders characterized by the accumulation of insoluble fibrillar protein material in extracellular spaces. Sixteen different peptides are known to form amyloid-like aggregates. The aggregation of these peptides is involved in several diseases. β-amyloid (Aβ) is involved in Alzheimer's disease, the conversion of the prion protein PrPc to PrPsc leads to the transmissible spongiform encephalopathy, and the synuclein protein is responsible for Parkinson's disease.

During the last year, we worked on methods to obtain large amounts of fibrillar peptide material. Fibril preparation is crucial for obtaining narrow lines, maximizing spectral resolution, and optimizing signal intensities. Fibril formation is also important for the biological relevance of the structural model. Furthermore, a uniformly ^{13}C, ^{15}N labeled 9mer peptide (Aβ34-42) that resembles the C-terminal part of Aβ has been synthesized. High-resolution AFM (Atome Force Microscopy) images indicate that this fragment forms regular fibrils as well.

Currently, we are working on methods of obtaining structural information on uniformly labeled samples to determine the three-dimensional fold of a protein. This includes measurement of NH-NH dipolar interactions that yield the relative orientations of backbone/backbone and backbone/side chain amides. Furthermore, we want to introduce proton-proton distances into the structure calculation protocol by performing $^{1}H,^{1}H$ recoupling experiments in perdeuterated peptides.

SOLID STATE NMR STUDIES OF MEMBRANE PROTEINS

During the past year, we have focused both on methodology for studying membrane proteins in general and on the structure of one particular membrane protein—bacteriorhodopsin (bR).

In methodology, we presented an approach to 3D spectroscopy of solids that will be useful in resolving and assigning resonances in membrane proteins. We plan to develop this technique further. We addressed methods of measuring torsion angles in proteins which we plan to apply to the study of retinal conformation in bR. We also described an approach to recoupling the shift anisotropy and the heteronuclear dipolar interaction in rotating solids, a technique that could be used in heteronuclear correlation spectroscopy. In addition, the desire to assign a set of resonances to the η nitrogens of Arg_{82} stimulated the development of a new approach to performing frequency selective cross polarization.

We also studied the effect of dynamics on peptide spectra by examining gramicidin-A in lipid bilayers. Our spectra indicate that the rotational diffusion of the peptide interferes with the proton decoupling. We developed a method to elucidate the dynamics of lipid bilayers without resorting to ^{2}H labeling. A review of these developments appeared in Nature Structural Biology.

In addition, we studied protonated Schiff base model compounds that are models for the M state of bR. We have detailed methods for trapping the various photointermediates of bR and also described measurements of the ^{15}N chemical shift of the L_{550} intermediate. In NMR spectra of several forms of bR, we observed two M intermediates that are possibly the switch that provides directionality to the proton pump in bR. Furthermore, we described the involvement of Arg in the proton pumping cycle of bR. In the M intermediate we find an Arg that exhibits a 25 ppm difference in the shifts between the η nitrogens of Arg_{82}. This effect appears in both wild type bR and the D85N mutant.

Our results demonstrate convincingly that we are able to measure distances in membrane peptides and proteins and explain the mechanism of the intensity losses in the spectra. The results establish the structure of the Schiff base in the L-intermediate of bR, the presence of two forms of M and the perturbation of an Arg in the formation of the M intermediate.

SOLID STATE NMR STUDIES OF PEPTIDES & PROTEINS

During the past year we made significant progress in developing methods that will be useful for determining the structure of large and/or insoluble proteins or peptides, and we have improved the resolution with new 3D sequences.

We continue to develop new and improved pulse sequences to perform dipolar recoupling, methods for controlling the bandwidth of the sequences—either spectrally selective or broadband—and for reintroducing chemical shift anisotropies. Resolution is always a problem in NMR spectra and we illustrated the possibility of significantly increasing the resolution via 3D ^{15}N-^{13}C-^{13}C chemical shift correlation spectra. We have also employed $^{15}N^{13}C$ correlation spectra for assigning spectra of peptide and proteins, and nucleic acids. We described the resolution of a structural question in the 9-mer peptide that is part of a β-amyloid. Specifically with powder experiments we established the configuration of the GG peptide bond as trans.

Our continued experiments on I≥3/2 nuclei via multiple quantum excitation could be widely applicable to biological systems. We published three papers concerned with spectroscopy of quadrupolar nuclei based on the development general approaches to spectroscopy of I≥3/2 spin systems. We recorded some of the initial spectra of ^{17}O, discussed J-couplings in quadrupole spectra, and presented a new technique to measure distance using a ramped RF field. The approach should be useful for multiply labeled systems since only one spin pair at a time is recoupled.

The measurement of torsion angles ϕ and ψ was the subject of additional research. Our initial approach relied on $^{1}H,^{13}C$ and $^{1}H,^{15}N$ dipolar couplings. Most recently, we have employed $^{15}N,^{13}C$ couplings in NCCN experiments.

A competing proposal was recently submitted to NIH for the next five-year funding cycle.

CENTER FOR MAGNETIC RESONANCE

The Center for Magnetic Resonance has completed its 22nd year of operation as a facility open to scientists needing access to high field NMR EPR and magnetic resonance imaging equipment. During this year, more than 80 projects were worked on by over 100 investigators, some from departments within MIT including Chemistry, Physics, and Nuclear Engineering, as well as users and collaborators from institutions outside of MIT such as Harvard University, Brandeis University and Brigham & Women's Hospital. Work resulted in close to 70 publications in print or in press.

Highlights of work conducted at the center include advances in high frequency dynamic nuclear polarization of proteins (DNP), high precision NH Bond distance measurements in a serine protease active site and protein structure determination of Human Zα.

A competing proposal was recently submitted to NIH for the next five-year funding cycle.

MAGNET DESIGN & TECHNOLOGY

"Cryotribology and 'Electromaglev'" is an HTS research program headed by Dr. Yukikazu Iwasa. Our focus centers on a new magnetic levitation system called "electromaglev" or "active-maglev" in which an HTS bulk sample, e.g., YBCO, is levitated stably in the DC magnetic field generated by electromagnets placed underneath the floating object. During the past two years, we completed a comprehensive theoretical and experimental study on lift, lateral and tilt stabilities, and other dynamic parameters. We hope to continue this work as a new 3-year program effective September 1, 1998.

We continued research on the key operational issue of protection for high temperature superconducting (HTS) magnets operating in the temperature range 10-60 K. In addition to this basic protection study, practical aspects of cryocooler-cooled operation will also be investigated. Small coils wound from silver-sheathed BSCCO-2223 tapes will be investigated in the temperature range 4.2— 60 K. Accurate analytical models have been developed for low-Tc magnets in past research. However, these models do not apply well to high-temperature superconductors due to their wide current-sharing temperature regions and significant variation in thermophysical properties across these regions.

We developed a numerical NZP model for a three-dimensional, dry-wound, BSSCO-2223 superconducting magnet. The test magnet operates under quasi-adiabatic conditions at 20~K and above, in zero background field. It is contained in a stainless steel cryostat and cooled by a Daikin cryocooler. The NZP model is based on the two-dimensional transient heat diffusion equation. Quenches are simulated by a numerical code using the finite-difference method. Agreement between voltage traces obtained in the test magnet during heater-induced quenching events and those computed by the numerical NZP model is reasonable. The model is also used to simulate quenching in magnets similar to the test magnet. Specifically studied were effects of magnet inductance, for a given set of operating current and temperature, on the maximum temperature reached in one full turn of the conductor located at the magnet outermost layer driven normal with a heater. The simulation demonstrates that there is an operating current limit for a given magnet inductance and operating temperature below which the magnet can be considered self-protecting. The model indicates that thermal contact resistance has a dominant effect on propagation in the azimuthal direction (across layers).

Our work on developing a "permanent" HTS magnet system is continuing. The system combines the simplicity and ease of operation of a ferromagnetic permanent magnet with the strength, capability and versatility in field generation of an electromagnet. Once energized and producing a desired field, the system, without being coupled to a cooling source, can maintain the field for a long period. This HTS magnet is particularly suitable for an on-board or portable unit requiring a constant field and where "permanence" means a duration of hours, days, weeks, months, or even years. The systemís other features are "recooling" and "recharging" capabilities designed to have the system re-cooled while maintaining its constant field to make the field literally permanent, and recharged if its upper operating temperature is exceeded and the field decays.

THIN FILM MAGNETISM, SUPERCONDUCTIVITY AND TUNNELING

In condensed matter physics, in particular magnetism, our research has resulted in significant contributions both fundamentally as well as for industrial application. Several issues of interfacial spin transport and magnetic excitations were addressed in the past year's research emphasis. Now we are even closer to verifying the fundamental theoretical predictions of certain exotic magnetic compounds (which are technologically important materials), using our new molecular beam epitaxy (MBE) system. Our research in these materials has already shown the possibility of a four level memory/logic element - a first of such kind of thin film tunnel device. International collaborative research is taking place with scientists and professors from the University of Paris at Orsay, the University of Eindhoven and the Ukrainian Academy of Sciences. Exchange of scientists and graduate students are part of this program.

In the area of semiconductors, our continued research in collaboration with Hewlett-Packard Company has been valuable, in search of far future material for atomically resolved storage (> Terabytes/in^2). We are exploring the materials with the right properties and giving HP the fundamental information necessary for their program. There is also continued collaboration with other companies such as IBM, Seagate, Read-Rite and Motorola in the field of magnetism.

Currently, there are three graduate students and two postdocs taking part in the research. Among the four high school students and four undergraduates who took part in the research activities, one high school student was a finalist in Westinghouse Science Competition and one undergraduate won the best BS senior thesis award in Materials Science Department. Another undergraduate is currently doing research at Los Alamos National Lab, taking a term off from MIT. Our research during this past year has resulted in several research publications, many invited talks and two patents. The PI received the IBM Research Partnership Award for the third year in a row. He also participated in the National Research Council's survey of research thrust for the next 10 years in the area of magnetism in USA. The PI has been invited by Joseph Fourier University (France) to be a distinguished visiting professor in their university.

MOSSBAUER SPECTROSCOPY LABORATORY

The Mossbauer Spectroscopy laboratory continued to operate as a user facility under the direction of Dr. Georgia Papaefthymiou.

Primary investigations included studies of: (a) large iron complexes of nanometer-size dimensions that delineate the molecular/solid state boundary; (b) nanoscale magnetic particles on silica or plolymeric supports, leading to the

development of advanced nanocomposite materials for magnetic and catalytic applications; and (c) nanostructured iron-palladium alloy films developed as hydrogen separation membranes in high temperature chemical reactors.

The results were presented at the "International Conference for the Applications of the Mossbauer Effect" held in Rio de Janeiro, Brazil in September of 1997. Various aspects of this research were published in the Journal of Applied Physics, the Journal of Magnetism and Magnetic Materials and in Hyperfine Interactions.

FACILITIES

During the past year, FBML resources were consolidated into one building. We now boast an upgraded space for two 750 MHz NMR magnets, as well as space for the wide bore 750 MHz magnet to be built under Dr. Yukikazu Iwasa.

Newly renovated facilities have recently been provided for Prof. Cory's research group, including a wet lab and a computer lab.

Extensive renovation is taking place on the second floor to prepare office space for Professor Jacquelyn Yanch, Prof. David Cory and their students.

Professors Keith Nelson and Andrei Tokmakoff of the Department of Chemistry have moved into temporary lab space on the first floor pending completion of their permanent laser lab facility in the Chemistry Department. Additional Chemistry faculty are also considering moving to the Magnet Lab while their current lab space undergoes renovation.

EDUCATION AND PERSONNEL

The Laboratory contributes to undergraduate education by participation in the Undergraduate Research Opportunities Program (UROP), a program that encourages and supports research-based intellectual collaborations of MIT undergraduates with Institute faculty and research staff. In addition, the laboratory has 25 full-time graduate and 15 postdoctoral students performing research.

FUTURE PLANS

For several years now, we have been pursuing the development of an Imaging Center here at the Magnet Lab. These plans are being revised in conjunction with the Harvard/MIT HST program.

Once construction is complete on the second floor magnet hall, instruments currently housed on the fourth and fifth floors will be relocated in order to create a comprehensive "Center for Magnetic Resonance."

A new classroom is being designed to replace one lost to construction of office space on the second floor. Work is scheduled to begin in early 1999.

Robert G. Griffin

HAYSTACK OBSERVATORY

The Haystack Observatory, located in Westford MA, is an interdisciplinary research center engaged in radio astronomy, geodesy, atmospheric sciences, and radar applications. The radio astronomy program is conducted under the auspices of the Northeast Radio Observatory Corporation (NEROC), a consortium of 12 educational and research institutions in the northeast. The Observatory receives financial support primarily from federal agencies including the NSF, NASA, and the USAF through MIT Lincoln Laboratory.

INSTRUMENTATION

The Haystack Observatory instrumentation consists of the following facilities:

- A 37-m diameter radio telescope used for astronomical observations and for radar measurements.
- 18-m diameter radio telescope involved in geodetic measurements of the Earth's rotation parameters using very long baseline interferometry (VLBI).
- A VLBI correlator used to process global geodetic and astronomical observations.
- A high-power UHF radar that utilizes two large antennas, 46 m and 67 m in diameter, to study the earth's upper atmosphere using incoherent backscatter techniques.
- An optical observatory consisting of Fabry-Perot interferometers to measure airglow emission and determine upper atmospheric winds. A lidar system using the Firepond 1.2-m telescope is now under development.

RADIO ASTRONOMY

Amongst the highlights of the radio astronomy observations using the 37-m diameter radio telescope in the year has been the discovery of a compact outflow towards a very strong molecular gas region, S68N in the Serpens cloud core, by a group led by Grace Wolf-Chase of the University of California, Riverside, and which included Joel Kastner of MIT. The images obtained using the CS tracer line at 98 Ghz were combined with radio interferometric and other observations to identify for the first time the source responsible for the outflow and to establish the exact location of the infall center of the core. The survey for infall motions in dense cores using 160 starless cores was completed during the past year by a group led by Phillip Myers of the Harvard-Smithsonian Center for Astrophysics. Using the CS and the N_2H^+ lines in the lines in the 3-mm wavelength band, 65 sources were detected that showed a slight excess infall asymmetry in the measured spectra, but most starless cores appear to be static. Dan Clemens of Boston University and his students conducted observations to determine the distances to IR sources from CS-derived velocities observed at Haystack in 10 detected sources, and concluded that these sources are high-mass protostars at large galactic distances. In other staff research using facilities elsewhere, Colin Lonsdale of Haystack and his colleagues studied the extreme luminosity resulting from the collision of two spiral galaxies in Arp 220. New massive young stars formed as a result of the collision are thought to release the luminous energy. In a later stage of evolution, a luminous quasar is expected to form from the black hole at its center.

In May 1998, the Haystack Observatory ended its program as a user facility for radio astronomical research under NEROC's oversight. Under new support from NSF, the Observatory is implementing a program using the Haystack telescope to allow undergraduate students to engage in radio-astronomical research as part of their education. In the past year, 60 students from local area universities including MIT, Harvard, Boston University, University of Massachusetts, Wellesley College and Northeastern University, used the telescope for observational projects associated with courses or independent research programs. Pilot projects have been developed by Haystack staff to allow such educational projects to be undertaken, and workshops have been provided to faculty and students to acquaint them with the radio telescope systems and observational methods in radio astronomy. Web-based tutorials have been started, and a new computer control system has been developed to allow remote operations of the telescope and monitoring of the observations. A small radio telescope, 3 m in diameter, has also been developed to provide students with a direct experience in the construction of a radio telescope, and the telescope will be offered as a kit to interested institutions. This will provide an opportunity for students to perform hands-on observational training prior to the use of the Haystack telescope. With the successful demonstration of the educational value of the program, it is expected that the telescope will be made accessible to students nationwide for research experiences.

VERY LONG BASELINE INTERFEROMETRY

Very Long Baseline Interferometry (VLBI) applied to astronomical observations at 3mm-wavelength has continued successfully at Haystack through the Coordinated Millimeter-VLBI Array (CMVA) project. Eleven radio

telescopes, globally distributed in the US, Europe, and South America, participate as part of the CMVA to map galactic cores with angular resolutions of 50-100 microarcseconds, and the data are processed using Haystack's VLBI correlator. While on-going CMVA projects map the evolution of the structure of active galactic nuclei, emphasis at Haystack has recently shifted to spectral-line observations aimed at the study of interstellar maser pumping mechanisms and the determination of maser proper motions. Towards that end, a series of experiments on a short baseline from Haystack to the Five College Radio Astronomy Observatory at Quabbin, MA, have been conducted under the leadership of Shepherd Doelman of Haystack. Methanol masers at 95 and 107 Ghz were detected, indicating that the emission in the source OMC is likely to be thermal. In a new technically-challenging thrust, VLBI observations have been attempted in April 1998 at a wavelength of 1.3 mm, using five telescopes in the US and Europe. Due to poor weather conditions at several of the telescopes, interferometric fringes have not been detected, and the test experiments will be continued with emphasis on short-baseline observations using telescopes in the western US. Instrumentation improvements such as the development of water vapor radiometers to enhance the coherence time for mm-wavelength observations are in progress with the involvement of MIT graduate student David Tahmoush.

Haystack Observatory, in partnership with the MIT Physics Department, Harvard-Smithsonian Center for Astrophysics, Boston University, Brandeis University, and the University of Massachusetts, has participated in a proposal for an NSF Science and Technology Center for Advanced Interferometry. The effort is led by Professor Jacqueline Hewitt of MIT. Based on a successful pre-proposal recently selected by the NSF, a full proposal is now being prepared. The goal of the center is to provide a cohesive and integrated approach to the development of advanced interferometry at all wavelengths. Amongst the proposal components to be carried out at Haystack is the design of a large multi-element correlator system to support the One-Square Kilometer Array project led by Professor B. Burke of MIT Physics, the mapping of GPS satellites in collaboration with Professor Thomas Herring of MIT Earth, Atmospheric and Planetary Sciences, the adaptation of high-speed network links for transmission of VLBI data, the development of lightning detection systems, and the characterization and mitigation of radio-frequency interference. The proposed STC will include strong interactions with industrial firms, national laboratories and international institutions, and will include a strong educational component and public outreach.

INSTRUMENTATION DEVELOPMENT

The Mark IV correlator system is now in its full production phase using local area industrial firms, and the assembly of correlator boards and other subsystems is in progress. In addition to the Haystack correlator developed under NASA support, copies will be constructed for the US Naval Observatory to support the USNO-NASA geodetic program, the Smithsonian Institution for the Sub-Millimeter Array, the Joint Institute for VLBI in Europe, the Netherlands Westerbork Array and the Max Planck Institute in Bonn, Germany. In the past year, Haystack staff have contributed to the resolution of difficulties encountered with station units designed by an industrial firm in England which have delayed the completion of the Mark IV correlator. The station units are now being replicated in the US. It is expected that the correlators will be completed by mid-1999 and will allow a vastly increased capacity for VLBI data processing.

Implementation of the Mark IV data acquisition system on telescopes worldwide is in progress. This will allow the data to be recorded at high rates for processing with the Mark IV correlator. Haystack technology has been transferred successfully to industry for the replication of these systems, and scientific studies, such as NASA's CORE program (Continuous Observation of the Rotation of the Earth) are now being started. To facilitate the application of the new system, Haystack hosted an international workshop in May 1998 to provide operational training for personnel who will use the new system at their telescopes. Over 100 scientists and engineers from 18 countries took part in this workshop. In addition, a special forum was held following the workshop to discuss the use of high speed networks in the transfer of VLBI data from the telescopes to correlators. Strong international interest was expressed in such a capability.

Feasibility tests of the new thin-film recorder head-arrays developed by Seagate Tape Technology Division were completed in the past year. The measured signal-to-noise ratio of thin film heads in reading recorded data showed a significant advantage over traditionally-used ferrite heads, but some modifications were identified to enhance their writing performance. Prototype head-arrays are now expected from Seagate to allow further development and tests of wide bandwidth recording systems (1-2 Gbits/s) using thin-film heads. The modeling of the head-tape interface is

proceeding successfully under an NSF grant, and a gift from Quantum Corporation has allowed further developments in recorder head modeling to proceed.

ATMOSPHERIC SCIENCE

In the past year, emphasis has been placed on the development of an atmospheric lidar system as part of the cluster of instruments at Millstone Hill to study the coupling between the Earth s middle atmosphere (30-100 km altitude) and the upper atmosphere. The lidar utilizes the Lincoln Laboratory Firepond 1.2m-aperture telescope together with a 25 Watt Nd:Yag laser obtained through a collaborative effort with Clemson University. Through grants obtained from the NSF Major Research Instrumentation and CEDAR programs (Coupling, Energetics and Dynamics of Atmospheric Regions), a Rayleigh-Doppler system is being implemented to measure the neutral density, temperature and wind velocities in the middle atmosphere. Together with the other radar and optical instruments at Haystack, the lidar will allow us to study the effects of tidal and gravity wave propagation from the Earth's lower atmosphere into the upper atmosphere.

Our second initiative in atmospheric science has involved participation in the design and development of the Polar Cap Observatory (PCO) at Resolute Bay, North West Territories, Canada (near the geomagnetic north pole) in response to an NSF solicitation. MIT/Haystack is a partner in a consortium led by SRI International, and which includes Boston University and the University of Michigan. Our joint proposal was peer-reviewed and approved by NSF and the National Science Board. Haystack's responsibility is the design and development of the data acquisition system for the incoherent scatter radar that is the central element of the PCO. This system will remotely control the radar, monitor its data output, and analyze its observations in real time. Regrettably, the location of the facility has become an issue in Congress, and funding has not been released for initiation of the project. Our expectation had been to complete the development by 2001, in order to take advantage of the peak of the solar cycle when important geomagnetic effects will occur. The study of such effects at the Earth's polar cap is crucial to understanding the solar-induced phenomena that influence the Earth's ionosphere and magnetosphere.

EDUCATIONAL PROGRAMS

The program to provide undergraduate students access to the Haystack radio telescope for research projects, described under the radio astronomy program, is a key effort which represents our contribution to strengthen the linkage between education and research. In addition, our summer internship program involves twelve undergraduate students this year, recruited from across the nation. The students are mentored by members of the Haystack staff and participate in the staff's research projects in astronomy, atmospheric science and instrumentation development. Two students from the University of Massachusetts at Lowell are constructing a copy of the small radio telescope for use at the Lowell campus, and a special pilot project to control the Haystack telescope from that campus is being tested. Several graduate students and post-doctoral associates are also engaged in research associated with our radio interferometry program.

In order to maintain our contributions to the local area schools, we have prepared a project on teacher enhancement in science and mathematics. Several teacher-student teams at the high school level are to be mentored by Haystack staff on a specific project which will be initiated during summer internships and then carried into the classroom during the following academic year. The project has been proposed to NSF.

More information about the Haystack Observatory can be found on the World Wide Web at the following URL: http://www.haystack.mit.edu

Joseph E. Salah

MIT/WHOI JOINT PROGRAM IN OCEANOGRAPHY

The Joint Program of the Woods Hole Oceanographic Institution and the Massachusetts Institute of Technology offers advanced degrees in oceanography and applied ocean science and engineering. Graduate study encompasses virtually all of the basic sciences as they apply to the marine environment: physics, chemistry, geology, geophysics, and biology. Students who choose applied ocean science and engineering may concentrate in the major fields (civil, environmental, mechanical, and electrical), materials science, or oceanographic engineering. More than 160 scientists/faculty from the two institutions participate in the Joint Program.

Since all the MIT faculty involved in the Joint Program are members of an academic department, their individual accomplishments and awards are reported through those departments. These include Courses I, II, VI, VII, XII and XIII.

Effective August 1997, Paola Rizzoli became the MIT Director of the MIT/WHOI Joint Program, succeeding Marcia McNutt, who left the Department to assume the Directorship of the Monterey Bay Research Institute (MBARI).

A Masters of Engineering degree in Marine Environmental Systems with the MIT Department of Ocean Engineering has been added to the degrees granted by the Joint Program. The degree program's goal is to prepare professionals for three missions: first, to understand, explore and monitor the ocean environment; second, to design, build and use technologies that maintain the integrity of the ocean and its resources; and third, to manage the marine systems and activities they support. This one-year program is designed to fill the rapidly-growing need for environmental training to manage complex ocean systems.

An external review of the Joint Program will take place in August, 1998 as a follow-up to the Internal Review which was conducted in 1994.

Plans are underway for a formal celebration of 30th Anniversary of the Joint Program, which was begun in 1968. The three-day event will be held September 25-27, 1998 and will feature a symposium entitled "Ocean Science and Engineering Education: Meeting the Challenge of the Year 2000".

More information about this Program can be found on the World Wide Web at the following URL: http://web.mit.edu/mit-whoi/www

Ronni Schwartz

NUCLEAR REACTOR LABORATORY

During the past year the Nuclear Reactor Laboratory (NRL) continued its joint interdisciplinary activities with both MIT and non-MIT collaborators, including academic departments and interdepartmental laboratories and a number of other universities, schools, and nonprofit research institutions such as teaching hospitals. These joint research or teaching and training activities cover a wide spectrum in the life and physical sciences and in engineering, including development of cancer therapy, nuclear engineering, computer control of reactors, training in reactor operations, dose reduction and materials performance in power reactors, radio-chemistry and trace analysis applied to the health effects from energy use, nutrition, earth and planetary sciences, archeology, environmental studies, and nuclear medicine. Plans are in progress for the relicensing of the MIT Research Reactor (MITR) and a possible power upgrade. Engineering studies have indicated that the current core design will allow doubling of the reactor's power with relatively minor changes to the heat removal systems.

An especially noteworthy development was the continued program in joint research with Beth Israel - Deaconess Medical Center on the treatment of cancer utilizing the boron neutron capture method. The clinical trials of boron neutron capture therapy were continued successfully with no observed toxicity and with clear indications of tumor regression in several cases. Patient trials are now in progress for both melanoma and glioblastoma multiforme (brain cancer).

NEUTRON BEAM TUBE RESEARCH

The prompt gamma neutron activation analysis facility was used both for research and in support of the neutron capture therapy clinical trials. A neutron reflectometry system that was designed by a faculty team headed by Professor X.-L. Zhou (Department of Nuclear Engineering) is now being installed.

ENVIRONMENTAL RESEARCH AND RADIOCHEMISTRY

Professor Frederick A. Frey, Department of Earth, Atmospheric and Planetary Sciences, and Dr. Pillalamarri Ila operate a Neutron Activation Analysis Facility dedicated to determining the abundance of trace elements in natural materials. The current emphasis is on determining the chemical composition of lavas erupted from upwelling mantle plumes which are postulated to be an important part of the mantle convection cycle. Current research is focused on lavas erupted during the 115 million year history of the Kerguelen mantle plume which has contributed to forming the oceanic crust of the eastern Indian Ocean. The JOIDES Resolution, the research ship used in the Ocean Drilling Program will be used to acquire the oldest, perhaps 115 million years, lavas associated with this mantle plume. This research complements our efforts in the ongoing Hawaiian Scientific Drilling Program which is focused on the Hawaiian plume. This program is entering Phase 2 of a drilling project which will recover lavas erupted during the 1 million year growth of a Hawaiian volcano.

Dr. Ilhan Olmez continued a major attempt to increase the utilization of NRL by making its neutron activation analysis (NAA) facilities and expertise available to industry, other universities, private and governmental laboratories, and hospitals. Research and/or service-oriented collaborations were established with several MIT research laboratories as well as with other educational and research institutions including: University of Miami, University of Southern California, Harvard, Woods Hole Oceanographic Institute, Brandeis University, and the California Institute of Technology.

Within MIT, research support has been provided to several departments. This research support includes analysis of various environmental and biological samples for trace and toxic metals for Professor William G. Thilly (Center for Environmental Health Sciences) as well as faculty in both the Department of Civil and Environmental Engineering and the Department of Chemical Engineering.

Dr. Olmez has been actively engaged in a number of environmental research projects. A two year grant to study toxic substances from coal combustion and a three year grant to determine the sources and the effects of fine particles on visibility in the Eastern United States continued, supported through the Department of Energy and the Electric Power Research Institute. Course 22.78, Nuclear Techniques in Environmental Analysis, was offered by Dr. Olmez and Professor Frederick A. Frey.

A number of other research applications of NAA are summarized in a subsequent section, Reactor Irradiations and Services for Research Groups outside MIT.

NUCLEAR MEDICINE

Clinical trials of boron neutron capture therapy (BNCT) for melanoma on the extremities were successfully continued up to the second dose level of 1250 RBE-cGy. Five irradiations have been completed. No adverse reactions have been observed on the subjects. However, three of the five lowest dose irradiations of deep seated melanoma have resulted in significant tumor regression. In one case a subject had two separate melanoma lesions irradiated at different times; two years later she is disease free in the irradiated areas.

Phase One studies of brain cancer, brain metastases of melanoma and glioblastoma multiforme were initiated. Thirteen volunteer subjects have been irradiated, and the fourth dose level of 1280 RBE-cGy has been reached. One serious adverse reaction was observed at one of the lower dose levels. It is unclear if this was due to the BNCT irradiation. Two of the eight brain tumor subjects have experienced improved performance following the experimental BNCT irradiation. One intracranial melanoma showed essentially complete regression. These trials are continuing.

A new high intensity and low background epithermal neutron beam has been designed for the MITR. The design is based on using spent fuel from the MITR in a fission converter concept. This beam would be able to irradiate patients in several minutes and would be suited for advanced clinical trials and routine therapy involving treatment of many patients per day. A $2.5 M proposal to the USDOE to construct this facility has received approval and construction is in progress. It is expected that upon completion of this new facility, MIT will possess the best neutron beam in the world for BNCT irradiations.

BNCT research at the MIT Research Reactor is under the direction of Professor Otto K. Harling and is carried out in collaboration with the medical staff at the Beth Israel - Deaconess Medical Center. Seven MIT graduate students and one undergraduate student are completing their theses on these projects.

RADIATION HEALTH PHYSICS

The NRL supports a subdiscipline in the Nuclear Engineering Department (NED), Radiation Health Physics, by providing relevant research opportunities and a specially designed laboratory/demonstration course. This course, 22.09/22.104, Principles of Nuclear Radiation Measurement and Protection, is appropriate for all students in NED. Research topics and support for Health Physics students were provided by NRL projects, especially the BNCT and Dose Reduction projects of Professor Otto K. Harling.

Dr. John A. Bernard taught course 22.581, Introduction to Health Physics. This course uses the MIT Research Reactor to provide practical examples of health physics issues.

DOSE REDUCTION AND COOLANT CHEMISTRY STUDIES

No experiments were done under this program during the past year. However, Professor Ronald Ballinger (NED) and Dr. Gordon E. Kohse (NRL) are planning continued studies.

IRRADIATION-ASSISTED STRESS CORROSION CRACKING

Use of the multiple specimen constant load test facility continued to study the urgent problem of core shroud cracking in boiling water reactors. Several thousand hours of testing were completed with a variety of materials including actual core shroud weld material from a U.S. reactor that was built but never operated. The system by which the identity of a broken specimen can be determined using cross-head displacement data was successfully demonstrated. This program is under the direction of Dr. Gordon Kohse of the NRL and Professor Ronald Ballinger of the Nuclear Engineering Department and is funded by the Tokyo Electric Power Company and the Electric Power Research Institute.

MITR RELICENSING AND REDESIGN

The relicensing of the MITR with a concomitant upgrade in power is in progress. During the past year, it was identified that the MITR can operate at a maximum power of 6-7 MW with the existing equipment. A decision was subsequently made to submit the licensing documents for a power increase from 5 MW to 6-7 MW. Neutronic and

thermal hydraulic analyses were completed as well as several chapters of the new Safety Analysis Report. Also, system diagrams for the MITR are being updated and stored digitally.

REACTOR IRRADIATIONS AND SERVICES

In nuclear medicine, the development and/or continuing production of radioisotopes for use by researchers at hospitals and other universities included: 1) production of Dy-165 for Dr. Clement B. Sledge of Brigham and Women's Hospital for research studies in the treatment of arthritis; 2) investigations using track etching techniques by Dr. David Slaughter of the University of Utah to determine the uptake pattern of heavy metals by humans as well as the environment; 3) evaluation of copper and gold for arthritis treatments by Dr. Alan B. Packard of Children's Hospital; and 4) study of neutronic behavior of acrylic rods doped with boron and lithium for use in neutron monitoring devices by Dr. John Doyle of Harvard University.

In a number of other areas reactor irradiations and services were also performed for research groups outside MIT. Most of these represent continuations of previous research. Examples include Dr. Alan P. Fleer of Woods Hole Oceanographic Institute who used irradiation to determine natural actinides and plutonium in marine sediments and Captain Daniel J. Robbins of the McClellan Air Force Base who is investigating calibration of ultra-sensitive neutron monitoring devices by thermal neutron fission of uranium foils.

Whereas most of the outside users pay for irradiation services at the reactor, educational institutions needing such services for their own academic or research purposes are assisted in this regard by the USDOE through its "Reactor Sharing Program." A grant to MIT NRL reimburses us for the costs of providing irradiation services and facilities to other not-for-profit institutions (including teaching hospitals and middle and high schools). Under this program, 400 students and 50 faculty and staff from over 35 other educational institutions benefited from visits to and use of the MITR during the past year.

Research utilization of the MITR by other institutions under the Reactor Sharing Program during the past year has included: 1) use by Professors J. Christopher Hepburn and Rudolph Hon of Boston College to activate geological specimens and standards for the NAA of rare earth and other trace elements in studies of the geological development of the northeastern United States; 2) irradiation of air particulate samples for NAA by Professor Gerald Keeler of the University of Michigan; 3) gamma irradiation of plant seeds for several area high school students participating in science fair projects; 4) measurements of boron concentration and work on high resolution track etch autoradiography for Professor Robert Zamenhof of Beth Israel - Deaconess Medical Center; 5) participation in several special high school student projects; 6) neutron activation analysis of subsurface water supplies by Professor Jack Beal at Fairfield University; and 7) neutron time-of-flight and Bragg angle measurements by Professor Martin Posner's group at the University of Massachusetts.

For education of the general public and students at all levels in local and other New England schools, the reactor staff provides lectures and tours periodically throughout the year. One local university incorporated reactor visits and experiments into its regular course curricula, as follows: The University of Massachusetts, Harbor Campus, Professor Martin Posner, Department of Physics, Physics (Course#603), 8 students, 3 visits.

MAJOR REACTOR SERVICES

A major project to neutron transmutation dope semiconductor grade silicon single crystals continued for a successful fifth year. Approximately 12 metric tons of Si crystals were accurately irradiated in shielded, automated irradiation facilities at the MITR. This project is under the technical direction of Professor Otto K. Harling.

AFFIRMATIVE ACTION

The NRL supports the affirmative action goals of the Massachusetts Institute of Technology. Of a staff of 39 there are currently five engineering and management positions held by minorities and women. The NRL participated in the USDOE's program for minority training in reactor operations, and one of our current senior reactor operators is a graduate of this program. Several women are currently in training to become licensed reactor operators.

MIT RESEARCH REACTOR

The MIT Reactor completed its 40th year of operation, its 24th since the 1974-75 shutdown for upgrading and overhaul. The reactor originally operated on a Monday through Friday schedule. However, for the past several years the reactor has operated continuously (seven days per week) to support major experiments. On average, the MIT Reactor was operated 114 hours per week at its design power level of 5 MW. Energy output for the MITR-II, as the upgraded reactor is now called, totaled 426,100 megawatt-hours as of June 30, 1997. The MITR-I generated 250,445 MW in the sixteen years from 1958 to 1974.

To summarize briefly the reactor utilization described in more detail above, it was well utilized during the year, although still more experiments and irradiations can be accommodated due to the number and versatility of its many facilities. The number of specimen irradiations was 640. There were 25 irradiations in the medical room, most in support of the neutron capture therapy program for the treatment of brain cancer and subcutaneous melanoma. Theses and publications on research supported by the reactor are running at about 15 and 30 per year, respectively. A total of 1272 people toured the MIT Research Reactor from July 1, 1997 through June 30, 1998.

John A. Bernard

OPERATIONS RESEARCH CENTER

The Operations Research Center (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 45th year of operation in 1997-98. The Center administers its own graduate programs and a varied research program of methodological and applied projects. It maintains a reading room with a small library, as well as a contemporary computational environment of workstations and microcomputers.

This report summarizes the Center's 1997-98 activities and briefly reviews its educational, research and outreach programs.

FACULTY, STUDENTS, STAFF

Robert M. Freund, Seley Professor of Operations Research and Thomas L. Magnanti, Institute Professor, continued as Codirectors of the ORC. Professor Magnanti was on sabbatical leave for 1997-98.

This year the ORC had 34 affiliated faculty and senior staff, with faculty drawn from the School of Management and the Departments of Electrical Engineering and Computer Science, Civil and Environmental Engineering, Ocean Engineering, Mathematics, Aeronautics and Astronautics, Mechanical Engineering, Nuclear Engineering, and Urban Studies and Planning.

The Operations Research Center offers two interdepartmental graduate degree programs, a Ph.D. and a master's degree. During 1997-98, these programs enrolled 44 students — 36 Ph.D. candidates and 8 SM candidates. The Center conferred 12 master's degrees and 11 Ph.D.'s. Several other Ph.D. theses were in the final stages of completion in the summer of 1998.

ACADEMIC PROGRAMS

The ORC's academic programs continue to be recognized as ranking among the very best nationally and internationally. The program, moreover, is repeatedly cited as achieving an excellent balance between application and methodological domains.

Several affiliated faculty were active in significant educational development projects at MIT. Professors Thomas L. Magnanti, Amedeo R. Odoni, and James B. Orlin taught in MIT's first distance-learning program, System Design and Management (SDM). Professor Orlin continued to undertake significant changes in the Sloan undergraduate subject offerings in operations research. Professors Dimitris J. Bertsimas, Robert M. Freund, and Thomas L. Magnanti are part of the proposal team for a thrust program in High-Performance Computation for Engineered Systems as part of MIT's proposed collaboration with Singapore in graduate education and research in engineering.

RESEARCH ACTIVITIES

Research activities spanned a wide spectrum of methodological topics and applications, ranging from small, unsponsored projects involving a single faculty supervising a student's thesis, to much larger sponsored programs involving several faculty/staff and students.

Methodological research includes such topics as linear, nonlinear, and combinatorial optimization, solution methods for integer programming, interior point methods for linear and nonlinear programming; cluster analysis; parallel and distributed computation and algorithms; network flow algorithms; network design; probabilistic combinatorial optimization; deterministic and stochastic facility location; queuing theory, including queuing networks; risk analysis, stochastic processes; classical and Bayesian statistics; and decision analysis and statistical decision theory.

ORC faculty are also currently contributing to application domains as wide ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, health care, and nuclear engineering. Current projects are addressing such topics as air traffic control, epidemiology, AIDS testing, life-cycle modeling of municipal solid waste, safety and risk analysis in air transportation, telecommunication network design, supply chain management, production scheduling, and transportation logistics.

Several organizations sponsored research projects at the ORC during 1997-98, for example: the National Science Foundation; C.S. Draper Laboratory (several projects and Draper Fellowships); Federal Aviation Administration's

Center of Excellence for Aviation Operations Research; Logistics Management Institute; Massport Authority; Office of Naval Research; and the United Parcel Service Foundation.

OUTREACH AND PROFESSIONAL SERVICE

In its effort to serve the professional community at large, the ORC regularly undertakes a number of outreach activities.

Professor Amedeo R. Odoni offered a professional course during the 1997 summer session: "Airport Systems: Strategic Planning and Detailed Design." Professors Richard C. Larson and Thomas L. Magnanti offered a Public Broadcasting Corporation short course entitled, "Data Informed Management Decisions."

The ORC Seminar Series was privileged to have many distinguished speakers from industry and academia this year. Among the many operations research professionals who made presentations were: Levent Tuncel (Univ. of Waterloo); Sridhar Tayur (Carnegie-Mellon); Maurice Queyranne (Univ. of British Columbia); Nick Bambos (Stanford); Sanje Arora (Princeton); S. Stidham, Jr. (Univ. of NC at Chapel Hill); Yinyu Ye (Univ. of Iowa); David Tse (Univ. of CA/Berkeley); Debasis Mitra (Bell Labs); Ravindra Ahuja (Inst. of Tech/India); Tom Leighton (MIT); Hershel Safer (Genome); William Pulleyblank (IBM); Leslie Servi (GTE Labs); Mitchell Burman (Analytics Inc.); Murray Campbell (IBM); Gerard Cornuejols (Carnegie-Mellon); Guillermo Gallego (Columbia); Ross Darrow (SABRE); David Yao (Columbia); Masakazu Kojima (Tokyo Inst. of Tech); and Stephen Ross (MIT).

The Center also offered a program of activities during the January independent activities period, including a series of presentations on the practice of operations research and management science presented by Robert Ferstenberg (ITG); Leslie D. Servi (GTE Labs); Susan O'Dell (PTCG); David Gamarnik (IBM); Mike Ricard (Draper Laboratories) and Sergiu Luchian (Massachusetts Highway Dept. and the Central Artery/Third Tunnel Project).

DIVERSITY

The ORC has always attempted to provide an environment that is responsive to the varied professional and personal needs of the OR community at MIT, and that builds upon diversity.

The ORC makes no faculty appointments. This year the ORC's active affiliated faculty members included one woman, but no under-represented minorities. However, the Sloan School recruited a woman faculty member, Dr. Georgia Perakis, who will join the faculty in July 1998. We anticipate that Dr. Perakis will become an active affiliated faculty member at the ORC.

The staff of the ORC is composed of two support staff members and one administrative officer. Of these three staff, all are women, and one is African-American.

The Center's graduate students are diverse, representing over 17 countries. This past Spring, we successfully recruited an African-American student, Kermit Threatte, to accept our offer of admission in the ORC doctoral program in September.

In keeping with the Center's tradition of seeking and attracting outstanding women, the number of female students has consistently averaged about 30%.

In order to enhance the enrollment of under-represented minorities, we have begun a number of outreach activities. We have set up a working group that will develop web-based, print-based, and multi-media material to promote operations research and the MIT OR Center to undergraduate students, with a particular emphasis on minority students. We have assigned volunteers to work with minority databases to identify highly qualified minority students in the US who might be interested in pursuing graduate study in OR. We have written letters to targeted minority students inviting them to apply to the OR program. And most recently, we have established a working group to target specific schools in the US and to try to arrange for faculty and/or student visits to these schools and make informal presentations.

PROFESSIONAL ACTIVITIES

The ORC-affiliated faculty and students continue to assume positions of leadership and receive many awards within the Operations Research and Management Science community. Professor Cynthia Barnhart was chosen as Director at Large for INFORMS. Professor Dimitris Bertsimas received the Bodosaki Prize, given to an outstanding Greek scientist under the age of 40. Also, Professor Bertsimas was one of the finalists for the INFORMS 1998 Franz Edelman Award. Professor Ismail Chabini was the recipient of a 1998 NSF Career Award. Dr. Stanley Gershwin became a Fellow of the IEEE. Professor Richard C. Larson was awarded an honorary membership in the National Omega Rho Honorary Society and presented the Omega Rho Distinguished Lecture at the INFORMS semi-annual meeting in Montreal. In addition, Professor Larson was awarded the Philip McCord Morse Lectureship Award. This award is given to an outstanding operations researcher who is chosen to represent the profession in a series of speaking engagements. Professor John D. C. Little received an Honorary Doctorate in Management Science from the Catholic University of Mons in Belgium. Professor Andrew Lo was the co-winner of the TIAA-CREF 1997 Paul A. Samuelson Award for Outstanding Scholarly Writing on Lifelong Financial Security for his book, *The Econometrics of Financial Markets* (co-authored with John Campbell and A. Craig MacKinlay). Professor Thomas L. Magnanti was elected President-Elect for INFORMS. In addition, Professor Magnanti received an Honorary Doctorate from the Catholique University de Louvain in Belgium. Professor Yossi Sheffi received the Distinguished Service Award of the Council of Logistics Management (CLM). This award is presented each year to individuals who have made a significant contribution to the art and science of logistics management, and is the highest honor for achievements in logistics. Amy Cohn, an ORC graduate student, was awarded a three-year fellowship for graduate studies from the National Science Foundation. Jay Sethuraman , an ORC graduate student, was awarded an IBM Cooperative Fellowship for graduate studies. In addition, Jay received second place in the Writing and Humanistic Studies for Scientific and Engineering Writing for his essay entitled, ``Linear Programming Brings Marital Bliss." Rafael Epstein, an ORC alumnus, was a member of the winning team of the INFORMS 1998 Franz Edelman Award which is the most prestigious award for management science practice. Kermit Threatte, an incoming graduate student for the fall term was awarded a fellowship from the MIT Graduate Education Office.

More information about the Operations Research Center can be found on the World Wide Web at the following URL: http://web.mit.edu/orc/www

Robert M Freund, Thomas L. Magnanti

PLASMA SCIENCE AND FUSION CENTER

The primary objective of the Plasma Science and Fusion Center (PSFC) is to provide research and educational opportunities to develop a basic understanding of plasma behavior, and to exploit that knowledge by developing useful applications. The central focus of the activities at the PSFC has been to develop a scientific and engineering base for the development of fusion power. Research is being carried out, however, in a number of nonfusion areas such as ionospheric research, generation and acceleration of particle beams, laser-plasma interaction, and industrial applications of plasmas.

The Plasma Fusion Center is recognized as the leading university laboratory in developing the scientific and engineering aspects of magnetic confinement fusion and related plasma science and technology. Its research programs continue to produce significant results on several fronts: (a) experimental confinement research on the Alcator C-Mod tokamak (investigations of the stability, heating, and transport properties of compact high magnetic field, diverted plasmas), (b) the basic physics of plasmas (plasma theory, theoretical support of ITER and IGNITOR, new confinement concepts, nonneutral plasmas, coherent EM wave generation, development of high-temperature plasma diagnostics, basic laboratory and ionospheric plasma physics experiments, and novel diagnostic of inertial fusion experiments), (c) a broad program of fusion technology and engineering development that addresses problems in several areas (e.g., magnetic systems, superconducting materials, fusion environmental and safety studies, advanced millimeter-wave sources, system studies of fusion reactors, including operational and technological requirements), and (d) a significant activity in industrial application of plasmas.

Programs at the Plasma Science and Fusion Center are supported principally by the Department of Energy's Office of Fusion Energy Sciences. There are approximately 256 personnel associated with PSFC research activities. These include: 18 faculty and senior academic staff, 38 graduate students and 6 undergraduates, with participating faculty and students from Electrical Engineering and Computer Science, Materials Science and Engineering, Mechanical Engineering, Nuclear Engineering, and Physics; 77 research scientist and engineers, and 51 visiting scientists and engineers; 39 technical support personnel; and 27 administrative and support staff.

Overall funding to PSFC remained stable this year. Funding of our major research activity (the Alcator Project) rose slightly over last year and is expected to rise again next year. This year's increase, however, was offset by a reduction in a second major program at PSFC (the ITER Program). Diminished support for ITER within Congress is likely to contribute to an overall decline in PSFC funding next year. In the meantime, our staff has been aggressive in submitting new research proposals to other initiatives launched by DoE and other sponsors. As a result, we have been successful in obtaining funding at the ~ $1-million level for a new joint MIT-Columbia University magnetic confinement experiment, the Levitated Dipole Experiment (LDX).

ALCATOR DIVISION

The Alcator Division, led by Prof. Ian Hutchinson and deputy division head Dr. Earl Marmar, carries out experimental research on Alcator C-Mod, a compact, high-performance divertor tokamak devoted to investigating the physics of high temperature magnetically confined fusion grade plasmas. The total staff of the Alcator Project is about 100, including 18 full time physicists, two faculty members and 18 graduate students.

Alcator C-Mod is now well established as one of the two national centers for U.S. tokamak research, along with DIII-D at General Atomics in San Diego. Alcator C-Mod is the only high-field compact divertor tokamak experiment in operation, and therefore plays a unique role in providing critical tests of scaling and theory at high power density. Substantial collaborations with the University of Texas, Austin, and the Princeton Plasma Physics Laboratory, are making major contributions to all areas of the C-Mod research effort, with particular emphasis on plasma heating (PPPL) and diagnostic enhancements (U. Texas and PPPL). Considering these projects in combination with our smaller University and Laboratory collaborative efforts, both domestic and international, more than 20% of the total funding for C-Mod research flows to groups outside of MIT. Funding at MIT grew to $12.6M in FY98, and is expected to grow again in FY99, to about $14.4M. Nevertheless, utilization of the facility is still significantly constrained, with experimental campaigns totaling 10 weeks of operation in FY98 and an anticipated 14 weeks in FY99.

There are four key areas of investigation on Alcator C-Mod. Transport studies on C-Mod provide critical tests of empirical scalings and theoretically-based interpretations of tokamak transport at unique dimensional parameters, but with dimensionless parameters comparable to those in larger experiments. Divertor research on C-Mod takes advantage of the advanced divertor shaping, very high scrape-off layer power density, high divertor plasma density, unique abilities in diagnosis and neutral control, and a high-Z metal wall. Ion cyclotron radio frequency power provides the auxiliary heating on C-Mod, and is exploited for research into wave absorption and parasitic losses and mode conversion processes. Advanced tokamak research on C-Mod proposes demonstrating fully relaxed current profile control and sustainment through efficient off-axis current drive by radio waves in the lower hybrid range of frequencies.

In the area of transport research, we have continued investigations of enhanced confinement regimes ("H-mode") with emphasis on local measurements. Trends demonstrating a temperature threshold have been elaborated and compared to high beta edge-turbulence simulations; reasonable agreement has been obtained. New ultra high spatial resolution (~1 mm) measurements of the H-Mode edge pedestal show features with scale lengths as short as 2 mm. We have begun to gain an empirical understanding of the enhanced D_a (EDA) H-mode regime, which is unique in its combination of good energy confinement, finite impurity particle confinement, and the absence of strong edge localized instabilities (ELMs), thus producing no transiently high heat loads onto the divertor. We are mapping out the plasma conditions which favor the formation of the EDA regime, and are beginning to understand the edge dynamics which produce these favorable conditions. Strong on-axis toroidal flows are observed in C-Mod during ICRF heating, and scalings of these flows with density, current and confinement properties have been measured. The flow is fastest in discharges with high stored energy, as well as those with core transport barriers (PEP mode). Such flows are very important in projecting to operation of larger, reactor-scale plasma devices, where external momentum input will be difficult or impossible to achieve.

In divertor research, we have implemented impurity injection feedback techniques to achieve quasi-steady-state detached divertor operation during EDA H-Mode plasmas. Using nitrogen, the peak divertor plate heat flux was reduced by about an order of magnitude, while the core plasma was only minimally affected by the injected impurities. This latter benefit is due, at least in part, to the effective divertor screening action which leads to a very high compression of impurity gases in the divertor volume. We have developed an analysis technique for determining the local plasma recombination rate in detached regions, using the deuterium Balmer and Lyman series radiation intensities. Opacities for the Lyman lines are measured, and the opacity effects reduce the overall recombination rates. The importance of ion-neutral friction has been verified from parallel flow measurements of ionized and neutral species in the divertor using spectroscopic techniques.

As the U.S. effort in support of the international ITER project has been decreasing, there has been renewed interest in the ignition/burning plasma mission for a next step fusion device. At the recent national fusion forum held in Madison, there was broad community support for such a step, with one embodiment being a compact, high field tokamak. As the prototype for such an experiment, C-Mod has already provided a number of important physics results needed as the basis to move along this path, and is very well positioned to continue in this role in the international program.

In the past year, the Alcator group submitted a proposal to DoE for the next five years of our research. The proposal has received very favorable peer review. Our support will change from the existing contract form to a Cooperative Agreement, with an anticipated start date of November, 1998.

Student involvement in the project remains strong. We anticipate maintaining the current graduate student number in the foreseeable future; Alcator remains the foremost university-based plasma fusion experiment.

PHYSICS RESEARCH DIVISION

Headed by Prof. Miklos Porkolab, this Division seeks to develop a theoretical and experimental understanding of plasma physics and fusion science. This Division is also a base for developing new confinement concepts, exploring inertial fusion energy and for studying space plasma physics.

FUSION THEORY AND COMPUTATIONS

Edge Plasma Physics Theory

Analytic and numerical investigations of edge plasma science for fusion relevant devices are the primary emphasis of Dr. Dieter Sigmar and coworkers. The edge plasma group aims to improve the understanding of basic plasma science phenomena and enhances the Alcator physics program by interpreting observations from the Alcator C-Mod tokamak and other fusion related devices around the world, while continuing to lead the national Divertor Task Force. The goal of this effort is to find ways to divert and control the severe heat and particle fluxes impinging on the first wall and divertor target plates of magnetic fusion devices while simultaneously maintaining good core plasma purity and confinement.

The collaboration between Dr. Sergei Kracheninnikov in our group, the Nagoya University NAGDIS-II linear simulator group led by Prof. Shuichi Takamura, and the Alcator C-Mod staff resulted in the first experimental observations of molecular activated recombination involving vibrationally excited molecules in a plasma simulator and a tokamak, respectively. Recombination is the mechanism that reduces the particle and heat load on the divertor target plates to acceptable levels. In addition, Dr. Kracheninnikov's insight that retaining transport across the magnetic field substantially widens the V shaped radiation front, thereby strongly enhancing radiation losses and allowing significantly higher input powers, has been confirmed by observations on ASDEX-U in Germany and C-Mod at MIT. Presently the group is leading efforts to i) understand the mechanisms at work just inside the separatrix, ii) improve radiation transport and neutral particle modeling, and iii) develop adaptive, unstructured grids necessary to effectively resolve radiation and ionization fronts in numerical modeling.

Advanced Tokamak Physics, MHD Stability, and RF Interactions

In this effort under the leadership of Drs. Paul Bonoli, Jesus Ramos, and Prof. Miklos Porkolab, a state of the art simulation code has been developed to compute self-consistent MHD equilibria in the presence of non-inductively driven currents. These equilibria are then analyzed for ideal MHD stability using a numerical equilibrium and stability code. Such studies are of great importance in the C-Mod program since they offer a means to improve tokamak performance, ultimately leading to an attractive steady state reactor. These so-called advanced tokamak operating modes are characterized by relatively high fractions of non-inductive bootstrap current (approximately 75%) and non-monotonic (``reversed shear") profiles of the safety factor. Such a reversed shear mode of operation in steady state has been identified for Alcator C-Mod using a combination of on-axis current drive in the ion cyclotron range of frequencies (ICRF) and off-axis lower hybrid current drive (LHCD) or mode converted ion Bernstein waves (IBW). The numerical model used in this work was developed by Dr. Marco Brambilla at the Max Planck Institute in Garching, Germany and was implemented at MIT. This current drive technique will be tested in the coming year on C-Mod using a new four strap ICRF antenna. These techniques will be used to optimize the expected performance of a "Next Step Burning Plasma Experiment" that may be designed by the world fusion community.

Reversed Field Pinch Theory

In another area, work was completed on an analysis of energy transport in a reversed field pinch (RFP) fusion configuration (with graduate student Antonio Bruno and Professor Jeff Freidberg). By assuming that the magnetic field and pressure profiles relax to a state which is marginally stable to the Suydam criterion (because of the related MHD turbulence) they derived an expression for the energy confinement time. This expression is in exact agreement with the empirically determined scaling law obtained from various RFP data .

RFD Theory and Basic Plasma Theory

The Plasma Theory Group under the direction of Prof. Abraham Bers and Dr. Abhay K. Ram has continued work on their proposed new means of plasma heating and current drive in the National Spherical Tokamak Experiment (NSTX), first reported in last year's President Report. Coupled analytical and computational work has shown that in a range of frequencies from 14 to 18 GHz more than 70% of the external power incident in the extraordinary wave can be mode-converted to electron-Bernstein waves (EBW) in the core of the plasma; EBW deposit their energy locally and efficiently on electrons. Basic studies of coherent and chaotic wave-particle interactions, carried out by this group, have lead to discovering new means for heating ions in a magnetic field by two lower hybrid waves, which is much more effective than the usual single wave heating. The frequencies of the two waves have to be separated by a multiple (1,2, or 3) of the ion-cyclotron frequency, and their wavenumbers have to be close in magnitude. Appropriate choices of the wave parameters can also be made to lead to energy extraction from energetic

ions, such as from fusion produced alpha-particles. Also ongoing in this group are studies of nonlinear wave-wave interactions relevant to laser-plasma systems for inertial confinement fusion, and in collaboration with the laser-plasma group at the Los Alamos National Laboratory. In particular, a new model for the saturation of stimulated Raman scattering, which invokes coupling to spatiotemporal chaos in the excited Langmuir decay, has been shown to predict some experimental observations of light backscattering form laser produced plasmas.

PLASMA PHYSICS EXPERIMENTS

Levitated Dipole Experiment

During FY98 we began the design of a new fusion research facility, the Levitated Dipole Experiment (LDX). The LDX represents a new concept exploration experiment funded by the DoE as a joint collaborative project with Columbia University. The LDX facility is being designed by the engineering division of the PSFC and it will be located within the Tara cell in NW21. We envision a 5 year research program and the first plasma results are expected in the spring of 2001. The levitated dipole experiment represents a new and innovative approach to magnetic fusion which will utilize a levitated superconducting coil to confine plasma in a dipole magnetic field. The principal investigators of this project are Dr. Jay Kesner of the MIT Plasma Science and Fusion Center and Professor Michael Mauel of Columbia University.

The project includes a 5 year funding period with an approximate budget of $1 million per year, (shared between MIT and Columbia University). The construction of the project will be directed by Dr. Minervini during the initial 2 1/2 year period and a substantial fraction of the FY98 and FY99 budget will go to the PSFC engineering division for the design and fabrication of the facility.

Ionospheric Plasma Research

The Ionospheric Plasma Research Group (Dr. Min-Chang Lee and students) have been conducting laboratory experiments on the Versatile Toroidal Facility (VTF) at PSFC and ionospheric plasma heating experiments at the Arecibo Observatory (Arecibo, Puerto Rico). These experiments, aimed at investigating wave-plasma interactions and plasma turbulence, can effectively cross-check the results obtained in tenuous space plasmas and dense laboratory plasmas. The most important research results in the past year are the discoveries of RF-excited ionospheric plasma bubbles and sheet-like plasma density striations(reported by Lee et al. in the Geophysical Research Letters) In a different area of research funded by DoD's Defense University Research Instrumentation Program (DURIP), a portable radar system will be purchased this year. This broad-band radar will be used as a diagnostic instrument for ionospheric plasma heating experiments, and as new RF sources for VTF laboratory experiments.

Basic Physics Experiments on the Versatile Toroidal Facility (VTF)

Professor Ambrosio Fasoli has been appointed the leader of the VTF toroidal facility. He will establish a new program in basic experimental plasma physics, transferring much of the equipment from Versator II in the Research Laboratory of Electronics (RLE).

Inertial Confinement Fusion Experiments

Recent work of the MIT, Univ. of Rochester, and LLNL collaboration (Dr. Richard Petrasso and coworkers) has resulted in the first spectroscopic measurements of energetic charged particles on the Omega inertial fusion experimental facility. Individual line profiles of charged fusion products have been obtained, and include D-^{3}He protons (14.7 MeV), D-^{3}He alphas (3.6 MeV), D-T alphas (3.5 MeV), D-D protons (3.0 MeV), and D-D tritons (1.0 MeV). Knockon tritons and deuterons have also been observed and quantified. From these different particle measurements, the first ever obtained on an inertial confinement device, it has been possible to determine fusion yields, ion temperatures, fuel and ablator core conditions (i.e. ρRs), and anomalous accelerations. Such parameters are crucial to understanding the dynamics of the implosion process. In addition, surprising and copious fluxes of energetic ablator proton "lines" have been observed from ~ 100 to ~ 700 keV. The endpoint energy of these ablator protons suggest that the capsule is sometimes charging up to ~ 700 kV. This result was quite unexpected.

At the end of July a second large spectrometer, again the result of the MIT, Univ. Rochester, and LLNL collaboration, will be interfaced to Omega. In addition to the previous measurements, the two spectrometers working in tandem will be able to make detailed determinations of implosion symmetry. Both spectrometers are prototypes of a set which MIT and collaborators are in the process of designing for the National Ignition Facility

(NIF). The NIF will be the first facility in the world to achieve ignition, and we expect the MIT spectrometers to play a prominent role in this national facility and the achievement of ignition.

Phase Contrast Imaging on DIII-D

This collaborative effort between General Atomics and MIT (Professor Miklos Porkolab) has enjoyed a new period of 3-year funding cycle. Through careful studies over the course of several years, the properties of edge turbulence have been mapped out by Dr. Coda, a former MIT physics graduate student. The novel observation of the existence of radially propagating modes has been found to be in agreement with recent analytical and numerical code predictions on the global structure of a class of plasma instabilities (ITG modes). For his pioneering studies, Dr. Coda won the 1997 APS Division of Plasma Physics Outstanding Thesis Award in November, 1997. Two new post doctoral fellows, Dr. Peter O'Shea and, very recently, Dr. Chris Rost have been upgrading the experimental installation to comply with new safety regulations, and will continue the experiments in the next fiscal year.

Gyrotron Scattering Experiments on JET

A collaborative effort with the European community to develop and utilize a unique advanced fusion plasma diagnostic capability for highly energetic ions inside the plasma core is expected to continue next year. A successful demonstration of high-power collective Thomson scattering from energetic ions was achieved this fiscal year with MIT participation (Drs. Paul Woskov and John Machuzak) on the JET tokamak in England. A 100 - 400 kW millimeter-wave Russian gyrotron was used with a sensitive heterodyne receiver to obtain scattered millimeter-wave signals from radio frequency heated minority helium species in the core plasma of a tokamak for the first time. Planning is currently under way to either continue this work at JET or to temporarily pursue additional experimentation at the TEXTOR tokamak in the Netherlands.

WAVES AND BEAMS DIVISION

The Waves and Beams Division, headed by Dr. Richard Temkin, conducts research on novel sources of electromagnetic radiation and on the generation and acceleration of particle beams.

GYROTRON RESEARCH

The gyrotron is a novel source of microwave, millimeter wave and submillimeter wave radiation. Gyrotrons are under development for electron cyclotron heating (ECH) of present day and future plasmas as well as for high frequency radar. These applications require tubes operating at frequencies in the range 100-300 GHz at steady-state power levels approaching 1 MW. The gyrotron research group is led by Dr. Kenneth Kreischer. In 1998, research has concentrated on 3 major issues in gyrotron research: (i) increasing the power output of gyrotrons, (ii) producing nearly perfect Gaussian microwave beams, and (iii) increasing the efficiency of gyrotrons. Progress in these areas requires investigating the physics issues, including mode competition and beam quality, of high power, high frequency gyrotrons. A prototype experiment at M. I. T. has been built and has demonstrated a power level of 1.5 MW at a frequency of 170 GHz with an efficiency of over 35%. A novel mode converter for this gyrotron has been built and tested. A first attempt at this technique was recently tried at Communications and Power Industries of Palo Alto, CA. The result is an excellent Gaussian beam that is passed through a low loss, diamond window. Future work will concentrate on increasing the efficiency of the gyrotron to close to 70% using depressed collectors. A program of research is also underway to demonstrate a 140 GHz coaxial cavity gyrotron. The coaxial cavity gyrotron may be capable of higher power than conventional cavity gyrotrons, up to 3 MW. A new idea for a gyrotron microwave window, a dome shaped window, is also under investigation. This research is primarily sponsored by MIT Lincoln Lab through their Advanced Concepts Committee (ACC) internal funding program. First pressure tests of the window were completed and are being analyzed. A new research program has been initiated to develop a 250 GHz gyrotron for use in electron spin resonance and nuclear magnetic resonance studies. This research, funded by NIH in collaboration with Prof. R. Griffin of the Magnet Lab, is a pioneering effort in high frequency spin resonance studies. The first equipment for this experiment has been built and is under test.

HIGH GRADIENT ACCELERATOR RESEARCH

The High Gradient Accelerator Group is conducting research on a novel, 17 GHz, microwave driven, photocathode electron injector. This device, sometimes called an RF gun, can generate a 2 ps beam of 1-2 MeV, 50-500 A electrons at high repetition rate. A 26 MW, 17 GHz klystron power source drives the electron gun. This electron beam can be used for microwave generation or it can be used as an injector into a 17 GHz, high gradient accelerator. This research supports the program to build new electron accelerators that can reach the TeV range of energies.

In 1998, the RF gun was operated and the beam output energy and energy spread were measured. This is the first photocathode electron gun to operate at a frequency above 2.856 GHz. Conditioning of the cavity allowed operation of the gun at surface fields of up to 250 MV/m before dark current and breakdown were observed. Using 10-20 μJ, picosecond pulses from a Ti:sapphire laser tripled to 267 nm, electron bunches of 0.1 nC were obtained with energies exceeding 1 MeV. In 1998, we installed a high gradient accelerator built by Haimson Research Corp. This accelerator can achieve beam energies of about 30 MeV. This research should establish 17 GHz as a feasible frequency for future TeV electron colliders.

THEORETICAL RESEARCH

The Intense Beam Theoretical Research Group, led by Dr. Chiping Chen, has contributed significantly to our understanding of coherent radiation generation and particle acceleration. Topics covered include coherent radiation sources (CARM, FEL, gyrotron, relativistic klystron, relativistic TWT), intense beam transport and beam halo formation, beam-beam interactions, cyclotron resonance accelerators, two-beam accelerators, photocathode design, and other topics. Research explores self-field-induced nonlinear resonant and chaotic phenomena in intense charged particle beams. This research supports the U. S. program to construct advanced accelerators for such applications as nuclear waste treatment, heavy ion fusion and free electron lasers.

PLASMA TECHNOLOGY DIVISION

The mission of the Plasma Technology Division led by Drs. Daniel Cohn and Paul Woskov, is to develop new plasma technology applications with particular emphasis on environmental applications; to develop new fusion diagnostics; and to develop new fusion system concepts.

The Division is developing microwave plasma spectrometer systems for continuous monitoring of metals emissions from plasma furnaces, incinerators and other technologies for treatment of waste at DoE sites. The microwave plasma spectrometer approach has unique capability for meeting DoE needs of real time in situ measurements. The Division is also developing plasma technology for conversion of hydrocarbon fuels into hydrogen rich gas. It is investigating the use of plasma produced hydrogen-rich gas for pollution reduction in both stationary power and vehicular applications. Application to pollution reduction from internal combustion engines could have an important impact on air quality. In addition, plasma conversion of difficult to use biofuels into readily usable clean combustion fuels is being investigated.

During the last year substantial progress has been made in developing a real time calibrated microwave plasma continuous emissions monitor for hazardous metals. A field test was successfully carried out at the U. S. Environmental Protection Laboratory in Research Triangle Park, North Carolina. In the area of plasma generation of hydrogen rich gas, a major improvement in conversion efficiency and in electrical power requirement has been achieved. In addition, initial experimental studies of plasma conversion of biofuels have produced promising results.

During the next year, improvements will be made in the performance of the real time calibrated microwave plasma continuous emissions monitor. This work will include novel studies of atmospheric microwave plasmas. In the area of plasma generation of hydrogen-rich gas, a new program is underway to investigate vehicular applications. This program will be funded by the DoE Office of Transportation Technologies and will be carried out in collaboration with Battelle Pacific Northwest National Laboratory.

Paul Woskov has been notified that he will receive a 1998 R&D 100 award. The Award will given for development of the real time calibrated continuous emissions monitor. Dr. Woskov, Dr. Dan Cohn and other members of the Plasma Technology Division have also received R&D 100 Awards in 1994, 1995, and 1997.

TECHNOLOGY AND ENGINEERING DIVISION

The Technology and Engineering, headed by Dr. Joseph Minervini, conducts research on conventional and superconducting magnets for fusion devices and other large scale power and energy systems.

During the past year the major emphasis of the Division's effort has been on completing the Central Solenoid Model Coil (CSMC) as one of the major R&D tasks of the ITER Engineering Design Activity (EDA). This work has been carried out both through subcontracts to industry, with Lockheed Martin being the prime contractor, and through coil fabrication activities by engineers and technicians from the Technology and Engineering Division and from the Alcator Division, in an MIT-leased facility in Hingham, MA. When completed by end of the current fiscal year, the CSMC will be the world's most powerful superconducting pulse magnet, storing 650 MJ of energy at the design field of 13T.

Other activities within the Division included operation of the Pulse Test Facility (PTF), a unique, large bore magnet facility, specifically built under the ITER program, to test large size superconducting cable-in-conduit conductors and joints under pulsed field conditions. During the PTF's most recent test campaign, a prototype conductor and joint -- designed and fabricated by our staff -- was successfully tested to meet the operating requirements of the CSMC. Although scheduled to test at least one additional superconductor sample provided by Japan, the facility operations were stopped halfway through the fiscal year to conserve funds for continued CSMC construction.

Other major Division activities included completion of a materials database on the new superalloy Incoloy Alloy 908 in the Materials Laboratory of the Technology and Engineering Division under the leadership of Prof. Ronald Ballinger. This alloy was specifically developed by Prof. Ballinger and INCO Alloys International (Huntington, WV) to enhance the performance of Nb3Sn superconductors when used in a cable-in-conduit conductor configuration. During the ITER CSMC fabrication program, over 60 tons of this material was commercially produced in extruded cross-section and welded form, and it provides the major structural component of the CSMC.

Another active area of research was performed under sub-contract to the Princeton Plasma Physics Laboratory for magnets and magnet systems design for the Korean K-STAR superconducting tokamak program. Additional supporting superconductor R&D was performed under direct contract to Samsung Advanced Institute of Technology.

In related research activities, Dr. Jeffrey Freidberg and his colleagues have developed an elegant method for mapping the magnetic fields in the large detectors located in high energy particle accelerators (with Drs. Stefano Migliuolo, Ali Shajii, Jay Jayakumar). The method makes extensive use of Green's theorem and the theory of integral equations to greatly reduce the cost and time of traditional volume mapping techniques to a much simpler surface mapping procedure. The procedure is now being implemented on the PHENIX detector of the RHIC facility at Brookhaven.

Work continues on developing a continuum model of a multistrand superconducting CICC magnet in order to explain the ramp rate limitation observed in certain coils (with graduate student Michael Thomas and Dr. Joseph Minervini). This is a significant modeling effort attempting to account for transverse geometric effects in cables with as many as 1000 strands with time varying transport current and transverse fields.

Development work also continues on a procedure for determining pipe thickness from a series of external impedance measurements (with graduate student Julio Rangel and Prof. Ron Ballinger). Such a procedure would be of great safety value and economic importance to the nuclear power industry where steam pipe thinning due to corrosion is a critical problem. The new procedure saves time (i.e. money) by allowing continuous monitoring of pipe thickness without the need for shutdown as is the current practice.

Overall funding became constricted during fiscal year 1998, which resulted in layoff notices being issued to 4 research staff members, and 5 regular and 2 temporary technicians. In addition 1 research staff member and 1 postdoctoral associate left for industry positions and were not replaced. Severe reduction in funding expected for ITER in the post-EDA period, combined with the cost overrun for the CSMC, indicates that fiscal year 1999 funding will not be sufficient to maintain the Division at it's already reduced size, so additional layoff actions are required.

The Division supports 6 graduate students in the Departments of Nuclear, Mechanical, and Materials Science and Engineering. We are committed to maintain continuity of support for these students at least through FY99.

EDUCATIONAL OUTREACH PROGRAMS

The Plasma Science and Fusion Center's educational outreach program is planned and organized under the direction of Mr. Paul Rivenberg, Outreach and Public Relations Coordinator of the PSFC. The program focuses on heightening the interest of K-12 students in scientific and technical subjects. The PSFC seeks to educate local students and the general public by conducting general tours of experiments being done here. Special "Outreach Days" are held twice a year, encouraging high school and middle school students from around Massachusetts to visit the PSFC for a day of hands-on demonstrations and tours. This year these days attracted record numbers.

The Mr. Magnet Program, headed by Mr. Paul Thomas, Technical Supervisor, brings a traveling demonstration on magnetism into local elementary schools, inspiring and exciting students with the chance to take part in hands-on experiments with magnets. Over the past year he has worked with over 30,000 students at over 66 schools and other events. Since receiving the 1997 Billard Award from MIT, Paul Thomas has significantly increased his national visibility, traveling in his truck to Pittsburgh for the November, 1997 APS-DPP meeting, and to Washington, DC in April, 1998, to participate in a Plasma Expo (see below), also visiting area schools on both occasions. As the program has grown, Paul has increased the size and number of his demonstrations to help accommodate the now large auditoriums in which he works. His show has expanded to the point where we now need to seek funding for a larger truck for his demonstrations. The Department of Energy continues to be impressed with this program, and encourages more and more national outreach. We plan to seek funding from this agency for this and other PSFC educational programs.

The PSFC continues to work with other national laboratories to educate students and the general public. An annual Teacher's Day (to educate teachers about plasmas) and Open House (to which they can bring their students) has become tradition at each year's APS-DPP meeting. The 1997 event in Pittsburgh was the result of a year of planning involving the local education community and representatives from various laboratories. It attracted over 60 teachers to Teachers Day and 1,000 students/public to the Plasma Expo. PSFC Outreach Coordinator Paul Rivenberg was involved with the planning of this event, and heads MIT's leading organizational role in the 1998 APS meeting in New Orleans. Over 170 teachers have already applied for the 1998 Teachers Day, and we anticipate over 3,000 students at the Expo. The PSFC participated in a similar outreach event in March and April of 1998 in Washington, DC, sponsored by General Atomics and the Coalition for Plasma Science (CPS).

The Coalition for Plasma Science is a growing organization formed by members of universities and national laboratories to promote understanding of the field of plasma science. Associate Director Dr. Richard Temkin, who oversees PSFC education efforts, is working with this group on goals which include requesting support from Congress and funding agencies, strengthening appreciation of the plasma sciences by obtaining endorsements from industries involved in plasma applications, and addressing environmental concerns about plasma science, particularly fusion. Tobin Smith of MIT's Washington Office has been Acting Chairman of the Coalition during this year. In June, 1998, the group presented" Plasma-Science and Technology for the 21st Century," a reception for congressional representatives and their staff, geared to educate them about the potential of plasma research. Many of the popular, interactive demonstrations used for this event were supplied by MIT's Mr. Magnet Program, and were transported to DC by Paul Thomas in his truck. Mr. Thomas Pedersen, a graduate student, and Mr. Paul Rivenberg, Outreach and Public Relations Coordinator, also made presentations at the Washington event.

APPOINTMENTS AND PROMOTIONS

During the past year, there have been several important appointments and promotions in Plasma Science and Fusion Center program areas.

Professor Ambrosio Fasoli, a new Assistant Professor in the Physics Department has joined the Plasma Science and Fusion Center. He was appointed leader of the VTF experimental program. Other appointments included Xavier Bonnin, Darren Garnier, Anders Odblom and Jon Christian Rost as Postdoctoral Associates in the Physics Research Division.

In the Office of Resource Management, Matthew Fulton was promoted to Facilities and Safety Coordinator. The Alcator Project promoted Stephen Wukitch to Leader, RF Experiments. The Fusion Technology and Engineering Division promoted Shahin Pourrahimi to Advanced SC Materials Group Leader.
During the past year there was one Institute promotion in the Plasma Science and Fusion Center, Dr. Richard Temkin, Associate Director.

GRADUATE DEGREES

During the past year, the following departments granted students degrees with theses in plasma fusion and related areas:

Electrical Engineering and Computer Science: Michael Rowlands, M.S.; and Kenneth Wu, M.S.
Nuclear Engineering: Allen Aaron, M.S.; Shaun Meredith, M.S.; George Miller, M.S.; John Novak, Ph.D.; Jeffrey Schachter, Ph.D.

Physics: William Daughton, Ph.D.; Darin Ernst, Ph.D.; Wen Hu, Ph.D.; Jon Christian Rost, Ph.D.

We take this opportunity to wish these graduates success in their future professional endeavors.

More information about the Plasma Science and Fusion Center can be found on the World Wide Web at the following URL: http://www.pfc.mit.edu/

Miklos Porkolab

RESEARCH LABORATORY OF ELECTRONICS

The Research Laboratory of Electronics (RLE), the Institute's oldest interdisciplinary research laboratory, was founded in 1946 as the natural evolution of the wartime MIT Radiation Laboratory. Initially, RLE was formed to bring together interests in physics and electrical engineering to work on problems in electromagnetic radiation, circuits, and specialized vacuum tubes. Over the years, RLE's research interests have branched out in many directions and, in fact, several of these interests have precipitated the formation of additional laboratories. Research within RLE is conducted by approximately 55 faculty members who are affiliated with the Departments of Electrical Engineering and Computer Science, Physics, Chemistry, Materials Science and Engineering, Aeronautics and Astronautics, and Linguistics. During the past year, approximately 200 graduate students and 75 undergraduates have worked on research projects within RLE. Major support is derived from Department of Defense (DoD) agencies; the Department of Energy (DOE); the National Science Foundation (NSF); the National Institutes of Health (NIH); and the National Aeronautics and Space Administration (NASA). In addition, many research projects are funded through industry and private foundations. Although RLE has a very heterogeneous character, its organization is composed of two major thrusts and several smaller focus areas. One major thrust is centered on electronics and optics, and the other is centered on language, speech, hearing, and sensory communication. Each of the smaller focus areas often has substantial overlap with other research in RLE.

In the following remarks, several research highlights from 1997 are mentioned. The interested reader can obtain further information from *RLE Progress Report No. 140*, which describes research activities during calendar year 1997.

ELECTRONICS AND OPTICS

MATERIALS AND FABRICATION

Professor Jesús del Alamo built a dynamic model for the kink effect in indium-aluminum arsenide/indium-gallium arsenide high-electron mobility transistors on indium phosphide. The kink effect refers to prominent distortion of the output characteristics in these transistors, which seriously affects high-frequency circuit operation. Professor del Alamo found that impact ionization generation of holes and subsequent storage is the origin of the kink. Hole storage takes place at the source and at the surface of the device. With this new understanding, the kink can now be modeled by only three parameters, which provides a useful framework for practical circuit design.

QUANTUM-EFFECT DEVICES

Professor Marc Kastner studied the Kondo effect in a quantum dot. The theory for this effect first appeared in 1963, and it seeks to explain why the resistance of some metals begins to increase as the metal is cooled below a certain temperature. Kondo theorized that the local moments of magnetic impurity atoms have an antiferromagnetic coupling to the spins of the conduction electrons. This coupling becomes stronger, and increasingly impedes the flow of current, as the temperature decreases. The variation of conductance with gate voltage, where temperature is a parameter, shows peaks that are clustered in pairs. A pair of peaks corresponds to the addition of an electron pair in the same spatial state; one electron with spin up and the other electron with spin down. The next electron that is added goes to the next spatial state. Additionally, in the region between the paired peaks, the quantum dot (or artificial atom) has an odd number of electrons. The non-zero conductance between the paired peaks arises because the quantum dot has an unpaired electron, which is free to form a singlet with the electrons in the leads. Thus, as theoretically predicted, the Kondo interaction accounts for conductance in a region where none is ordinarily expected.

Professor Henry Smith developed a new scheme for spatial phase-locked electron-beam lithography that is based on an efficient, patternable scintillator. This technique is widely recognized as the most promising approach to achieve nanometer-level accuracy in electron-beam patterning. Professor Smith also made the first definitive study of the resolution limits of x-ray lithography, and has demonstrated that this is the only technique with reliable replication of sub-100-nanometer features. He has also carried out the first lithography using an array of Fresnel zone plates. This is a promising approach to future maskless lithography in the sub-100-nanometer domain. In collaboration with Professor Caroline Ross of the Department of Materials Science and Engineering, he has fabricated large arrays of discrete magnetic posts that measure 50-nanometers in diameter on 100-nanometer centers. These arrays provide the highest density of magnetic information storage yet attained.

OPTICS AND DEVICES

Professor James Fujimoto demonstrated how optical coherence tomography could be combined with fiberoptic delivery systems to create catheters and endoscopes for imaging internal organ systems. He performed the first demonstration of *in vivo* optical coherence tomography imaging by using such a catheter/endoscope system. He also investigated the development of new nonlinear optical materials for short-pulse generation in the near-infrared spectrum. This will enable the study of ultrafast processes in physics, chemistry, and biology.

Professor Hermann Haus studied the characteristics of optical waveguide structures with high index contrast, such as silicon and silicon dioxide. Using computer simulation, he demonstrated right-angle bends and waveguide crossings with excellent performance. He also carried out simulations on pulse propagation along dispersion-managed fibers. He found a form of nonlinear pulse propagation that suppresses the Gordon-Haus effect, which refers to the pulse timing jitter that is produced by amplified spontaneous emission-induced frequency shifts of the pulses. Finally, he demonstrated shot-noise reduction as much as 5 decibels, which was produced by propagating pulses along a nonlinear birefringent fiber and subsequent superposition using a beam splitter. This is a new method of "squeezing" that is particularly robust against environmental perturbations.

Professor Erich Ippen observed coherent terahertz acoustic oscillations, which were excited by femtosecond pulses, in lead telluride quantum dots in a glass matrix. These oscillations modulate optical transmission and reveal information about dot sizes and distributions. Professor Ippen also demonstrated a new ultrashort-pulse glass waveguide laser that promises a more compact and higher repetition-rate source for fiber communications. In collaboration with Dr. Katherine Hall of Lincoln Laboratory, he demonstrated the operation of a novel optical storage loop that buffers kilobits of optical data at 5 gigabits per second for more than 150 milliseconds.

Professor Qing Hu seeks to develop sensors and sources for millimeter-wave, terahertz, and infrared frequencies. He observed narrow-linewidth intersubband emission (less than 0.5 terahertz) at the designed frequency of 4 terahertz. This research contributes to the design of a future laser source that can operate in this frequency range.

SURFACES AND INTERFACES

Professor John Joannopoulos studied the difference in energy barriers between adsorption and desorption of the hydrogen molecule in relation to the silicon (111)-(7x7) surface. Based on first-principals density functional theory calculations, he verified the experimentally observed difference in these energy barriers. These results demonstrate a novel effect, whereby the localized dangling bonds on the semiconductor surface "bend toward" the incoming molecule in order to facilitate its dissociation.

Professor Simon Mochrie studied the morphology of stepped surfaces of silicon (113) and silicon (112), each of which may develop a periodic grooved superstructure under appropriate conditions. Recently, he showed how steps on a silicon (113) surface agglomerate after a rapid change in temperature at which single steps are stable to a temperature at which step bunches are stable.

CIRCUITS AND SYSTEMS

Professor Jacob White uses computational prototyping and fast numerical algorithms to characterize integrated circuit interconnect and packaging, micromachined devices, and offshore structures. He developed the next generation of fast algorithms by using the precorrected-fast Fourier transform (FFT) method. This method is faster than fast multipole algorithms and can be used with any Green's function. In contrast, fast multipole methods are only used for $^1/_R$ Green's functions. Combined with new integral formulations, these new algorithms enable the accurate determination of capacitances and inductances in the presence of materials with high permitivity or permeability.

Professor John Wyatt continues to develop an ocular prosthesis for blind patients with outer retinal degeneration, such as macular degeneration or retinitis pigmentosa. Recently, he briefly implanted a thin, flexible, and nondestructive electrode array in the eye of a blind subject under local anesthesia. Currents were applied to the electrodes and the patient reported his perceptions, which, unfortunately, were inconclusive. Nevertheless, this initial surgery was successfully performed with no harm to the subject, and much was learned about improvements for further human testing.

LANGUAGE, SPEECH, HEARING, AND SENSORY COMMUNICATION

SPEECH COMMUNICATION

Professor Kenneth Stevens continues to develop models of speech sound generation and human word recognition, with special attention paid to the variability that occurs in speech sounds across speakers and their modes of speaking. He refined his model of human word recognition and developed procedures that account for some of the rule-generated modifications of speech sounds that occur in casual speech. His research on the acoustic and articulatory manifestations of certain speech disorders has led to the development of measures that provide quantitative assessments of the severity of these disorders. These assessments have potential for future clinical use.

AUDITORY PHYSIOLOGY

Dr. Donald Eddington investigates hearing produced by electrical stimulation of the human auditory system. He has focused on loudness growth in cochlear implant subjects by using commercial sound-processing schemes. By measuring the electric loudness growth function of each implanted electrode, he computed a level mapping function for each processing channel that restores normal loudness growth for tones. Initial speech reception tests show that some subjects score significantly better when using sound processors based on the level mapping functions that are designed to restore normal loudness growth.

Professor Dennis Freeman continues to develop video methods to measure nanometer motions of micrometer-sized objects. He has applied this system to measure sound-induced motions of inner-ear structures, as well as microfabricated accelerometers and gyroscopes. There is considerable interest in developing this technology as a research tool and as an aid to fabricate microelectromechanical systems. He has also begun to apply this technology to microfabricated optics, such as those used in fiberoptic communication networks.

ATOMIC, MOLECULAR, AND OPTICAL PHYSICS

Professor Wolfgang Ketterle continues to study the properties of Bose-Einstein condensates and to further develop the atom laser—an intense, coherent beam of atoms. Recently, he observed the formation process of a condensate *in situ*. This provided evidence for bosonic stimulation or coherent matter-wave amplification, which is crucial to the concept of the atom laser. He also realized the all-optical confinement of a Bose-Einstein condensate, thus allowing the study of condensates in arbitrary magnetic fields and with arbitrary spin orientation. In addition, he observed that the forces between Bose-condensed atoms could be altered significantly through Feshbach resonances. Such resonances were observed by varying an external magnetic field, and this opened the possibilities to study and manipulate Bose-Einstein condensates.

Professor David Pritchard recently developed theories and techniques for longitudinal atom interferometry. One of his theories explains how short regions of oscillating fields can create and recombine longitudinal momentum coherences in an atomic beam. Thus, these fields serve as atomic beam splitters. Professor Pritchard also used his techniques to carry out the first search for longitudinal coherences that emanate from a supersonic atomic oven, which is a topic of considerable historical controversy. With enough sensitivity to detect signals 20 decibels weaker than 100 percent modulation, he found no modulation between 5 hertz and 150 kilohertz, which is the anticipated frequency range of such modulation (if it exists). This means the quantum density matrix has finally been determined for an atom source.

RADIO ASTRONOMY

Dr. Philip Rosenkranz built an improved microwave temperature sounder for use in high-altitude aircraft. New algorithms that infer profiles of temperature, water vapor, and cloud liquid water from the measurements have enabled the improved detection of clouds and precipitation.

DIGITAL SIGNAL PROCESSING

Professor Gregory Wornell developed a new class of highly robust and efficient information-embedding techniques for digital watermarking of media that includes audio, video, and various types of imagery and graphics. These techniques can be used for copyright protection and authentication. He also developed a new class of ultralow-complexity error-correction coding strategies that can be used for reliable transmission over unreliable channels with feedback. These new methods were adapted from familiar, computationally efficient source-coding algorithms for channel coding applications. For unknown channels, the methods are universal and can achieve the performance of the best possible codes, were the channel known.

ELECTROMAGNETICS

Professor Jin Au Kong developed new theories for inverse scattering and forward models to invert important geophysical parameters, such as a biomass of forest and sea ice thickness. In addition to his theoretical development, he participated in data interpretation of the active spaceborne imaging radar and passive airborne radiometric experiments for remote sensing of the earth and its oceans.

OPTICAL COMMUNICATIONS

Professor Jeffrey Shapiro continues to explore issues that relate to the measurement of eigenkets for continuous-time photodetection in its various basic modes of operation. His results are being applied to unify and extend the theory for quantum-wave propagation in a single-mode fiber. He also developed new techniques for laser radar-range imaging with model-based object recognition using posterior marginal pose estimation. This is the first principled end-to-end system for object recognition based on laser radar-range images.

Dr. Ngai Chuen Wong continues to study optical parametric oscillator technology for applications in precision measurements and quantum optics. This work will improve understanding of the optical parametric oscillator's phase noise characteristics, which are essential in ultraprecise optical frequency metrology.

INDIVIDUAL RESEARCH

Professor Donald Troxel developed a tool to assess the reliability of metal interconnect in a VLSI device from its mask layout information. This tool is being used to understand and model the crystal structure of copper, which is of increasing importance for large integrated circuits. In addition, he continues to develop MEMStation, a workstation used to design microelectromechanical systems.

AFFIRMATIVE ACTION

RLE has worked and will continue working to increase the number of women and minorities in career positions in the laboratory, in the context of the limited pool of qualified technical applicants and the unique qualifications of RLE's sponsored research staff. Specific measures will include: (1) maintaining our high standards for recruitment procedures that include sending job postings to minority colleges and organizations; (2) working closely with the RLE faculty/staff supervisor at the beginning of each search to identify ways of recruiting minority and women candidates for the new position; and (3) being committed to finding new techniques to identify more effectively women and minority candidates. During the past year, due to limited turnover in RLE's research staff, success in affirmative action for research staff has been limited. Of the two research staff appointments made this year, one was made to a woman.

More information about the Research Laboratory of Electronics can be found on the World Wide Web at the following URL: http://rleweb.mit.edu/

Jonathan Allen

SEA GRANT COLLEGE PROGRAM

The MIT Sea Grant College Program provides funds for research, education, and technology transfer directed toward wise utilization of marine resources. MIT has been a leading participant in the national program since 1969. In 1976 the Institute was designated a Sea Grant College Program. Sea Grant College status offers the potential for greater funding and confers a responsibility to work with marine researchers throughout the Commonwealth.

Funds are distributed among the 29 Sea Grant Programs in a competing grant process by the National Oceanic and Atmospheric Administration through its National Office of Sea Grant. Each program is required to match every two dollars of its federal grant with one from non-federal sources. Congress established this matching provision to ensure that Sea Grant universities would be responsive to public and industry needs. Sea Grant provides funds explicitly for technology transfer through its mandate for advisory services and education in addition to its research mandate.

In FY 1998 the National Office of Sea Grant awarded MIT $1.9 million. MIT, industry partners, the Commonwealth, the Massachusetts Water Resources Authority (MWRA) and other federal (most notably ONR) and non-federal agencies provided more than $4.5 million. In all, these funds provided partial support for 20 faculty members, 11 post-doctoral and research fellows and 31 students from MIT's departments of Chemical, Civil and Environmental, Ocean, Mechanical and Electrical Engineering, and Earth, Atmospheric and Planetary Sciences; as well as partial support for faculty and students at UMASS/Amherst, UMASS/Boston, UMASS/Lowell, Boston College, Boston University, Harvard University, Northeastern University, Massachusetts Maritime Academy, Woods Hole Oceanographic Institution (WHOI), University of Washington and University of California.

A substantial portion of the $4.5 million is represented by the third year portion of a five year $11.6 million award from the Office of Naval Research (ONR). This award is intended to further the development of the Autonomous Oceanographic Sampling Network (AOSN) and will involve our Autonomous Underwater Vehicles Laboratory in collaboration with WHOI, the University of Washington and the University of California at San Diego (Scripps Institute of Oceanography).

Particularly noteworthy this past year are the results from a program review conducted in May. All 29 programs will, over the next three years, be evaluated during a lengthy process conducted by specifically structured Program Assessment Teams (PATs) under the direction of the National Office of Sea Grant. Our program review held this past spring was among the first put through this process. The program aspects evaluated included quality of research, connection to our broad constituency, management structure, and strategic and tactical planning. We are pleased to report that our overall rating was an "excellent" attesting to the relevancy and quality of the entire program.

RESEARCH

Research at MIT Sea Grant is guided by the unique intellectual resources of colleges and universities in the Commonwealth and by the needs of the marine community. Our research is divided into two categories. The first area is our core research program, which reflects the ongoing MIT Sea Grant management process and the guidance provided by our two advisory bodies: the State Advisory Council and the Faculty Committee. Within the core research area, we have four theme areas, with quite specific concentrations: *Marine Biotechnology , Coastal Management and Utilization, Coupled Ocean Observation and Modeling,* and *Technology Development and Management for Ocean Uses.* The second research category is our focused research, intended to address major regional and/or national issues or needs. Projects under focused research are also called *Marine Center* projects. In addition, *Automation in the Manufacture of Marine Systems*, now supported entirely from sources outside Sea Grant, continues to be one of Sea Grant's strongest activities. We continue to build upon advances made in these areas. In addition, MIT Sea Grant has successfully competed for and been awarded special enhancement grants in several areas.

Sea Grant's research objective in *Marine Biotechnology* is the advancement of technology that can contribute to better use of the biological resources of ocean and coastal ecosystems. Recent and ongoing research has included studies of novel delivery systems for the vaccination of farmed fish, *Development of New Methods for Efficient Vaccination of Farmed Fish: Controlled and Sustained Delivery of Vaccines*, led by Professor Robert Langer with Dr. Yonathan Zohar, Visiting Scientist, both with the Department of Chemical Engineering. Professor Don Cheney, Northeastern University, Marine Science Center, continued his research into novel and potentially important research in seaweed as a source of compounds

having commercial potential in food processing and pharmaceuticals, *Novel Polysaccharide Production Through Seaweed Genetic Manipulation and Cell Culture Technology*. These two research projects will be completed on July 31, 1998.

Also of commercial interest is Cheney's work on developing a strain of *nori* – a food product of high importance throughout the world – that will adapt well to the colder waters of the northwest Atlantic Ocean. This project – *Strain Improvement by Protoplast Fusion-Somatic Hybridization*– was completed in May, 1998.

Two new research projects began activities in March of this year. Professor Ralph Mitchell, Gordon McKay Professor of Applied Biology at Harvard University, is researching environmentally-acceptable methods of antifouling based on the activity of metabolites from marine microorganisms, *Development of Novel Environmentally-Acceptable Marine Antifouling Coatings Based on Microbial Metabolites.*

Professor Don Cheney, Northeastern University, continues his research activities in *nori* aquaculture, *Effect of Nori Aquaculture on the Marine Flora of Cobscook Bay and Selected Sites within the Gulf of Maine*, which is being done as a component of a Non-indigenous Species grant with investigators from the Universities of New Hampshire and Maine.

Research projects within the *Coastal Management and Utilization* theme area seek to advance the science and engineering needed to more effectively utilize our coastal and ocean resources and, either as an integral component or separately, increase our understanding of the marine ecosystem and our ability to influence its sustainability.

During the past year there have been twelve projects active during some portion of the twelve months. Many of them either have been or will be completed by July 31 of this year - these for the most part have been covered in prior year's reports.

Professor Ole Madsen, MIT Department of Civil and Environmental Engineering, continued his research into the effects of seawalls on coastal sediment transport - his current project, *Effect of Seawalls on Longshore Currents*, is now in the final year of a two-year study. Professor Ivan Valiela of Boston University along with Professor Harry Hemond, MIT Department of Civil and Environmental Engineering, is also in the final year of a two-year study, *Denitrification and Nitrogen Attenuation in the Aquifer of an Estuarine Watershed*. Professor Joseph Montoya, Harvard University, had been awarded a one-year grant *A Preliminary Stable Isotope Tracer Study of Sewage Nitrogen Inputs to Massachusetts Bay*, that investigated the use of stable isotope as tracers of sewage nitrogen as distinct from marine nitrogen within the Massachusetts Bay ecosystem. Montoya followed this work with a successful proposal to continue his research with a two-year grant beginning in March 1997.

Work on underwater systems is carried out under *Coastal Management and Utilization*. Led by Professor Robert Chen of UMASS/Boston , *Development of a Fiber Optic UV Fluorometer for Autonomous Underwater Vehicles* a two-year research project, will be completed this summer. This project included participation of and support by the MIT Sea Grant Autonomous Underwater Vehicles Laboratory. The Lab, unique in its status as a research laboratory within a Sea Grant Program, is the center of much of MIT Sea Grant's AUV research and development. Its projects are aimed at making autonomous underwater systems useful tools for coastal and open ocean research and/or engineering programs. Investigations focus on intelligent control, navigation, and the application of autonomous vehicles to specific scientific missions. Professor Chen's latest research grant follows a recently completed study of real-time measurement of organics in Boston Harbor utilizing spectrofluorometry.

Current efforts continue to focus on developing the key technologies for Autonomous Ocean Sampling Networks. The MIT Sea Grant AUV Lab, sponsored by ONR, leads this multi-university research effort. The goal is to further our ability to carry out real-time oceanography over the long term, through the synergistic combination of AUVs, moorings, gliders, and satellites. Collaborators have included the Woods Hole Oceanographic Institution, the Institute of Ocean Sciences (Sidney, BC), Harvard University, the Scripps Institution of Oceanography, the University of Washington Applied Physics Lab, the Smithsonian Institution, and National Geographic Society. Professor Henrik Schmidt, MIT Department of Ocean Engineering, oversees this research area as Associate Director for Research and Dr. James G. Bellingham (Principal Research Engineer) directs the AUV Lab with support from Dr. James W. Bales, Dr. Bradley A. Moran, and Mr. Robert Grieve, as well as seven Post-Doctoral Associates, Research Fellows and graduate students, as well as undergraduate students.

A substantial effort, during the past year, for the AUV Lab was the preparation and actual field trip to the Labrador Sea in early February. This field trip involved a number of research teams - all with an interest in gaining a clearer understanding of global climate change. The AUV Lab deployed their AUV docking station at a depth of 500 meters which was to provide both a communication node and a battery re-charging facility for two AUV's conducting extensive spatial and temporal surveys at great depth. Results of this field work were very encouraging but revealed challenges not encountered in more hospitable ocean venues - the Labrador Sea in winter months often presents 30 foot seas and 35 knot winds to complement the intense cold. These severe conditions acted to underscore the need for very robust, fail-safe subsystems that have been extensively tested and studied in a controlled field environment.

The team was successful on a number of fronts - the most significant was the ability to communicate acoustically with the docking station which in turn transferred data and control information via the ship between team participants on-shore and the actual AUVs in the Labrador Sea depths.

In our most recent solicitation for new proposals we introduced a new theme area, *Coupled Ocean Observation and Modeling*, to address the need to involve available measurement methodologies in highly integrated systems for nowcast and forecast capabilities. This theme area has the added benefit for more effective collaboration of Sea Grant with other elements of NOAA, and the National Aeronautics and Space Agency. A number of new proposals that fit this research area are currently in peer review.

Lastly is a theme area we have traditionally included in our proposal solicitation that is deliberately broad in focus and title – *Technology Development and Management for Ocean Uses*. This theme area is meant to serve as an avenue for new and exciting ideas, and has, on occasion, yielded successful proposals that have evolved into continuing research theme areas. Our solicitation for new research to begin on March 1, 1997 did indeed result in a successful proposal in this theme area. This research, *Development of Particle Tracking Equipment for Flow Visualization Around Live, Unrestrained Fish* now in its second year, is led by Professor Michael Triantafyllou as Principal Investigator with Dr. Thomas Consi as Associate Investigator – both of the Department of Ocean Engineering. This work follows a previous Sea Grant project that provided valuable insight as to how fish are able to display accelerations and sustained velocities that seem impossible from the viewpoints of available energy and conventional understanding of locomotion processes. The current research is focused on better visualization and analysis of the flow of fluid through which live, unrestrained fish swim. This will require development of sophisticated instrumentation and software to allow individual water particles to be illuminated and their motions precisely measured in space and time. The objective of this research is twofold: to better understand the mechanisms fish employ in their natural habitat is important to our appreciation of them as a species; secondly is the benefit to be gained in applying this knowledge to man-made vehicles to make better use of energy.

Our most recent solicitation for proposed research beginning on March 1, 1998 yielded two successful proposals in this theme area: *Computational Analysis of In-Situ Holograms of Marine Micro-organisms,* led by Professor Jerome Milgram, Department of Ocean Engineering and *Submerged Coastal Offshore Mussel Aquaculture System: A Multi-Disciplinary Approach*, led by Dr. Walter Paul, Applied Ocean Physics and Engineering Department, Woods Hole Oceanographic Institution. The Milgram research represents a unique use of hologram technology and signal processing to allow observations of marine micro-organisms influenced by the effects of flow turbulence.

The proposal from Dr. Paul deserves particular note in that it satisfies the definitions of a "regional proposal" - a concept encouraged and specifically supported by the National Office, The intent of the regional concept is to provide an incentive for more than one program to collaborate on an issue or problem of regional importance (often with significance to other regions around the nation). Dr. Paul's proposal involves both marine biology and policy to compliment his emphasis on the physical oceanography and engineering aspects of offshore mussel aquaculture. We are funding Dr. Paul's portion, WHOI is funding the Marine Policy portion and the Commonwealth is funding the biology portion.

The objective of the *Focused Research/Marine Center* concept is to plan and conduct research programs in collaboration with, and jointly sponsored by, industry and government agencies in order to attack major problems of broad interest to the marine community, and to foster industrial competitiveness by transferring the resulting technology to users.

A close relationship among industry, government and academia is essential for a strong, goal-oriented university research program. Such a relationship allows faculty to contribute directly to industrial development and to meet societal needs, and in turn strengthens educational programs by keeping academic researchers attuned to evolving societal needs. The

real contribution of such a relationship, however, is not just the solution of specific problems and the improvement of education, but also the familiarization of faculty with generic industrial and societal problems. This knowledge allows researchers to steer their long-term research in directions that may be more beneficial to industry and government agencies.

In July 1983, the director of the MIT Sea Grant College Program approached leaders of the offshore industry with a proposal to form an industry and government partnership. In this partnership, the MIT Sea Grant program would invest up to a maximum of $50,000 per project per year. Projects were not undertaken unless there was a good possibility of equal (or greater) industry funding. Preliminary funding of most of the studies came from the MIT Sea Grant Core Research Program, with additional support from other government funding sources, endowed professorships and/or MIT discretionary funds.

We have funded more than a dozen Focused Research Program projects at the $50,000 level and received matching industry support totaling almost $1 million. These projects have been reported in earlier proposals, in Sea Grant Publications and in the technical literature.

While the model described above has been very successful (and we will utilize it on appropriate occasions), it became clear that all parties would benefit if federal, state and local government agencies were included in the research and technology transfer partnership. Inclusion of government agencies has two advantages. First, it allows us to identify and address problems of broader societal interests, as well as those of industrial interests. Second, it assures us that we can obtain sufficient additional funds to support a critical mass of researchers.

The idea of including federal sponsors as sources of additional funds was stimulated by our success in the theme area *Automation in the Manufacture of Marine Systems*. This project, which began in 1986, attracted over $3 million in government funding and required only $425,000 in Sea Grant funds. That research activity has been so successful we have retired the theme area, but productive research, the education of students, and the transfer of technology continue under Sea Grant management.

Autonomous Underwater Vehicles: Basic Technologies, our second Focused Research project concluded in 1996. It served to develop robotic multi-use platforms (the Odyssey class of AUV) for coastal as well as deep-ocean applications. Lessons learned from these vehicles are being incorporated in Odyssey II, which is being built under the third Focused Research Program project, *Autonomous Underwater Vehicles: Scientific and Industrial Applications*. This Focused Research Project is also supported as a Tactical Research Project of the National Sea Grant Office, entitled *Rapid Response to Seismic Activity on the Juan de Fuca Ridge*. A recent Focused Research project, *Development of Autonomous Surface Craft,* resulted in a prototype and field studies conducted in local waters. We have decided that this research effort more appropriately belongs within the broader research focus of the AUV program where the field infrastructure better exploits its anticipated capabilities.

As a consequence of the success of the Focused Research Programs that addressed AUV technologies and applications we have been able to capture additional funding. Today the AUV Laboratory is supported by ONR and others at an annual rate of more than $2.5 million. This illustrates the intent of our Focused Research theme area and further demonstrates how early funding of well thought out research areas can establish the soundness of more specific research and development objectives.

On August 1, 1996 the initial, first year work began on the fourth Focused Research/Marine Center, *Behavior of Capped Contaminated Sediments,* under the leadership of Senior Research Engineer and Lecturer, Dr. E. Eric Adams of MIT. This research will address theoretical analysis and field studies to determine the processes occurring in a capped contaminated sediment site. It follows a recently completed Focused Research Marine Center, *Contaminated Sediments in Boston Harbor*, led by former MIT Professor Keith Stolzenbach - a full history, results, and recommendations now embodied in an MIT Sea Grant publication by the same title. This work will allow a fuller understanding of the site selection criteria, transport processes of contaminated material through the capping material and further aid in predicting benthic impacts.

Our most recent Focused Research/Marine Center, *Poseidon: A Coastal Zone Management System via the World Wide Web,* initiated work in March of this year. This project is a consequence of the high availability of raw ocean data, the

various modeling approaches one can apply to large, multi-parameter data sets, and extensive uses such data derived knowledge make possible (weather forecasting, fisheries management, environmental impacts, etc.).

EDUCATION

Sea Grant is committed to providing learning opportunities for students, professionals, and the public. Support for graduate students is included in almost every research project. In addition, the program continues to provide major support for marine-related Undergraduate Research Opportunities Program (UROP) projects. Sea Grant UROP directly provided $25,000. A substantial contribution from the Department of Ocean Engineering and the MIT UROP itself raised this to a total of $50,000. Sixteen UROPs were supported this year representing five MIT departments.

TECHNOLOGY TRANSFER

The MIT Sea Grant Marine Industry Collegium promotes the active transfer of marine research and technology through the sponsorship of workshops, the distribution of publications and research reports, and direct interaction with members. Since 1975, the Collegium has provided member organizations with the opportunity to attend several technical workshops and symposia per year. The Collegium program collaborates with Draper Laboratories and other campus organizations in sponsoring symposia and workshops. Of particular note is the involvement of the Industrial Liaison Program (ILP) membership in Collegium activities. ILP members are invited and have been enthusiastic participants in these events.

In November of 1997 the Collegium sponsored a two-day symposium, *Coupled Ocean Observation/Modeling Systems,* to both provide a forum for current research in coastal research methodologies and to begin a process where our own research and outreach focus can expand into an important theme area. This symposium was successful on both counts and led to our including a new theme area in our most recent solicitation for proposals. The Collegium had announced in November its intent to host a second symposium in the spring which, in the same thematic track, would bring focus to remote sensing in coastal and shelf waters. This symposium, *Ocean Modeling and Data Assimilation: Satellite Oceanography* was held on May 4-5, 1998 and although not as heavily attended did produce substantial information and participation. Continuing this thematic track the Collegium is planning a third symposium for the fall of 1998.

MIT Sea Grant's engineering focus in marine fisheries continues with the Center for Fisheries Engineering Research (CFER). This project was initiated in 1982 and today continues to have a national impact by applying analysis and model-testing techniques to the hardware-related problems associated with marine living resource utilization. The project has assisted industry in the development of resource-sparing and selective trawl nets.

Since its establishment in 1982, CFER project director Cliff Goudey has varied the emphasis depending on the needs of the fishing industry. Early topics included vessel safety, fuel efficiency, and fishing gear selectivity. More recently bycatch reduction, ecosystem effects of fishing, stock enhancement, and aquaculture have become more important.

Notable efforts include a project to develop techniques for improving sea scallop productivity through controlled harvesting of seeded beds and through off-bottom culture in open waters. This project has lead to the establishment of the first experimental aquaculture research area in the US federal waters. In another project, CFER organized an experimental fishery to evaluate pair trawling for tuna and its effects on marine mammals. Recently CFER established Aqualab, a demonstration site for urban aquaculture at the Charlestown Navy Yard. This is the first step in exploring the potential for an aquaculture industry in Boston Harbor.

The Massachusetts Marine Liaison Service (MMLS) works with state and federal agencies and the public to identify and address local and regional needs in fisheries and coastal zone management. Marine advisory agent, Madeleine Hall-Arber continued to track the social impact of new fisheries regulations and has planned focus groups for Gloucester and New Bedford to assess their effects. Hall-Arber is President-elect of the American Fisheries Society's Subcommittee on Socio-economics and a member of the Atlantic States Marine Fisheries Commission's Committee on Economics and Social Sciences. In addition to these posts, Hall-Arber serves on the advisory board of the Massachusetts Coastal Zone Management Program, is a member of the New England Marine Advisory Council, and is president of the Women's Fisheries Network. Public education efforts continue through exhibits, participation in conferences and festivals and articles in Commercial Fisheries News.

The Sea Grant Communications/Information Service under the leadership of Andrea Cohen produces outreach materials for a wide variety of consumers. This includes the continued production of the new joint publication produced by the MIT

and WHOI Sea Grant Programs. *Two if By Sea* highlights the research, advisory and outreach activities of Sea Grant programs in the Commonwealth and provides the public with information about coastal and marine issues in the region. Communications continues to write for the *Nor'easter* magazine (circ. 12,000), along with other Sea Grant programs in the Northeast region. From July 1997 to June 1998, the Communications office filled many requests for publications. This distribution included schools, businesses, government, citizens, media, the MIT community and others. In the past year, Communications also collaborated with the Metropolitan District Commission and Friends of Magazine Beach, a community group, in sponsoring the third Annual Clean-Up of Magazine Beach and the Banks of the Charles. We also maintain a reference center available to the community for informational purposes. Carolyn Levi, formerly a member of the Communications staff, left during the year to accept a position with the New England Aquarium.

The newest addition to MIT Sea Grant, the Center for Coastal Resources, brings science and technology research to state and federal agencies' staff, local government officials and other entities. The Center helps improve decision making in management of coastal resources and strengthens policy development. The Center for Coastal Resources has continued to provide outreach activities that bring scientists, coastal resource managers and users together. This past year has seen the continued collaboration in convening several conferences and workshops, and continuing efforts for coordinating regional research and management of the Gulf of Maine. A Mass Bay web page has been developed to provide linkage to data and research, and other information for the Massachusetts and Cape Cod Bays and Boston Harbor regions. Follow up activities include communicating workshop and conference outcomes to coastal managers and have resulted in guidance and policy documents relating to appropriate use of introduced species in aquaculture.

The joint educational program established with the Massachusetts Maritime Academy (MMA) twenty years ago has grown in terms of the educational/training needs it addresses and in its participation. During the past year MMA continued to expand a series of seminars oriented towards aquaculture and fisheries issues – these are natural extensions to their traditional constituency of recreational and commercial users of coastal waters.

MMA's annual Saltwater Fishing Seminar is now in its 19th year and continues to draw approximately 100 participants every year. Shellfish Farming Forum and Aquaculture Symposium events held this past winter drew considerable interest. Most recently the Massachusetts Shellfish Wardens Association requested the Sea Grant/MMA program to develop a training program for the more than 60 shellfish wardens in the Commonwealth to better prepare them for managing local town shellfish resources.

PROGRAM MANAGEMENT

The program director is Chryssostomos Chryssostomidis, professor in the Department of Ocean Engineering. Associate directors for research are Professor Henrik Schmidt and Dr. E. Eric Adams. Richard Morris continues to serve as Executive Officer for the program..

MIT Sea Grant administers the Doherty Professorship endowed by the Henry L. and Grace Doherty Foundation. In December of 1977 Professor Bettina Voelker of the Department of Civil and Environmental Engineering was awarded the two-year chair for her proposal, *Effects of Terrestrial Organic Matter on the Specification of Cu and Cd in Coastal Waters*. Professor Voelker's research will further the understanding of the biological responses to copper and cadmium by marine organisms (e.g. cyanobacteria) and by terrestrial humic substances. The costs in terms of overall productivity of the marine biota, and the quantitative influence of increased ultraviolet radiation as a consequence of the ozone layer decreasing are two important goals of this research. Extensive use of experimental facilities within the Institute will permit Professor Voelker to involve students in her research – an important aspect of the Doherty Professorship and one that continues to nourish the intellectual process so vital to a university community.

John J. Leonard, an Assistant Professor of Ocean Engineering continues in the second year of his Doherty Professorship. Professor Leonard's research concerns the unique ability of certain animals - dolphins in particular - to combine controlled movement of the animal with their sonar capability to determine size and shape of the object of interest.

More information about the Sea Grant College Program can be found on the World Wide Web at the following URL: http://web.mit.edu/seagrant/www/

Chryssostomos Chryssostomidis

TECHNOLOGY AND DEVELOPMENT PROGRAM

The Technology and Development Program's (TDP) primary mission is to provide a focus at MIT for research and education related to the role of science and technology in the socioeconomic growth of developing countries. TDP works with other academic departments and research centers throughout MIT to:

- Promote an awareness of the relationship between science, technology, and development on the part of faculty and students at MIT;
- Provide a focal point for the technology and development activities of faculty, students, and visiting scholars interested in the field of technology and development;
- Assist the faculty, students, and staff of collaborating institutions in other countries to develop research and academic interests consistent with their national needs; and
- Serve as a contact for interested organizations outside MIT (government, academic, private sector) to access the Institute's resources and its knowledge of developing countries—particularly of their socio-economic and technological problems.

TDP carries out these objectives through research, academic programs, and contacts with international and national organizations that have an interest in broad areas of technology and development. In order to fully utilize available resources, the TDP is structured to interact with other academic departments and research centers throughout MIT.

CURRENT RESEARCH PROGRAMS

The past year saw the continuation of three multi-year collaborative programs. TDP continued its collaboration with the Government of Mendoza to provide research, education, and administrative assistance to the newly created Fundación Centro de Innovación Tecnológica (CIT) Mendoza with a focus on Transportation; Internationalization and Competitiveness; and Water and Energy Resources in Mendoza.

The Collaborative Program of Science and Technology between MIT and the National Science Technology and Development Agency of Thailand (NSTDA) and the Collaborative Program of Science and Technology between MIT and the King Mongkut University of Technology, Thonburi (KMUTT) also continued.. Professor Joel Clark and Professor Alice Amsden completed their project on "Analysis of Relative Production Costs in Thailand and Other Countries and "Analysis of Adjustment to International Opening; Comparison of Thailand, Taiwan, and Mexico". Professor Michael Dennis completed his "Design Studio: The Case of KMUTT Rajaburi Campus". Professor Alan T. Hatton successfully completed the first year of the "Chemical Engineering Practice School in Thailand". During the coming year, the following research projects will be undertaken: Professor Hatton will continue to advise on the "Chemical Engineering Practice School in Thailand". In addition the following research projects will be undertaken: "Establishment of TGIST (Thailand Graduate Institute for Science and Technology" (Professor Fred Moavenzadeh); "Morphoogy Control in Immiscible Polymer Blends Through Interfacial Reaction and Rheology" (Professor Chris Scott); "Multi-Media Technology" (Professor Steven Lerman); "Thailand Integrated Water Resource Management System" (Professor Kevin Amaratunga); and "Air Pollution" (Professor Gregory McRae). Discussion is under way with regard to the initiation of two additional projects: "Leaders for Manufacturing Competitiveness" and "Engineering and Molecular Biology of Improving Microbial Desulfurization".

Since signing a multi-year Agreement with the Malaysia University of Science and Technology Ehsan Foundation (MUST) in January of 1997 to Support the Establishment of the Malaysia University of Science and Technology, TDP and MUST have devoted their efforts to developing a research agenda focusing on (a) infrastructure, (b) information technology/multi-media; (c) Biotechnology and Chemical Engineering; (d) Advanced Materials; (e) Manufacturing; and (f) Energy and Environment; as well as working on institutional building activities, and promoting industrial and governmental collaboration and linkages.

In addition to the above research efforts, TDP continued its association with the Consortium on Construction and Global Environment. Since 1990 TDP has been working with three major construction companies in Japan; namely, Hazama Corporation, Nishimatsu Construction Co., Ltd. and Sato Kogyo Co., Ltd. in helping to identify key areas and issues of global environmental change which will create future opportunities for the world's leading engineering

and construction firms; and to suggest effective strategies for capitalizing on these opportunities. The primary focus of this year's activities has been "Zero Emissions Technology".

FUTURE RESEARCH INITIATIVES

The Technology and Development Program has submitted proposal for Collaborative Agreements in Brazil and is also pursuing activities in Taiwan, Korea, Colombia, and Costa Rica.

In Brazil the collaborative effort would be between TDP at MIT and USP, UNESP AND UNICAMP in Brazil. The research would be conducted for a seven (7) year period for a total cost of $42 Million, with funding for the first two years at $10 Million. The Collaborative Program would support the establishment of a Center for Technological Innovation in San Paolo Brazil and would include activities in the following areas: (a) research projects, (b) educational (exchange of students and visitors), (c) curriculum development; (d) short courses, executive seminars and workshops; and (e) industrial linkages/outreach program. A similar program is also being considered in Costa Rica.

CURRENT EDUCATION INITIATIVES

The TDP-sponsored Middle East Program at MIT completed its eleventh year. The program (under the direction of Professor Nazli Choucri, TDP Associate Director) involves faculty from the Department of Political Science, Department of Economics, the History Faculty, the Department of Urban Studies and Planning, the Sloan School of Management, the Department of Civil and Environmental Engineering, the Science, Technology and Society Program, and the Aga Khan Program in Islamic Architecture. . The program enables students with an interest in the Middle East to develop an expertise in the area in addition to their own academic fields of specialization; and it examines the processes of socio-economic change, technological development, political change, institutional development, capital flows, and business and investment patterns in the region.

A number of short courses and executive seminars have been offered both in Thailand and Malaysia including the following: (a) Project Management for Capital Projects (Professor Robert D. Logcher); Fundamentals of Lasers, Fiberoptics, and Photonic Sensors (Professor Shaoul Ezekiel); Human-Machine Systems in Manufacturing, Process Control, Transportation and Communication (Professor Thomas B. Sheridan); and So you Want to Build an Airplane (Professor Leon Trilling).

In Malaysia TDP is working with MUST to promote the education of individuals to carry out the social and industrial development of Malaysia and is employing several mechanisms including: long-distance learning techniques, teaching of short courses in Malaysia, and faculty and student exchange. TDP has focused its efforts on developing four graduate academic programs (Transportation Systems, Information Technology and Multimedia, System Design and Operation, and Chemical Process Engineering and Biochemical Process Engineering).

Future offerings will include: Project Delivery Strategies; Use of Information Technology in Project Management, Site Characterization for Soft Ground Construction, Educational Impact of World Wide Web, Emerging Multimedia Technologies, Strategic Concepts for Modern Transportation Systems, Marketing and Managing of Technical Professional Services in the Global Market, Techniques for Managing and Operating Transportation Infrastructure, Project Delivery Strategies, Research Issues in Civil Infrastructure Construction, and Lean Enterprise Model in Product Development and Manufacturing.

ORGANIZATION

The TDP Director is Professor Fred Moavenzadeh, George Macomber Professor of Construction Management in the Department of Civil and Environmental Engineering. Professor Nazli Choucri of the Department of Political Science is the Program's Associate Director and Patricia Vargas is the Assistant Director.

Fred Moavenzadeh

TECHNOLOGY LICENSING OFFICE

The mission of the Technology Licensing Office (TLO) is to facilitate the transfer of technology from MIT. (and the Whitehead Institute) to industry, and thereby to benefit the public good through the development and subsequent sale of commercial products. A secondary goal is to generate unrestricted funds to motivate inventors and to support research and education at MIT. The TLO staff of 31 (14 licensing professionals and 17 administrative and support personnel) are responsible for identifying marketable technologies, managing the patenting and copyrighting of these technologies, finding licenses to develop the technologies and negotiating licenses.

This was a very successful year for the Technology Licensing Office, with income of $18.5 Million, of which $700,000 was cash-in of equity.

We consummated 73 new technology licenses, and 25 new option agreements a considerable increase over FY'97. We currently have 500 active licensees. We also sold 208 end-use software licenses and signed up 18 new trademark licensees in FY '97, and started 14 new companies.

With over 500 active licenses in house and about 125 startup companies extant (with equity in about 30 of them), we can expect that royalty streams will continue to mature and companies will reach equity liquidity—but the timing is unpredictable. Studies by others have shown that the average university license that matures into products takes eight years to do so. The stream of new inventions continues constant at about 350 per year (362 in this fiscal year), refilling the pipe line.

TLO staff are also active contributors to student activities at MIT. These include participation in the "50K" student business plan contest, guest lectures on patents and licensing in a number of Engineering, H.S.T. and Sloan School courses, both undergraduate and graduate and "open door coaching" for students thinking of starting a business, whether through an MIT. license or not.

Senior TLO staff also served pro bono on the boards or senior committees of a number of state, national and local entrepreneurial and tech transfer organizations.

They have served (usually pro bono) as advisors to over a dozen university or governmental technology transfer officers in the U.S., Brazil, Hungary, Argentina, Taiwan, Japan and Germany, in addition to hosting literally dozens of visits from other such organizations and corresponding company departments in our own offices.

More information about the Technology Licensing Office can be found on the World Wide Web at the following URL: http://web.mit.edu/tlo/www

Lita Nelsen

LIBRARIES

The academic research library has long played a critical part in learning, research, and scholarship in world-class universities. Here at MIT, as elsewhere, students, researchers, and faculty are dependent on libraries and library resources for important aspects of their work. Not surprisingly, however, MIT's Libraries reflect the Institute's own unique educational philosophy.

At the end of the 19th century, MIT introduced an innovative approach to the academic research library. Unlike other universities, which were at that time building large centralized libraries, MIT opted instead for a distributed library system. "With us," wrote MIT President Francis Walker in 1893, "books are tools for handy use; just as much so as the apparatus of the chemical or physical laboratories."

A century later, the MIT Libraries face the fascinating challenge of managing their superb and unique collections into the digital era. During 1997/1998 the Libraries learned a great deal about the true opportunities and diminishing technical barriers to a digital future, and—as a result—have a better understanding of the obstacles the Libraries face in their goal to create the integrated, mixed-media library of the future. In preparation for the future, in 1997/1998 the MIT Libraries focused on introducing digital resources and tools to the MIT community, and on integrating those resources and tools into MIT's own highly-successful distributed library system.

Librarians and computer scientists alike once held high hopes that the digital library would be achieved by the year 2000. Highly visible economic and technical advances to the Internet and the World Wide Web suggested that the materials of higher education, research, and scholarship might soon be available in a low-cost, readily-accessible, stable and archived environment. Few now expect the digital library environment will be so readily achieved. Neither will it be automatically easier to use, simpler to manage, or less expensive—at least for the foreseeable future. Among the present truths the MIT Libraries currently face are the following realities:

- Digital resources cost more, not less.
- Digital resources require extensive technical support; a compatible network and stable servers; printing capability and capacity; and ubiquitous, compatible clients.
- Faculty are neither uniformly nor universally in favor of a digital-only library.
- Intellectual property rights are a major conundrum.
- Research strategies and information seeking behavior are changing, yet the documented demand for traditional publications and services continues unchecked.
- Digital resources require specialized skills, continuous training, and adapted facilities.
- Digital archiving is a complex, as yet unsolved problem.

Perhaps the most significant trend in recent years has been the steady migration of scholarly communication into the commercial (and commercial-like) publishing sectors. The questions of who will own digital resources, how those resources will be retained over time, and what economic models will control intellectual property are increasingly the purview of multinational publishing and multimedia corporations that now control large and important segments of scholarly communication. Intellectual property issues of critical importance to higher education have become the focus of international treaties, litigation, legislation, and licensing, with the result that long-standing rights of fair use in libraries, in classrooms, and for non-profit research may not carry forward into the digital environment.

While digital remedies for the costs and problems of the networked environment and scholarly communication are neither certain nor obvious, during 1997/1998 the MIT Libraries developed a strategy for moving ahead. Supported by the Provost's willingness to enable multiyear financial planning, and building upon the planning and accomplishments of 1996/1997, the MIT Libraries took steps on several fronts. An extensive array of educational and research-oriented digital materials was acquired and served, the Libraries' capacity to digitize and serve digital material owned by MIT was significantly improved, key national experiments were supported, and planning for a new integrated library system was initiated. During this time, the work of MIT's Council on Educational Technology reinforced the MIT Libraries' agenda and supported a vision for the MIT Libraries that was consistent with the Libraries' own expectations for the future.

STRATEGIC AND OPERATIONAL INITIATIVES

The MIT Libraries are committed to meeting the needs of current students and faculty, even as planning for the future goes forward. As a practical matter, in 1997/1998 the work of the MIT Libraries continued to be dominated by print resources. The vast majority of material selected, acquired, and preserved in support of MIT's educational and research mission has, as yet, no digital (or no affordable digital) equivalent. In recognition of the dual nature of their responsibilities, Library Council targeted both strategic initiatives and important operational goals for special attention during 1997/1998. Combined, these strategic and operational initiatives provided essential stewardship for existing resources, and built the foundation on which the future will rise.

UNDERSTANDING INFORMATION NEEDS

The MIT Libraries have a long-standing commitment to understanding and meeting the evolving information needs of students, faculty, and researchers at the Institute. An in-library survey conducted during 1996/1997 revealed the critical importance of the Libraries to MIT students and in 1997/1998, with generous support from the Chairman of the Libraries' Visiting Committee, a student survey was conducted. Preliminary results suggest that despite the ubiquity of web access and the vast array of sites on the web, students continue to look to library resources for their research and educational needs. In particular, MIT's graduate and undergraduate students continue to rely heavily on the MIT Libraries' book collections, research tools, databases, and study spaces.

THE VIRTUAL LIBRARY

Staff

Digital resources require staff skills and physical facilities that differ significantly from those of the traditional library. The Libraries' approach to computer systems support was fundamentally redesigned in 1996/1997 and in 1997/1998 the remaining computer/systems positions were described and, for the most part, filled. The one notable exception was the Web Manager position, which should be filled in 1998/1999. The Libraries continued to invest systematically in computer resources, training, and software and by mid-year had begun to realize hoped-for service and productivity gains. The MIT Libraries' website continued to grow and improve in content and usability.

Resources

The Libraries also continued to add relevant digital resources to the MIT Libraries' collections and resources. Significant savings were achieved in the cost of these resources through the tenacious pursuit of academic, institutional, and group discounts. Working through consortia, and independently, the electronic resources acquisitions effort brought a multitude of new research materials to MIT desktops. Notable among the acquisitions were:

- Web of Science, the networked version of ISI's citation indexes.
- Lexis/Nexis Academic Universe, a full-text source for news, business and legal information.
- UnCover Reveal, a service that automatically e-mails current tables of contents of selected journals to registered faculty and researchers.
- Beilstein CrossFire, the most complete collection of structures, properties, and references to the literature of organic chemistry.

In all, the MIT Libraries added some 36 new databases to their digital collections. And by year end, the number of electronic journals available to the MIT community approached 300 titles.

Services

The success of the electronic reserves pilot project in 1996/1997 dictated that electronic versions of required reading material continue as a high-priority initiative for the Libraries, despite scaling concerns and the limitations and constraints of MIT's network. Several "off-the-shelf" software packages have been identified and evaluated, and the Libraries will proceed with a test deployment in 1998/1999.

In May, the Libraries' Instruction Team introduced the MIT Libraries Instruction Laboratory. This newly established web-based service was created for the purpose of assisting library instructors across the MIT Libraries in teaching core information competencies, utilizing pre-prepared instructional materials and handbooks, gathering statistics to inform future instructional activities, and sharing ideas and successful strategies.

THE ACTUAL LIBRARY

The MIT Libraries' print collections continue to grow at an estimated 10-15,000 linear feet per year, despite careful attention to acquisition and retention policies and the energetic pursuit of digital alternatives. With over 20% of the collections already in storage, the Libraries face difficult choices in balancing the space needs of education, research, computer facilities, and staff. Moreover, the Libraries' buildings are increasingly inadequate for the work and study habits of the contemporary MIT community. In 1997/1998 a report documenting these challenges was prepared by the Associate Director for Collection Services. The Libraries have initiated a series of conversations about options for dealing with this dilemma.

Dewey Library completed a major redesign and remodeling of its main service desks and entry area in 1997/1998. Administrative office areas in Building 14 were renovated to take better advantage of existing space. Security and furnishings were upgraded in several MIT Libraries' facilities. Network drops and power outlets were installed in Divisional Libraries to accommodate students and faculty who prefer to use their own laptops while working in the MIT Libraries.

The Associate Director for Public Services initiated a process to involve Public Services' staff in rethinking and redefining the way library services are delivered to the MIT community. The process has as its goal a redefinition of Public Services' structures and operations to create a work environment that is supportive and resource efficient for staff, while remaining flexible and responsive to changing student and faculty expectations. The process has engaged and energized a wide cross-section of Public Services' staff.

RESOURCE DEVELOPMENT

With energetic and capable support from Resource Development and the Alumni Association, the MIT Libraries continued to improve their resource development position. Gratifying progress was made in 1997/1998 in returns from the annual mailing, in private support for special projects, in alumni giving (thanks to a position on telethon place mats), and in Institute support for the Libraries' capital campaign goals.

COMMUNICATION

Each of the initiatives and operational priorities identified above and in the reports that follow illuminated a fundamental need for improved communication techniques and vehicles by and about the MIT Libraries. Effective strategies for telling interested parties about Libraries' capabilities and needs, and for informing the MIT community about new products and services are required. The Libraries need to improve the usefulness of text and online publications, and to develop better in-library self-service tools. To this end, in 1997/1998 the MIT Libraries obtained assistance from a professional communications consultant. A communications plan has been developed, and the recommendations will be implemented on a prioritized basis starting in 1998/1999.

AFFIRMATIVE ACTION

The MIT Libraries began the year at an all-time high for minority representation among the administrative staff. In 1996/1997 the MIT Libraries had achieved, for the first time, the goal of 10% representation of minority employees among professional and administrative staff. Regrettably for the Libraries, three of our minority staff accepted positions outside MIT during 1997/1998. Two staff members went to positions in private industry, and one accepted a higher-level position in another ARL library. Because only one minority was hired during this time frame, the Libraries' minority representation has again fallen to 7%. The MIT Libraries continue to examine their recruiting practices and retention options with regard to minorities, and to explore alternatives for expanding the pool of minority candidates for vacant positions.

In an effort to address the overall shortage of minority candidates in the library profession, and to improve diversity among the staffs of academic research libraries in general, the MIT Libraries supported and subsequently participated in a new diversity program of the Association of Research Libraries. The ARL Leadership and Career Development Program is designed to prepare racial minority librarians for top leadership positions in academic and research libraries. The program has as its goals (1) increasing the number of minorities in positions of influence and leadership in academic and research libraries by preparing participants to become more competitive in the promotion process, and (2) creating role models and mentors for minorities who might not have otherwise considered librarianship as a career. The MIT Libraries nominated Poping Lin for participation in the program, and supported her participation when she was accepted.

IN CONCLUSION

The significant progress described on these pages, and in the more detailed reports that follow, is a tribute to the dedication and professionalism of the staff of the MIT Libraries. Over the years the MIT Libraries have been exceptionally fortunate in the quality of their staffs. This good fortune continued in 1997/1998 when Eric Celeste agreed to serve as Assistant Director for Technology Planning and Administration, and Virginia Steel accepted the position of Associate Director for Public Services.

No annual report can chronicle all the important events of a given year, and this is particularly true in times of challenge and change. The extraordinary efforts associated with new technologies, new services, renovations, security, and Institute initiatives such as reengineering and SAP implementation are sorely underrepresented in this report; as are the efforts associated with recruiting and retaining staff in times of low unemployment, and with documenting and addressing salary inequities.

The staff of the MIT Libraries can look back on 1997/1998 with a strong sense of accomplishment and with deep satisfaction for the myriad achievements of the Libraries. Our success is due to the competence and commitment of the staff, to the interest and support of MIT's senior management, and to the generosity of the many friends of the MIT Libraries.

More information about the Libraries can be found on the World Wide Web at the following URL: http://libraries.mit.edu/.

Ann J. Wolpert

PUBLIC SERVICES

The past year was highly productive for the public services units of the MIT Libraries. After the arrival of a new Associate Director for Public Services in August 1997, the Divisional and Branch Libraries' staff renewed their focus on understanding more about the information needs of members of the MIT community and on developing electronic services to enhance those already available. A number of new initiatives were carried out, and work continued on several initiatives from the preceding year.

LEARNING ABOUT NEED FOR INFORMATION RESOURCES

Over the past decade staff members in the MIT Libraries have conducted periodic surveys of selected segments of library users to learn more about their information needs. During the past year, a more comprehensive approach was taken as the first part of a multiyear effort to track and analyze changes in the information-seeking behavior and needs of MIT students, faculty, and staff. With generous assistance in market research methodology arranged by Patrick McGovern, Chairman of the MIT Libraries' Visiting Committee, and provided by IDG Research Services, a team of three librarians developed a questionnaire that was mailed to a sample of 1500 undergraduate students and 1500 graduate students at the end of the 1998 spring semester. Questions on the survey inquired about techniques used to find information, whether and how the Libraries' electronic resources are used, whether and how the Libraries' facilities are used, and how the Libraries might be more helpful to students during their academic careers.

Information from the survey is still being tabulated, but the initial results show a greater than anticipated response rate of more than 40 percent. Some of the intriguing preliminary answers reveal a student population that has had little or no instruction in methods for finding information or using libraries, but that has substantial interest in receiving more assistance in both of these areas. The students who answered the survey identified a number of high-priority changes the Libraries should make to better meet their needs including extending hours, providing electronic reserves, and offering a web-based Barton online library catalog. The data from the survey will be studied further and used to determine strategic directions for the Libraries' public service programs, and a second study focusing on faculty information needs will also be undertaken.

Two additional, more targeted surveys were conducted during the year. One, focusing on Architecture and Planning students, was carried out earlier in the spring in response to a DUSP Student Council request for longer hours in

Rotch Library. Based on the feedback received, Rotch Library's open hours for summer 1998 were increased, and plans have been made to extend evening hours during the fall semester.

The Institute Archives' staff carried out a survey and analysis of use of the Archives Reading Room. After categorizing and counting the types of uses made at different times of the day, the Archives' open hours were adjusted to make more efficient use of limited staff time while maintaining a high level of service to the MIT community.

MEETING INFORMATION NEEDS

New Electronic Resources and Services

Among the new electronic resources offered by the MIT Libraries, the introduction of three new networked services covering a variety of disciplines created the need for a coordinated publicity and instruction program to educate faculty, students, and staff about their availability and usefulness. Public Services' staff developed communication strategies and instructional programs for the following new research capabilities:

- UnCover Reveal is an e-mail notification service for tables of contents of more than 17,000 journals in all subject areas as well as approximately 600 new book titles indexed each week. Members of the Libraries' staff developed a brochure and sent e-mail announcements about Reveal to departmental mailing lists. Usage of this service continues to grow.
- Web of Science, the networked version of the Science Citation Index, Social Sciences Citation Index, and Arts and Humanities Citation Index, was introduced early in 1998. Posters publicizing this new service were produced, and several instruction sessions were offered for interested faculty, staff, and students.
- Lexis/Nexis Academic Universe, which provides access to a wealth of news, business, and legal sources, became available on the MIT network mid-way through the academic year. Librarians offering instructional sessions began to highlight this as an important new, readily available resource.

In addition to purchasing or acquiring access to commercially-produced databases, library staff undertook or continued efforts to create web-based resources tailored for the MIT community:

- In the Rotch Visual Collections branch library, the IRIS project to make digitized images and site records of more than 500 architecture works available on the web was launched. With the financial support of two generous donors, Mary S. Newman and the Roy and Niuta Titus Foundation, hardware and software were upgraded, so that users are able to search by geographic location, site name, and Art & Architecture Thesaurus subject and/or style terms. This project is recognized nationally as a model for the distribution and management of digital images.
- As part of the Aga Khan Library Program at MIT, an electronic image database of 10,000 records of single images was created to provide easy access to materials in The Aga Khan Visual Archives. The database will soon be published on the web.
- The staff of the Lewis Music Library initiated a pilot project to provide sound and images for songs in the public domain that are included in the *Inventions of Note* Sheet Music Collection. To date, four songs have been added to the website with the scores scanned in and the audio available, and more will be added in the future.

Beyond making parts of the Libraries' collections accessible through the web, other efforts focused on providing enhanced services in a number of ways. One of the most well-received innovations in circulation operations was the introduction of an e-mail courtesy notice service that automatically sends a message to users who have borrowed library materials that are due in several days. This has resulted in fewer complaints and unhappy borrowers, and, as one would expect, the number of overdue fines collected has decreased.

Providing adequate access to the MIT network and web-based Libraries' resources from within the Libraries has been an ongoing challenge in the MIT Libraries. This year workstations that provide open web access were installed in several locations, and plans are in place to increase the number of machines with this capability. A related new development at the end of the year was the installation of patron-accessible network drops in Rotch, Dewey, and Hayden Libraries. These "dynamic" network connections can be used to access the MIT network and the web by anyone with a laptop registered with IS to plug into the network. If response from faculty and students is positive, additional drops will be added.

Building on work started last year, several projects continued to consume the time and energy of public services' staff. One of the most important of these was the task to identify and select an off-the-shelf electronic reserves system for use by faculty and library staff. A team of IS and Libraries' staff arranged demonstrations by two vendors, and they expect to make a recommendation early in the coming academic year. The team will then address solutions for managing printing volume on the network.

Continued development of the Libraries' website was another major undertaking which required the Libraries to decide what its structure must be to effectively manage its web presence. To do this, a task force was established in fall 1997. After studying web staffing structures at a number of research and academic libraries, the task force recommended that a web manager position be created and that this position be given responsibility for the overall development and maintenance of the Libraries' website. Until a position can be freed up to take on this assignment, the Information Technology Librarian/Public Services, also a new position but already filled, has been named Interim Web Manager.

One other activity that began was planning for a pilot project to accept MIT theses in electronic format. Several staff from Document Services collaborated with IS staff to develop a proposal for doctoral students in two or three departments to submit their February 1999 theses electronically. In spring 1998 the Committee on Graduate School Policy endorsed the plans for a pilot, so this will become a priority for the 1998/1999 year.

Enhanced Traditional Services

In spite of the demands of the numerous, high-visibility projects involving electronic resources and services, public services' staff remained committed to developing and refining existing, high-value traditional services. One of the most important areas of emphasis was the Libraries' instruction program. Through the efforts of the subject librarians, progress was made in contacting faculty and arranging for instructional sessions to give students a better understanding of techniques for finding information on their class or research topics. Three recently hired librarians were particularly successful in promoting bibliographic instruction, with the result that new course-based instruction was given in Chemical, Civil, and Electrical Engineering. Librarians in the Humanities and Dewey Libraries moved ahead in creating course-specific web pages as a supplement to other forms of library instruction. Among the most successful of these were websites developed for Product Design and Development (15.783J and 2.739J), System Design and Management, and Introduction to Psychology (9.00).

Another area of discussion and experimentation concerned the relationship between circulation, information, and reference services. With the advent of networked information resources, staff in research libraries across the country have begun to rethink the tried and true but often artificial division of services offered. In the Dewey and Rotch Libraries, support staff and professional staff collaborated on projects to test different staffing models for service points that combine circulation and reference assistance. At Dewey Library this model has become part of the standard service program throughout the year, while in Rotch the model has seemed most effective during the summer months when reference traffic is at lower levels. The rationale for changing the reference/information/circulation model is to attempt to provide "one-stop shopping" for library users rather than referring them from one service desk to another.

The two-year Building 20 Project, funded by the Provost, neared completion at the end of the year. Project Archivists have arranged for the transfer and processing of 47 collections or additions to collections of archival records from faculty and program offices being moved out of the building. The Project Archivists also supervised a photographic documentation project funded by Physical Plant that captured a visual record of the building in its pre-demolition state. In addition to these activities, one of the archivists contributed to the commemorative event held in March 1998, "MIT's Building 20: The Magical Incubator," by providing information about the building's history and occupants and designing displays and a timeline.

MIT LIBRARIES: THE ENDURING IMPORTANCE OF PLACE

With all the information resources available on the network and through the web, it is tempting to think that the Libraries as physical spaces for studying, browsing, consulting, and doing research are not, perhaps, as important as they once were. Based on responses to the survey of undergraduate and graduate students mentioned earlier, this is clearly not the case. In the survey, 50 percent of the students responded that the availability of electronic resources

has had no impact on their use of the Libraries' facilities, and another 24 percent reported that they visit the Libraries more frequently than in the past. With this in mind, the year's projects completed and in the planning stages to improve the Libraries' facilities are of great significance.

In the Dewey Library, work to renovate the Circulation/Reserve and Processing areas was finished just as the fall semester began. The contemporary design of the circulation/reserve desk now provides a single place where library users can go to check out regular and reserve materials and to get information assistance when reference librarians are not available. The redesign has also eliminated the queuing problems that had occurred during peak hours before the desk was modified. The space freed up on the ground floor by moving the microforms upstairs has become a popular reading space for users of Dewey Library newspapers and other materials. And the staff have benefited, too, by now having ergonomic, efficiently designed work surfaces that help keep the production operations of processing incoming serials and journals moving quickly.

One of the most exciting opportunities to collaborate with an academic department surfaced early this spring when the Aeronautics/Astronautics Department approached the Libraries to ask whether the Aero/Astro Library might want to be part of the project to reconceptualize the Aero/Astro pedagogical approach and design lab. The Libraries are eager to participate and have started the process of working with the Project Manager from Aero to plan a newly conceived vision of the Aero Library that will offer services similar to those found in corporate information centers, while still retaining the essential parts of the extensive and valuable print collections and traditional services.

One other smaller-scale renovation project that occurred was the reconfiguration of the Institute Archives' receiving area for materials recalled from storage. The space allocated for this function was problematic due to the placement of shelves and the need to have numerous booktrucks available to move materials upstairs to the Archives' reading room. A new layout was designed and the space was renovated with the center stacks removed and industrial-weight shelving installed around the perimeter of the room. This has created a safer working environment for Archives' staff and has reduced the physical effort required to handle materials.

STAFFING AND ORGANIZATIONAL STRUCTURE ISSUES

With the increasing emphasis on the use of technology as a tool for providing services in research libraries, staff members in the MIT Libraries' public services units experienced significant new demands on their time. Staff were faced with the need to continue traditional activities while simultaneously acquiring new skills in areas such as web authoring which enable the Libraries to create and offer an enhanced array of services. In each divisional and branch library there was a growing demand for coordination of public services' technology initiatives and for support for hardware and software. In order to address these needs, a position was reallocated from Dewey Library to create a centralized Information Technology Librarian for Public Services. Following a national search, the position was filled in December 1997. The incumbent has already played a lead role in arranging technology training for public services' staff and in overseeing projects such as the electronic reserves initiative. Additional information technology support was provided when the Engineering and Science Libraries, following the model established in other MIT library units, reallocated portions of positions to create part-time Local Technology Experts whose responsibilities include troubleshooting and providing first-line support for hardware and software.

On a broader level, the changes in technology and methods for delivering library services have caused many peer academic library public services' staff to rethink their structures and operations. The issues that these libraries have encountered are the same as those confronting the MIT Libraries—how best to remain flexible and responsive to changes in resources and expectations. To begin this discussion in the MIT Libraries, several vacant librarian positions were frozen and a Public Services Redefinition Process was launched in January 1998. With invaluable assistance from Human Resources' Performance Consulting and Training Team, a project plan was written and a series of task forces were appointed. The first task force developed a set of Public Services Values, and the second task force built on this to draw together a list of Service Priorities. The next task force will tackle issues arising from problems with the current structure of the Libraries' public services units. Their work will be followed by task forces charged to review and make recommendations for measuring public service performance and for the establishment of communication channels. While there has been some inevitable anxiety about this process, there is a great sense of energy and an encouraging willingness to discuss ways to resolve some of these thorny issues. The task force work is scheduled to conclude early in the year 1998/1999. The recommendations will then be reviewed in light of resource requirements and system-wide impact, and an appropriate implementation schedule will be established.

As can be seen by the list of accomplishments and projects included in this report, Public Services' staff have worked hard and achieved a great deal to meet the needs of the MIT community. Their ability to be aware of the expectations that MIT students, faculty, and staff have for library services, both virtual and physical, has resulted in many positive changes. These staff are the Libraries' closest link to our users, and they have become increasingly perceptive and creative in making the Libraries both proactive and responsive. The staff are a vital asset for the Libraries!

Virginia Steel

COLLECTION SERVICES

The significant achievements of Collection Services this year illustrate the ongoing tension within the Libraries to move forward in delivering new electronic resources and services, while maintaining strong traditional services and functions.

MOVING FORWARD – THE VIRTUAL LIBRARY

Networked Information Resources

The Libraries continued to acquire access to significant information resources for delivery to MIT faculty and students over MITnet, adding 36 new databases this year. Three significant scholarly databases were the primary additions: the Institute for Scientific Information (ISI)'s Web of Science, Lexis/Nexis Academic Universe, and Beilstein Crossfire:

- Web of Science provides comprehensive coverage of the most recently published research information from the world's most prestigious scholarly journals, including cover-to-cover indexing, detailed bibliographic data, linked cited references, and complete searchable author abstracts from over 5,300 of the leading science and technical publications, 1,700 of the leading social science journals, and 1,100 leading arts and humanities journals. This is a "power-house" tool for scholars in all disciplines at MIT. With the assistance of the Dean of Science, the Libraries were able to provide coverage back to 1988.
- Lexis/Nexis Academic Universe provides access to hundreds of sources of international news and business information, as well as state, federal, and international legal materials.
- Beilstein CrossFire provides a gateway and graphical interface to the most complete collection of structures, properties, and references to the literature in organic chemistry.

As research libraries face high costs in new electronic products, as well as continuing high inflation in prices for print serials, new collaborative buying patterns are emerging in order to leverage purchasing power. Each of the three products above were acquired through consortial arrangements. ISI's Web of Science was purchased cooperatively with other research libraries in the NorthEast Research Libraries consortium (NERL). NERL was established in 1996 in order to seek improved pricing structures and license terms for electronic products. Lexis-Nexis Academic Universe was also purchased through NERL, but in this case NERL itself collaborated with several other consortia in a nation-wide "mega-deal" including more than 600 university libraries. Beilstein Crossfire was acquired through cooperation within the Association of Research Libraries, with the University of

Wisconsin Library acting as the lead institution. Each of these collaborative licensing arrangements netted several thousand dollars' cost savings for the MIT Libraries.

The Libraries continued its efforts this year to negotiate appropriate license terms to ensure fair use of the products by MIT scholars and to establish processes for reasonable efforts compliance with license requirements. The Acquisitions Librarian for Digital Resources developed standard descriptions of MIT's site, computing environment, and authorized users to use in license agreements. She also developed a generic statement to be displayed on webpages describing the appropriate use of licensed electronic resources, accompanied by more information linked through an "I" (information) button for products with more restrictive license language.

Improving Barton, the Online Catalog

One of Collection Services' most important achievements this year, in collaboration with the Systems Office, was the reloading and reindexing of the Barton database after vendor processing of the 800,000 bibliographic records against an authority file. While the vendor processing took place in 1996/1997, the reload of the records took place in August, 1997, and the results were apparent to users of the catalog when the academic year began. The catalog now provides significantly greater consistency of author, subject, and series headings, as well as cross-references to headings from variant forms. Over 500,000 associated authority records were also loaded into the processing system and linked to the bibliographic records. Having linked authority records in the database will enable global changes and automated manipulation of headings in order to maintain a high level of database integrity over time.

The project required significant follow-up activity in a number of areas. First was a series of training sessions for cataloging staff on the creation and maintenance of local authority records. In addition, several focus sessions were conducted for public services' staff to ensure that they understand the implications of the "authorization" of the database for users. Secondly, staff prepared for ongoing quarterly loads of vendor-processed records. This included defining set-up tables and testing a loader for loading updates. Several serious problems arose during the post-load period: the documentation from the Libraries' integrated systems' vendor, Geac, was found to be inaccurate and incomplete, the Geac project manager abruptly left the company, and the authorities vendor, Blackwell North America, divested itself of its authorities services, making it necessary to search for an alternate vendor for the ongoing processing to keep the database current. It is a credit to several key staff members in Bibliographic Access Services and the Systems Office that the project has succeeded and that the planning for regular updates is proceeding effectively.

Cataloging E-Journals

In addition to multiple online databases, the Libraries currently provide access to approximately 300 e-journals. During September and October of 1997/1998, a pilot project to catalog a defined group of 76 e-journals, and to test standards developed in the previous year, was carried out by Serials Cataloging. The pilot project was successful, allowing staff to fine-tune and document policies and procedures. Since that time, staff have successfully cataloged remaining titles and now catalog new incoming titles on an ongoing basis. As a result of this work, users of the MIT Libraries' online catalog now find records for e-journals along with records for print journals and all other library collections.

MAINTAINING AND IMPROVING TRADITIONAL COLLECTION SERVICES

Space Planning

Even as the Libraries move steadily into the provision of networked digital resources, they continue to add print collections at a barely diminishing rate, and face extremely difficult challenges in housing those collections and in providing adequate work space for library users and staff. A report documenting these challenges, *MIT Libraries' Space Needs* (http://macfadden.mit.edu:9500/space97/), was issued in November. It demonstrated that total space, seating, and linear feet of shelving are all substantially below standards and also below that of other academic research libraries with similar size student bodies and collections:

MIT Libraries square feet	210,650
Standard for student body and collection size	286,500
Average for ARL libraries in similar size institutions	321,000

MIT Libraries seats per student population	13%
Standard for typical residential university	25-30%

MIT Libraries number of seats	952
Average for ARL libraries in similar size institutions	2,032

Hayden Library volumes per foot of shelving	9.25
Standard for volumes per foot of shelving	6

The Libraries have additional space needs which are not obvious from the numerical comparisons, such as the need for group study, consultation and teaching spaces, and for the accommodation of growing numbers of computer workstations. While these significant space needs require a long-term solution, severe interim strategies will be necessary before such a long-term solution can be realized. In particular, planning for significantly increased moves of collections to storage began in the last months of the year.

Automating Processes

Loading Invoices. This year staff in Serials Acquisitions worked together with Systems Office staff to implement the invoice loader program in the Geac Advance library system. This enabled automated loading of invoices for over 5,000 titles from four major serials vendors. Improved data accuracy and significant time savings have resulted.

Streamlining Processes

Direct Online Ordering. With assistance from the Systems Office and the Authorities Group, custom programming and a few "work-arounds" enabled Monograph Acquisitions' staff to overcome previous obstacles to placing orders directly online in the system of our major book vendor (Yankee Book Peddler). The order records are subsequently loaded into our Geac Advance library system. MIT Libraries was the first Geac Advance site to implement these processes. Several benefits have accrued: reduced keying, order duplication alert, speedier fulfillment of orders, reduced postage and paper costs, ability to continue ordering during year-end fiscal processes, ability to place a rush request on an existing order. In other words, this was a "big win".

Core Cataloging of Serials. In continuing efforts to find ways to streamline traditional processes and free-up resources for new initiatives, the Serials Cataloging Unit this year undertook an analysis of the potential of the newly defined national standard for Core Cataloging. Discussions with public services' staff were carried out to define elements of cataloging records that could be eliminated while still providing records that serve the needs of the broad range of users of the Libraries' catalog. Several fields were identified for elimination. Many others, it should be noted, were identified as necessary, and the result was a definition of a "pretty full" record, in the words of the Head of Serials Cataloging. While this effort resulted in a modest reduction in work per title, it was also noteworthy as a serious exploration of the utility of various cataloging tasks.

E-mail Transmission of Withdrawal Information. Bibliographic Access Services' staff realized a "creative break-through" this year in solving a long-standing issue related to managing withdrawals in a decentralized system. Divisional and Branch Libraries' staff can now wand barcodes of items to be deleted and transmit them to BAS staff via e-mail, eliminating the previous awkward and time-consuming procedures of making print-outs or detaching and sending barcodes through campus mail.

Improving Access

World Music Classification. Since 1990, the emphasis on world music in MIT's music curriculum has grown substantially. The Libraries have supported this curriculum change by building a significant collection of world music CDs. The growth in the collection strained a classification scheme which was originally intended to organize a collection of United States folk music. In order to streamline world music call number assignment and to facilitate shelving and browsing by country, a staff member in Bibliographic Access Services designed a new classification scheme based on the Library of Congress' G (Geography) schedule. It provides a constant number to each country, unaffected by changes in the country's name. The new scheme was implemented after review by the music faculty, and 500 music CDs were reclassified and relabelled. The response to the new shelving arrangement has been extremely positive.

Achieving Currency. Serials Cataloging eliminated backlogs of print serials held in "Pre-Cat" collections in all Libraries. Monograph Cataloging achieved currency in cataloging microforms, videos, and computer files, and significantly reduced the map cataloging backlog. The microform cataloging included creating individual catalog records for the Fowler microfilm collection of early architectural books.

IN SUMMARY

Once again the efforts of staff in Collection Services have paid off in the effective acquisition, cataloging and management of the print and electronic resources which provide the basis of the Libraries' services. When an MIT

student or faculty member finds a book on the shelf, a recorded performance on a CD, or an e-journal on the Libraries' web, the consistent, informed processes and practices of Collection Services' staff have made it possible.

Carol Fleishauer

TECHNOLOGY PLANNING AND ADMINISTRATION

A year of tremendous changes in staff and organization have left the MIT Libraries ready to develop a strategic approach to our technology needs. Not only is our Systems Office staffed with enthusiastic and expert managers and consultants who support the technology we put in place, but we also have a new Computer Coordinating Committee equipped to examine technology issues across the Libraries with an eye to devising appropriate policy and articulating a compelling vision of how we should harness technology to the tasks of librarianship.

TECHNOLOGY SERVING OUR PATRONS

During the year we have increased our emphasis on technology which serves our patrons. Some of our efforts (like "electronic courtesy notices") were wild successes, some of our failures (like the repeated system crashes of the Fall) reminded us how much a part of the fabric of the Institute library systems have become. In all cases we work to make sure the MIT community has access to the technological tools they need to make use of the resources we provide.

Patrons have given us positive reviews for instituting an "Electronic Courtesy Notice" this year. This notice, sent via e-mail, notifies patrons of books that will become due in three days' time. This early warning system was developed by Systems Office and Circulation staff who are now working on similar notices for holds and recalls.

A survey of undergraduate and graduate students confirmed that half the responding students are prepared to plug their portable computers in the Libraries if we only had network connections available for them. Seventeen such drops were installed across the Libraries and will be publicized for the Fall 1998 term. We are working with IS for both the installation and to develop consistent visibility for drops of this sort whether they are in the Libraries, dorms, or hallways around the Institute.

The importance of our web services continued to grow during the year. We defined the role of a Web Manager to ensure the quality and consistency of our website's content, and though we have yet to fill this position, the interim Web Manager (our Information Technology Librarian for Public Services) has already had a notable impact by responding to user demands for more navigable database menus and more informative news. Plans for a Web Advisory Group have also been put in place. This difficult planning work lays the foundation for significant improvements to come.

We still don't have proper Service Level Agreements in place for the equipment which forms the heart of our Barton library catalog, but we have been working to document our relationship with the IS Operations team at W91 more clearly. We did experience a spell of rough weather from August-November 1997 when the Barton server repeatedly crashed and the W91 and Sun technicians had trouble resolving the problem. The bitter complaints from our patrons during this time reminded us of our importance to the MIT community. We have worked hard to ensure consistent performance our patrons can count on; there has been no significant downtime since December 1997.

Other efforts continued to make progress during the year:

- The Computer Science Technical Report server managed by our Document Services department moved onto more stable equipment and was reborn in a much more usable format. Efforts are now being made to provide access to MIT theses with similar technology.
- The Electronic Reserves project entered the IS Discovery process this year and team members have begun to evaluate alternative systems on the market. Faculty and students continue to demand a service which would provide 24-hour electronic access to material on reserve for courses; a pilot deployment is anticipated next year.

TECHNOLOGY ENABLING OUR STAFF

Of course, though patrons are the center of our attention, our staff also serve our users and must be adequately supported in their technological endeavors. This year has seen us lay a solid foundation of networking for our workgroups, revise our equipment purchase strategy so that it can be more responsive to the needs of our staff, and build closer ties to IS through the use of common tools.

The Systems Office of the Libraries has firmed up its knowledge of Windows NT and deployed an NT domain ("MITLIBRARIES") to manage both staff and public access to our workstations. Requiring an NT logon for our workstations increases security for staff workstations and manageability for public workstations. The foundation of an NT domain also enables us to begin planning new services for our staff, including filesharing for workgroups and portable "profiles" for staff who work in more than one location.

Our Computer Coordinating Committee has rationalized the central purchase of equipment for the Libraries, and tied it to the goals of the organization and to a set of expressed principals. An almost fully staffed Systems Office has improved our ability to roll out new equipment efficiently. In 1998/1999 we will move from annual to quarterly purchases of new equipment in an effort to increase our responsiveness to patron and staff needs.

Our Systems Office has worked closely with the Computing Help Desk this year, forging a relationship that helps both parties be more efficient in passing tasks back and forth. We now track our own trouble reports with the Help Desk's CaseTracker system. Other units in the Libraries are also considering CaseTracker including our online reference staff and our interlibrary loan staff.

Many other staff projects have also seen steady progress:

- The Libraries have been taking part in the Institute-wide rollout of SAP. From a technological perspective, the upgrades provided by IS for SAP machines have been very valuable.
- We continue to struggle with Kerberized Telnet. While IS has provided a solid Macintosh solution for securing telnet sessions, we are mostly a Windows shop. The Windows program licensed by IS has some serious flaws which have forced us to explore other alternatives. We are still looking for an acceptable solution.
- We have been providing important computing services to efforts like the DDC retrospective conversion, Cataloger's Desktop, and Barton invoice and order loading.

STAFF MAKING TECHNOLOGY WORK

For technology to serve the needs of patrons and staff, someone has to make sure that we make the right technological choices and back those choices up with strong support. The year 1997/1998 marked a complete rebuilding of this policy-making and support structure within the Libraries. From a fresh Systems Office to a new Computer Coordinating Committee to a fleet of hard-working Local Technology Experts, the staff of the Libraries began to build a structure that will ensure a responsive computing environment for years to come.

Our redefinition of the Systems Office required a major push this year as the rest of our old staff left the office to be replaced by completely fresh faces. Nobody on the staff of the Systems Office in July 1998 was there in July 1997! The new staff has revitalized the office and drawn high praise from library staff. The new staff fill redefined positions in a much more team-oriented Systems Office. Their work to pull together as a team has paid off in productivity, presence, and professionalism.

The new Head of the Systems Office (who started in February) oversees a staff including a Library System Manager (who started in August) and two Library Technology Consultants (who started in March). Another Library Technology Consultant hired by the Engineering and Science Libraries works closely with the two Consultants in the Systems Office. In fact, the three Consultants share a job description which is closely modeled on the Consultant I job in IS. This alignment with IS jobs via the Consultant descriptions gives our staff a clear growth path they have not previously enjoyed.

All of our staff have done an extraordinary job of learning their jobs and becoming productive very quickly. We engaged MIT human resources' staff to provide us with team-building workshops and outside trainers to teach us more about administering NT servers. We continue to look for team-building and training opportunities.

Finally, we have started the process of renovating the rather dismal offices in which our Systems' staff work. An MIT-assigned architect has begun to work with the staff to plan changes which include much needed ergonomic improvements and staging space for equipment deployment.

In addition to a rededicated Systems' staff, the new Assistant Director for Technology Planning and Administration implemented our plans to distribute responsibility for technical planning beyond the Systems Office. This year we hired two new Information Technology Librarians (the ITL for Public Services started last winter, the ITL for Collection Services starts later this summer) who will pay particular attention to the technological needs of their areas. These two ITLs along with the new Assistant Director, the Head of the Systems Office, and our Head of Administrative Services have formed our Computer Coordinating Committee to guide the technological growth of the MIT Libraries.

STRATEGIES FOR SUCCESS

While we will be pursuing many efforts over the next year, we have identified these four important technological directions:

Converge on key technologies. We will continue to focus on the web as a service point for our patrons with additional data resources, new services, and expanded access off-campus. Behind the scenes we manage a set of NT servers and are looking to expand their capabilities with other tools; you will see more and more machines around you become NT workstations as a result.

Convey information. Our patrons should notice clearer instructions and more timely notification. To our staff we will convey information both through newsletters and training.

Emerge from the woodwork. We will be raising the Libraries' profile as learning space with more extensive network access and by telling the MIT community about our resources via public relations.

Become more strategic. We will be using the documents and goals established by Library Council and the Public Services Redefinition process to help us establish priorities for equipment and technology services.

Our strategies for success will continue to be: focusing on patrons, working together with the Libraries' staff, coordinating with Information Systems, and training our own staff to handle both the technology and the customer-service aspects of their jobs.

Eric Celeste

LINCOLN LABORATORY

Lincoln Laboratory is operated by MIT as a Federally Funded Research and Development Center for performing research and development in advanced electronics. During the past year, agencies of the Department of Defense (DoD)—namely, the Air Force, the Army, the Navy, the Defense Advanced Research Projects Agency (DARPA), and the Ballistic Missile Defense Office (BMDO)—supplied approximately 84% of the Laboratory's budgetary support. The Federal Aviation Administration (FAA) provided most of the non-DoD support, which additionally includes work for the National Aeronautics and Space Administration (NASA) and the National Oceanographic and Atmospheric Agency (NOAA). Lincoln Laboratory also carries out pre-competitive research with industry under approved Cooperative Research and Development Agreements. For the federal fiscal year 1997, Lincoln Laboratory received $394 million, supporting the efforts of 1112 professional technical staff.

The following administrative changes occurred at the Laboratory Steering Committee level. Prof. Walter E. Morrow retired as the Laboratory's director on 1 July 1998, after having served Lincoln Laboratory for over 21 years. He is now Lincoln Laboratory's Director Emeritus. Dr. David L. Briggs became Director of the Laboratory and Dr. Herbert Kottler became Associate Director on 1 July 1998. Mr. Carl E. Nielsen, Jr., became Assistant Director for Administration. Mr. Lee O. Upton became Head of the Surveillance and Control Division, Dr. Kenneth D. Senne became the Head of the Air Defense Technology Division, and Dr. Lewis A. Thurman became Associate Head of the Air Defense Technology Division.

Activity at the Laboratory focuses on surveillance, identification, and communications technology development for the DoD, and on air traffic control technology for the FAA. Technical work areas include radar and optical sensors, measurements, and systems; communications; signal design and processing; lasers; solid state devices; digital technology, circuitry, and data systems; and tactical control systems. Unclassified summaries of several accomplishments during the past year are presented below.

SURVEILLANCE TECHNOLOGY

DISCOVERER II

Space-based radars offer advantages over airborne platforms for surface surveillance, including access to areas otherwise denied. Several radar satellites currently in operation provide synthetic-aperture radar imagery. However, satellite-based radar capability is desired to support tactical operations with rapid-response and near-continuous surveillance for both stationary and moving targets. The Laboratory is a key participant in the DARPA Discoverer II program. To meet the program's objectives, the Laboratory is developing a low-cost radar satellite for use in a low-earth orbit configuration of 24 to 48 satellites.

FOLIAGE-PENETRATION SYNTHETIC-APERTURE RADAR TECHNOLOGY

Lincoln Laboratory continues to support DARPA in its efforts to develop Foliage-Penetration (FOPEN) radar for detection of obscured ground targets. In August 1997, a major field experiment conducted by Lincoln Laboratory utilized the Naval Air Warfare Center ultrawideband UHF synthetic-aperture radar (SAR) and the Swedish National Defense Research Establishment CARABAS II VHF SAR to collect foliage-penetrating imagery. This experiment was performed at Fort Indiantown Gap, PA, collecting over 250 km^2 of clutter data and over 250 views of targets in realistic deployments. Complementary data was collected with other sensors, including Lincoln Laboratory's X-band SAR. Data from this experiment is being used to support phenomenological studies as well as development of algorithms for automated target detection and cueing.

LINCOLN NEAR-EARTH ASTEROID RESEARCH (LINEAR) PROJECT

The LINEAR project operates a wide-area asteroid search program employing an advanced electro-optic search system originally developed for the Air Force space-surveillance applications. Recent advances in large-format, highly sensitive charge-coupled devices (CCDs) with fast readout rates, combined with customized data processing systems, allow the LINEAR project to search in excess of 10,000 square degrees per month to a limiting visual magnitude exceeding the 19th magnitude. This coverage, combined with an effective moving-object detection algorithm, has allowed LINEAR to be very productive when searching for near-Earth objects (NEOs), comets, and main-belt asteroids. During the period of only three months, March through May 1998, LINEAR searched 34,086 square degrees of sky and reported 293,598 observations to the Minor Planet Center. During this three-month interval, the observations produced by LINEAR account for approximately 80% of the asteroid observations

generated worldwide. This effort resulted in discovery designations for 35 new NEOs (a total of about 500 NEOs are now known), 4 new comets, and over 7134 main-belt asteroids. These results were obtained with a one-meter ground-based electro-optical deep-space surveillance (GEODSS)-type telescope at the Lincoln Laboratory Experimental Test Site near Socorro, NM.

MISSILE DEFENSE

COBRA GEMINI RADAR

Since the end of the Cold War and dissolution of the Soviet Union, the missile data collection effort has focused on the Theater Ballistic Missile (TBM) systems of rest-of-world (ROW) countries. A key and consistent recommendation of studies addressing ROW missile data collection is the need to provide a low-cost, air- and ground- transportable, mechanical scanning dish radar system. Lincoln Laboratory has developed the prototype of such a concept: the COBRA GEMINI radar system. It will be used to acquire data on ROW theater ballistic missile launches. COBRA GEMINI operates at both S- and X-band frequencies and has wideband imaging capability. The system is currently in test and evaluation at the Millstone Hill Field Site in Westford, MA. The radar will be integrated onto a ship platform early this fall and undergo ship-based testing for the remainder of the 1998 calendar year.

THEATER HIGH-ALTITUDE AREA DEFENSE PROGRAM

The Theater High-Altitude Area Defense (THAAD) system is currently undergoing demonstration/validation flight testing at White Sands Missile Range. The system is designed to provide large-area defense against theater ballistic missiles. Lincoln Laboratory provides the independent assessment for all THAAD flight tests of the radar performance to the government evaluators, and also detailed characterization of the sensor's performance to the radar product office. In addition, the Laboratory conducts testing and analysis of the baseline classifier, as well as continuous development and transfer of discrimination upgrades being implemented in the next-generation THAAD radar.

THEATER MISSILE DEFENSE CRITICAL MEASUREMENTS PROGRAM

The Theater Missile Defense (TMD) Critical Measurements Program (TCMP) employs a sequence of flight tests executed at Kwajalein Missile Range (KMR) to provide IR and radar measurements that address critical TMD system-level issues. Lincoln Laboratory supports TCMP in four task areas: (1) mission planning and integration, (2) payload development, (3) fly-away IR sensor development, and (4) data analysis. The planning for the next campaign (TCMP-3) has begun, including four theater ballistic missile flights for the FY99-00 time period.

NATIONAL MISSILE DEFENSE GROUND-BASED RADAR PROGRAM

The Ground-Based Radar (GBR) program is being developed as a surveillance and fire control sensor for the National Missile Defense (NMD) system. The GBR-Prototype (GBR-P) is undergoing calibration and checkout at the KMR, and will be used during the NMD system testing in FY99. Lincoln Laboratory has provided support in several key areas, leveraging off the THAAD Radar program experience. This support includes test planning for the GBR Radar Credible Target (RCT) test to be conducted in February 1999, and development of data reduction and analysis tools for use in radar characterization and sensor performance assessment in flight tests. The data reduction activity includes development of workstations to be implemented at the GBR-P site to provide on-site data reduction and analysis, near real-time imaging, and sensor performance monitoring. Development and testing of algorithms to be implemented in upgrades for discrimination to the GBR-P software are continuing.

NAVY THEATER BALLISTIC MISSILE DEFENSE TECHNOLOGY PROGRAM

Over the past several years Lincoln Laboratory has supported the Advanced Electronic Guidance and Instrumentation System (AEGIS) office development of a Theater Ballistic Missile Defense (TBMD) capability. This capability is separated into two programs; a Navy Area System (lower tier) and a Navy Theater-Wide (NTW) system (upper tier), and differs significantly from the current Anti-Aircraft Warfare capability. Early work focused on both autonomous and cued search modes as well as predictive analysis based on the system's projected capabilities.

The Laboratory effort has been central to the characterization and modeling of the TBM debris environment, based on recent data collections by the KMR radars, Cobra Judy, and the Airborne Surveillance Testbed. This RF and IR

debris characterization has gained wide acceptance within the Navy TBMD community and is impacting the design and requirements for both the Area and NTW systems.

AIR DEFENSE TECHNOLOGY

AIRBORNE SEEKER TEST BED

The capabilities of modern air defense missile systems have been severely challenged by the advent of low-observable vehicles and modern electronic countermeasures. The Airborne Seeker Test Bed (ASTB) is an instrumentation platform developed by Lincoln Laboratory to investigate these challenges and identify appropriate seeker architectures and signal processing algorithms for dealing with them.

A RF seeker pod added to the test bed in 1997 has undergone extensive measurement testing in Nevada. Additional efforts over the last year have focused on implementing a control architecture for this RF seeker so that its actions in flight are controlled by a ground-based radar. This architecture allows flight testing of target intercepts in which the tracking radar and the seeker share data and act as an integrated system. In October of 1997 a new IR seeker pod containing two seekers was added to the sensor suite, and has been used in air-air target detection and clutter testing. Flight testing with these RF and IR seeker pods will continue through the next year, with a focus on RF countermeasures testing.

MINIATURIZED DIGITAL RADAR RECEIVER

The modern battlefield requires that airborne early-warning surveillance platforms, such as the E-2C, detect small targets in the presence of severe jamming and sea/land clutter. Adaptive signal processing techniques, such as Space-Time Adaptive Processing (STAP), enable enhanced target detection capability in the presence of clutter and jamming. These techniques use multiple receive antenna channels and digital signal processing algorithms to shape the receive beam pattern in the spatial and Doppler domains. The current E-2C APS-145 radar has two receive channels; a significantly higher number of receive channels are required for STAP processing. A miniaturized digital receiver technology will significantly reduce the receiver form factor by using advanced multichip module technologies and by using one stage of RF down-conversion instead of the two or three stages used in conventional receivers.

Another challenge with STAP processing is that it requires a very high computational throughput. Each receive channel requires digital in-phase/quadrature down-conversion, channel equalization, and pulse compression prior to STAP processing. The computational throughput requirement could be as high as 2 to 10 trillion operations per second, which is too high for conventional parallel processors. Therefore, these front-end signal processing functions have been incorporated into the miniaturized digital receiver using a high-performance VLSI signal processor. A full custom CMOS VLSI signal processor was developed by using a very high-performance scalable bit-level systolic cell library. Each chip functions as a massively parallel signal processor and consists of tens of thousands of one-bit processors. Using massively parallel signal processing, each chip can perform up to 23 billion operations per second with an established 0.6-micron CMOS fabrication process. The resulting multichip module-based receiver/processor is approximately 3.5" x 5.0" x 0.5" and performs approximately 60 billion operations per second. The multichannel chassis being developed will contain 32 receiver channels, which will perform approximately 2 trillion operations per second in a cubic foot.

MOUNTAINTOP PROGRAM

In February 1998, the Office of Naval Research (ONR) assumed sponsorship for the Radar Surveillance Technology Experimental Radar (RSTER) system at the Pacific Missile Range Facility (PMRF). The RSTER was relocated at the PMRF from April to June and became ONR's multisensor testing and integration site. The first major system to be integrated with RSTER will be a new antenna for the Navy's future airborne surveillance radar, the UHF Electronically Scanning Antenna (UESA). The UESA is a multi-element, cylindrically configured antenna currently being industry-developed and fabricated. The UESA is scheduled to be delivered to PMRF during FY99 for functionality demonstrations.

COMMUNICATIONS AND INFORMATION TECHNOLOGY

ALL-OPTICAL FIBER NETWORKS

Under the Next-Generation Internet (NGI) initiative, DARPA initiated a consortium to explore the application of Wavelength Division Multiplex (WDM) All-Optical Networks technology to access networks. In addition to MIT,

the consortium includes service providers, router equipment manufacturers, and a WDM component manufacturer. Though Internet usage has soared, the low bandwidth and relatively high cost of the access network have severely limited the speed, applications, and overall accessibility of internet communications. The huge capacity and configurability of optical networks can be harnessed to improve this situation. The NGI access network initiative will explore physical-layer architectures that make the most efficient use of the optical technologies, and higher-layer software and protocols that work effectively with the underlying optical layer. A test bed will be constructed in Eastern Massachusetts to demonstrate and validate the architecture, technology, and software, as well as applications being developed under the NGI program.

MILITARY COMMUNICATIONS

During this year, concepts for extending networks over military communications satellites were implemented and tested in the laboratory. This work included the initial implementation of a teleport capability that interfaces remote military users of the Milstar communications satellite system to the public switched telephone network. This extended network will be used for secure voice and video teleconferencing, as well as to packet data services (such as the Internet and similar classified networks). Access control and traffic security issues continue to be under development.

Many of the satellite communications concepts and technologies being developed are also applicable to augmentation of tactical communications via micro air vehicles used as switching and routing nodes in a data network serving terrestrial (commercial and military) users. Individuals with small, handheld radios will be able to link into the network through the airborne platforms. These platforms are interconnected by high-rate backbone circuits and then to entry points on the ground, where interconnection with terrestrial communications systems can be accomplished. Since the aircraft can be quickly flown into an area of operations, there is little logistic strain in establishing a communications capability on the ground. The network also covers large areas from a single high-flying aircraft and is thus able to link together widely dispersed military units. A detailed engineering study of this concept was completed this year under DARPA sponsorship.

ADVANCED DISTRIBUTED SIMULATION

Under the Advanced Distributed Simulation Program, funded principally by DARPA and the Defense Modeling and Simulation Office (DMSO), Lincoln Laboratory developed prototype Run-Time Infrastructure (RTI) software for linking a broad range of DoD models and simulations. The prototype RTI software was used for a major demonstration in October 1997 as part of DARPA's Synthetic Theater of War program, which is being developed for use by the U.S. Atlantic Command. The software successfully linked 450 computers at seven geographically separated sites, supporting over 30,000 simulation objects. About 150 gigabytes of data were logged over 48 hours of continuous operation, without network disruption or data loss. The techniques used in developing the RTI software are now being considered for broader use in other applications that require reliable real-time database operations over heterogeneous networks.

COMPUTER NETWORK INTRUSION DETECTION EVALUATION

Lincoln Laboratory is performing a rigorous, objective, and repeatable evaluation of computer network intrusion detection systems. Under joint DARPA and Air Force Research Laboratory sponsorship, a realistic simulation network has been developed that can run real computer network attacks and anomalous sessions mixed with normal network traffic. Although this network contains fewer than a dozen real computers, it is able to simulate thousands of users on hundreds of PCs and UNIX workstations. Both the false-alarm rate of intrusion detection systems under normal conditions and the probability of detection for existing and new attacks are being measured. Prior work at the Laboratory using this approach with a simpler network and more limited traffic types revealed serious weaknesses in existing intrusion detection approaches and led to development of two new algorithms that reduce false-alarm rates by as much as two orders of magnitude. Training data are currently being generated and distributed to DARPA contractors. Test data will be shipped during September 1998, and the evaluation completed in the fall of 1998.

AUTOMATED ENGLISH/KOREAN TRANSLATION

In order to enhance communications among multinational forces in a tactical theater, Lincoln Laboratory has been working on a computer-automated translation system to relay command information. The initial effort has concentrated on Korean/English text, within the context of typical military sentence structure. In June 1998, the Laboratory demonstrated the first computer-automated English-to-Korean translation of an operational

Commander's briefing and speaker's notes at the Combined Forces Command Korea. In addition, the Laboratory has developed the first interlingua-based Korean-to-English translation system, including a unique capability to handle the wide range of word-order variations that are typical in Korean.

AIR TRAFFIC CONTROL

AUTOMATION TOOLS

Lincoln Laboratory is helping the FAA and NASA enhance air safety, reduce controller workload, and increase airport capacity by developing planning aids for air traffic controllers. The Center/Terminal Automation System (CTAS) developed by NASA Ames Research Center helps coordinate activities between arrival controllers located at en route centers and final-approach controllers located at airport radar control facilities. Lincoln Laboratory developed the prototype software now in operational use at airports in Atlanta, Denver, Los Angeles, and Miami. The Laboratory also wrote the system-specification and computer/human interface-requirement documents for the CTAS system currently in operation at the Dallas/Ft. Worth airport.

The En Route Air Traffic Management Decision Support Tool (ERATMDST) is a new FAA system being designed to assist air traffic managers and controllers in en route airspace by providing integrated conflict probe and scheduling capabilities. Lincoln Laboratory is also leading the effort to develop an ERATMDST test bed that integrates prototype software and display concepts developed at NASA Ames, MITRE, Lincoln Laboratory, and EuroControl.

SURVEILLANCE RADAR IMPROVEMENTS

The beacon surveillance systems deployed with radars such as the ASR-9 suffer from reflections off buildings, boats, signs, and aircraft that can cause false targets on controllers' displays. Lincoln Laboratory has developed dynamic reflector algorithms and software to automatically identify the location and orientation of the reflection sources and place this information in the beacon processor data base. Reflector information is then used to edit beacon reports and greatly reduce the occurrence of false targets. Dynamic reflection software was tested in the ASR-9 backup beacon processor starting in 1993 and is now being fielded in the production cards. Similar software was developed for the Mode S system in 1997 and was tested at two sites in 1998. This dynamic reflector capability will be fielded in the next several years.

DATA-LINK SYSTEMS

The Traffic Information Service that provides pilots with the location of nearby aircraft by uplinking surveillance information gathered by the Mode S radar has completed FAA acceptance testing and is being installed in the 118 Terminal Mode S radars located at airports across the United States. The Text Weather Service and Graphical Weather Service provide pilots with weather text and graphics uplinked via Mode S from ground-based weather sources, including weather radars. Both services are available to users in the greater Washington, DC, area through the Mode S radar located at the Washington-Dulles radar in an ongoing evaluation program sponsored by the FAA. A version of the Text Weather Service, derived from information provided by the Laboratory-developed and FAA-contractor-built Terminal Doppler Weather Radar (TDWR), is available to airline users via the airline-sponsored VHF data link known as the Aircraft Communications, Addressing and Reporting System. This weather reporting service, called Terminal Weather Information for Pilots (TWIP), provides wind -shear, microburst, and precipitation messages to aircrews departing or approaching airports served by the TDWRs. TWIP is now deployed as a software upgrade to the TDWR software at all 44 U.S. TDWR sites.

AVIATION WEATHER DETECTION AND PREDICTION

The Laboratory-developed Integrated Terminal Weather System (ITWS) will significantly extend the TDWR capability in the areas of hazardous airspace identification, winds to support automation systems, and the short-term forecasts of significant weather. The transition is under way for the Laboratory-developed algorithms to generate the ITWS products from FAA and National Weather Service's sensors and the numerical models to the FAA's ITWS full-scale development contractor. It is expected that production versions of ITWS will be installed at major airports starting in 2001. The Laboratory continued to operate ITWS test beds in Memphis, Orlando, and Dallas-Ft. Worth airports to increase the ITWS data base and test enhanced products such as the prediction of convective storm growth and decay. An additional experimental site in San Francisco supports the development of ceiling and visibility products. An experimental ITWS, funded by the Port Authority of New York and New Jersey, for the New York City airports will commence operations in 1998.

BIOLOGICAL AND ENVIRONMENTAL MONITORING

BIOAGENT IDENTIFICATION SENSOR

In a collaborative program between Lincoln Laboratory and the Department of Biology's Center for Cancer Research, a new type of sensor for identifying bioagents is being developed. The sensor concept involves using genetically engineered B cells, or white blood cells, for the bioagent identification. B cells have been genetically modified to express a bioluminescent protein called aequorin as well as specialized antibodies on their surface that are specific to individual bioagent simulants. When a bioagent simulant binds and crosslinks these surface antibodies, a signal-transduction cascade fires within the B cell that triggers the aequorin to emit photons at a wavelength of 469 nm. This signal-transduction cascade provides a strong biochemical amplification. In recent experiments, the observed photon output of engineered B cells was 56 times the bioluminescent background within 30 seconds after a bioagent simulant was introduced into the solution containing the B cells.

NEW LANDSAT SENSOR DESIGN AND FLIGHT PROGRAM

Lincoln Laboratory is responsible for the design, development, and demonstration of the Advanced Land Imager (ALI) that will be launched on the NASA's Earth Orbiter-1 mission in December 1999. ALI is a land-imaging instrument that will demonstrate advanced technology to meet NASA's Mission to Planet Earth science needs in the 21st century. The new technologies dramatically reduce the size, weight, and power of ALI versus the LANDSAT-7 Enhanced Thematic Mapper. The ALI multispectral images will be compared with 100 to 200 images from LANDSAT-7 to validate the new technologies. Fabrication of the telescope and focal plane have been completed, and ALI is in process of instrument assembly to be followed by calibration.

ELECTRONIC DEVICES

IMAGER FOR ADVANCED NIGHT VISION

Lincoln Laboratory has developed CCD imagers providing, for the first time with an all-solid-state imaging device, useful imaging under starlight conditions at standard television formats. The results achieved at television rates with the CCD imager at 1.9-mLux scene illuminance can be compared to commercial CCD camera systems at 1000-mLux scene illuminance. These substantial improvements will bring greatly improved capabilities to night-vision systems.

COMPACT 3-D LASER IMAGER

Compact components are under development for a 3-D active imaging system in which the vertical and horizontal dimensions are augmented with the range dimension as obtained by timing the return of photons from a brief laser illumination pulse. The light source is a miniature diode-pumped, passively Q-switched Nd:YAG laser. The detection electronics combine a 2-D array of silicon avalanche photodiodes (APD) with an array of CMOS timing circuits, providing accurate timing within each pixel. Operating in a Geiger mode, each pixel can resolve the return of a single photon to sub-nanosecond accuracy.

HIGH-BRIGHTNESS 2-μm DIODE LASERS

Efficient and compact high-brightness diode lasers operating near 2-μm wavelength are of interest for such diverse applications as medical surgery and countermeasures against missile seekers. Lincoln Laboratory has developed high-performance 2-μm diode lasers by using its molecular-beam epitaxy capabilities in the growth of various AlGaAsSb and GaInAsSb alloy layers. Diode lasers made in a tapered cavity configuration have outputs approaching a watt with near diffraction-limited beam quality. The tapered laser consists of a mode-filtering waveguide region and a tapered gain region combined with cavity spoiling grooves so that it can operate at high power without the destabilizing effects present in the more common rectangular-cavity lasers.

With CW output power in excess of 0.6 W with a horizontal divergence of only 0.7 degrees, the diffraction limit of the 140-μm diode-laser output aperture has recently been achieved. Because the output of these lasers is highly divergent in the vertical plane and highly astigmatic (different focus in the vertical and horizontal planes), anamorphic optics are required to collimate the radiation.

In a complementary microlens technology at Lincoln Laboratory, a surface atom transport process is being used with GaP wafers to convert etched mesa structures into well-defined optical surfaces. Arrays of high-quality f/0.5

microlenses have been made, and output beams from these arrays of tapered lasers have been efficiently collimated by matching arrays of GaP microlenses, enabling multiwatt powers at high brightness levels.

LOW-POWER DIGITAL CIRCUITS FOR SPACECRAFT

NASA's New Millennium Program is launching a series of low-cost spacecraft for which an important mission is the demonstration of space capability for new technologies. The first of these spacecraft, Deep Space 1, will carry ultralow-power silicon chips fabricated in the Laboratory's Microelectronics Laboratory by using the 0.25-μm fully depleted silicon on insulator (FDSOI) process.

The FDSOI chips comprise transistors and small circuits that will be tested periodically as the spacecraft moves through the radiation belts and away from the earth. The Laboratory-designed test board will automatically apply a sequence of test conditions. These results are to be reported to the central spacecraft computer and recorded for later transmission to the ground and analysis by the Laboratory. The board was integrated into the spacecraft in December 1997, with launch scheduled for October 1998. The goal is to make this low-power, high-performance process available for future spacecraft applications. Organizations are now submitting for fabrication designs of additional circuits using the Laboratory's FDSOI process.

More information about Lincoln Laboratory can be found on the World Wide Web at the following URL: http://www.ll.mit.edu

David L. Briggs

SCHOOL OF ARCHITECTURE AND PLANNING

During the 1997-98 academic year, the School of Architecture and Planning vigorously continued to improve its core physical facilities, to develop new computer and digital telecommunication capabilities, to sponsor new ventures in research and teaching, and to build and renew its faculty. These efforts are expected to position the School as a strong leader into the 21st century.

FACULTY

Faculty development and renewal remains a top priority. During 1997-98 there were important faculty appointments in all units of the school.

In the Department of Architecture Ellen Dunham-Jones was promoted to Associate Professor of Architecture and Qingyan Chen was promoted to Associate Professor of Building Technology. Bill Hubbard was appointed Adjunct Associate Professor while Wellington Reiter was appointed Associate Professor of the Practice of Architecture.

In Media Arts and Sciences Judith Donath, whose research explores the relationship between virtual identity and online communities, was named Assistant Professor. Brian Smith, whose primary research interest is the development and evaluation of an interactive video system for high school classrooms, joined the faculty as an Assistant Professor. Aaron Bobick, LG Career Development Professor of Computational Vision, was promoted to Associate Professor. Alex Pentland was promoted to Full Professor and named Toshiba Professor of Media Arts and Sciences. Marvin Minsky was named Toshiba Professor Emeritus.

In the Department of Urban Studies and Planning Professor Lawrence Bacow was appointed Chancellor of MIT. Bacow was also named Associate Director of the Center for Environmental Initiatives and the Lee & Geraldine Martin Professor of Environmental Studies. Assistant Professor Vicki Norberg-Bohm was named Co-director of the Program for Environmental Education and Research. Timothy Riddiough was promoted to Associate Professor, Dennis Frenchman was appointed Professor of the Practice of Urban Design, and Paul Smoke was appointed Associate Professor of the Practice of Development and Planning. The Department hired Eran Ben-Joseph as Assistant Professor of Landscape Architecture. Dr. Ceasar McDowell, a national leader in research and writing on the intersection of race, technology, and education, was named Associate Professor of the Practice of Community Development and appointed new Director of the Community Fellows program.

An overriding concern and goal for the School is to increase the diversity of our faculty and students. Over the past few years, with help from the Provost's special programs, we've had great success in attracting women and minorities to the School. We continue to apply aggressive recruitment efforts in every faculty search.

Two special fellowship programs in the Department of Urban Studies and Planning, the Community Fellows Program and the SPURS Program, bring to the School mid career practitioners from minority communities who work in urban and regional development in the United States and in developing countries. As Fellows, they study and pursue independent research.

SPACE

Renovations of main group spaces continued with further improvements to classrooms, research and support spaces. Last summer saw the move and renovation of the SPURS Fellows offices and the renovation of the Center for Advanced Visual Studies's new home on the third floor of building N52. The final phase of construction began this summer with renovations to the City Design and Development suite of studios, classrooms, and offices in 10-485.

The expected completion date of the final phase of renovation is fall 1999.

EDUCATIONAL INITIATIVES

Curricula throughout the School continued to evolve rapidly during the academic year in response to emerging conditions and opportunities.

The Department of Architecture's undergraduate program has benefited from clarification of its curriculum and now has a core group of committed faculty advisors and mentors in place. Dennis Adams assumed directorship of the

Visual Arts Program (VAP), which has five graduate students and continues to support the undergraduate visual arts curriculum at the Institute. The Department received a meritorious review and report from the MIT Corporation Visiting Committee and the National Architectural Accreditation Board Visiting Team.

In collaboration with Institute Committees and the departments of Physics and Materials Science and Engineering, the Program in Media Arts and Sciences (MAS) has begun developing an experimental MAS undergraduate program to be implemented in the near future. During the past year, MAS faculty and staff offered eight undergraduate subjects, conducted freshman seminars, and served as freshman advisors. MAS continued to provide an extraordinary number of positions to undergraduates in the Undergraduate Research Opportunities Program.

The Department of Urban Studies and Planning's (DUSP) Undergraduate Committee made significant progress towards forming a new interdisciplinary Minor in Public Policy. A committee of DUSP and Political Science faculty finalized a proposal that will be presented to the Committee on Curricula early next year. The non-degree Special Program for Urban and Regional Studies (SPURS) hosted fourteen international Fellows during the academic year, while the Community Fellow Program brought seven community activists to MIT, sponsored a seminar series, and initiated a Web Design program for minority youths.

EVENTS AND AWARDS

The academic year showcased innovative work from within the School as well as offering us the chance to learn from leading international figures in design and social issues.

This year in the Department of Architecture The Arthur H. Schein Memorial Lecture was given by Thomas Herzog. Renzo Piano delivered the Pietro Belluschi Lecture. The first Felix Candela lecture was given by David Billington. Distinguished guest lecturer Santiago Calatrava delivered three well received lectures and accompanying seminars. For their Beijing Urban Studio Design, Professors Jan Wampler and Dennis Frenchman were awarded the Irwin Sizer Award for Most Significant Improvement to MIT Education. In the fall, Visiting Associate Professor Hasan-Uddin Khan organized a symposium, "The Architecture/Landscape Pact: Pedagogical Initiatives." In the spring the Department hosted a symposium, "Architecture, Art, and Cultural History: Refractions and Reflections," to celebrate the 25th anniversary of the History, Theory, and Criticism program.

In the Program in Media Arts and Sciences Professor Tod Machover was awarded the first annual DigiGlobe Prize in Germany for his invention of hyperinstruments. The Computer Clubhouse, a collaborative program between the Media Laboratory and Boston's Computer Museum, won the seventh annual Peter F. Drucker Award for Nonprofit Innovation. Professor Pattie Maes received the International Engineering Consortium award and was named one of the 50 "cyber elite" in the publication, *Digital Time.*

In the Department of Urban Studies and Planning students and faculty in the City Design and Development Group organized and participated in the Boston Harbor Conference. The Conference drew together community and national experts who discussed how to best utilize this regional resource. In the spring, the Department sponsored a one-and-a-half day symposium on "Advanced Technology and Low-Income Communities." Over the summer, twenty-two students and faculty participated in the fifth Beijing Urban Design Studio, held in China. During his residence at MIT, Martin Luther King visiting professor Ernesto J. Cortés, Jr. received the prestigious Heinz Family Foundation Award for public policy.

The Aga Khan Program for Islamic Architecture (AKPIA) held an extensive lecture series and two roundtable discussions during the academic year. In the fall, AKPIA sponsored the roundtable discussion "Dead Cities of the Limestone Massif in Syria" and in the spring they hosted a roundtable entitled "The Sacred in Contemporary Architecture and Urbanism."

The Center for Real Estate (CRE) hosted a successful day-long focus group, attended by 20 senior real estate investment executives and CRE faculty, on the strategic information needed for real estate decision making.

Center for Advanced Visual Studies (CAVS) Professor Emeritus Otto Piene (Director Emeritus) coordinated a world-wide logo design competition for the city of Stuttgart, Germany. First prize was won by Media Lab Professor and former CAVS student, John Maeda. Professor Krzysztof Wodiczko was awarded the prestigious Hiroshima Art

Prize, presented every three years to an artist whose work demonstrates high achievement in international contemporary art and contributes to world peace. Senior Fellow Elizabeth Goldring received an award from the Charlotte Moorman Fellowship Fund for making art accessible to the visually impaired.

The Ralph Adams Cram Award for outstanding interdisciplinary work at the Master's level was jointly presented to three 1997 graduates of the Center for Real Estate's MSRED program. Aubrey E. Cannuscio, James C. Cole, and Michael T. Jammen won the prize for their report, "Field$ of Dream$," describing the relationship between the financing and design of sports stadiums.

During the academic year, curator of Architecture at the MIT Museum, Kimberly Shilland, organized three shows in the School's Wolk Gallery: *The Middle Passage Project, The Work of Allies and Morrison, Reflections: Drawing and Projects by Wellington Reiter.*

More information about the School of Architecture and Planning can be found on the World Wide Web at the following URL: http://sap.mit.edu/

William J. Mitchell

DEPARTMENT OF ARCHITECTURE

The Department of Architecture continues to maintain and enhance its role as one of the eminent professional schools of architecture, with a mission to provide students instruction in history, technology, and the arts, as well as the many domains of the discipline of architecture. By "discipline" we understand the full constituency of architecture to be much broader in scope than the profession; on a department level "discipline" refers not only to architectural design but also to the other distinctive domains of our program: visual arts, building technology, and history, theory, and criticism of art and architecture. We are committed to a leading role in the exploration of new technologies and electronic communications in relation to our physical and social environments.

This year both an MIT Corporation Visiting Committee and a National Architectural Accreditation Board Visiting Team reviewed and reported favorably on the department.

The discussion below is organized by discipline group, followed by individual topics that cross discipline areas.

ARCHITECTURAL DESIGN

The statement below was prepared for the accreditation of our professional architectural design degree, but also emphasizes the interconnecting roles of all discipline areas in the Department.

It is commonplace that new theories and new technologies are changing our conception of what architecture can do and how architects conceive their tasks and accomplish them. The unique position of the MIT Department of Architecture is that we survey the development of theory from a decades-old departmental commitment to viewing such developments through the long lens of the history of criticism. We also view technology within an Institute which for a half-century has profoundly shaped and investigated technology's role in society. So we are open to — indeed are enthusiastic about — new technologies and theories. But we also feel impelled to test the results of our designing against long-held social and environmental values. As we embrace new conceptions of architecture, we demand of ourselves that our designs have the qualities of space, light, air, tectonic soundness, and place that allow for appropriate, even poetic, inhabitation.

Beginning studios (undergraduate and graduate) build up modeling and drawing skills by focusing those skills on an expanding range of ideas that the students must synthesize in their design projects. The first semester of Level II completes the core studio sequence for graduates and qualified undergrads with an intentional focus on the tectonics — the making and the resultant feeling — of architecture.

Having "graduated" from the core sequence, MArch students in Spring Level II and in the two semesters of Level III choose that combination of diverse studio offerings which best meets their individual needs and desires. During those final semesters MArch students develop a concentration, a particular field of inquiry, which they pursue through closely-focused design "workshops" and course-work in this and other departments. The insights gained in this concentration then culminate, in the final semester, with the MArch students' theses.

A hallmark of studio education at MIT is that instructors propose to their students not merely a project but a process by which that design might be accomplished. Our faculty use a shared set of themes as vehicles for advancing their pedagogies. Here are those themes, not imposed by departmental fiat, but observed and endorsed by all of us in mutual consultation:

Tectonic Expression. We find among ourselves a poetic and pragmatic interest in how materiality, the manner of construction, and the means of managing natural forces (gravity, climate, airflow...) might be expressed.

Light and Inhabitation. We feel that attention must be paid to the capacity of light to transform and model space in ways appropriate to a range of human activities and emotions.

Building Community. We believe that respect must be accorded to the identity and social needs of inhabitants of places, both to establish private territories for them, and to enhance their abilities to participate in the public realm.

Cultural Heritage. We respect the value of cultural difference, and we seek strategies that preserve the legacy of artifacts and customs from the past while addressing the pressures and opportunities of the present.

Urbanism. We are acutely aware of architecture's ability to contribute spatially, symbolically, and functionally to the shared but divergent social and economic life of cities.

Engaging the Landscape. We understand the impact of buildings as material and experiential extensions of the land. We thus pay particular attention to the impacts that designed environments have on natural systems.
Sustainability. We feel a concern for the conservation of natural resources, not just in terms of the efficiency of the buildings we design and the practices our buildings foster among their inhabitants, but in terms of larger practices like settlement and transportation.
Virtual Environments. We are fascinated by the use of digital media to both research and represent physical spaces and phenomena. We are even more fascinated by the chance such media afford us to design sites, software, and protocols that might foster a sense of inhabitation, of place, in cyberspace.

A sample of research by faculty in Architectural Design includes sustainability (Andrew Scott), New American School Design Project (Roy Strickland), visualization (Julie Dorsey), shape grammars (George Stiny, Terry Knight), space planning and organization (William Porter), computation and unbuilt architecture (William Mitchell, Takehiko Nagakura), design in developing countries (Wampler, Goethert), and urban design (Dennis, Beinart).

BUILDING TECHNOLOGY

The building technology program has several research projects directed by Leon Glicksman and Qingyan Chen, underway in the state-of-the-art lab opened last year which can be used to study indoor air quality, thermal comfort, building energy analysis, and heating ventilating, and air-conditioning (HVAC) system control and design. Leslie Norford and Julie Dorsey continue their work on a computational tool to aid architects in complex lighting designs. Chris Luebkeman's research explores innovations in tensegrity structures. While a search continues for a faculty member in materials and construction, the teaching needs in these areas have been met by a line-up of local professionals. Barry Webb and Carl Rosenberg teamed again to teach lighting and acoustics.

HISTORY, THEORY, AND CRITICISM

Faculty and students are well represented by publications and conference contributions in their fields. It was an exceptional year in the quantity and quality of external research grants awarded to graduate students. A highlight of the year was a symposium marking the 25th anniversary of the program, featuring noted scholars and alumni/ae. Research interests of the faculty include architecture and urbanism of modern Europe and America, architecture and epistemology, historiography, architectural theory, modernization in the Middle East, urbanism in pre-modern Europe, late medieval and Renaissance architecture, French nineteenth century art, feminist and post-structural theory, American art, classical and medieval Islamic architecture and urbanism.

VISUAL ARTS

Dennis Adams assumed the directorship of the Visual Arts Program (VAP), which continues to support the undergraduate education curriculum at the Institute and in addition has five graduate students. VAP collaborated with the Graduate School of Design of Harvard to organize lectures and seminars with two internationally-known artists, Dan Graham and Muntadas. Further strengthening its investigation into the production of art and social responsibility, VAP appointed Joan Jonas as Visiting Artist in the spring. VAP students participated in "Repeat/Reverse," an exhibition of work by visual arts students shown at Yale University School of Architecture.

UNDERGRADUATE PROGRAM

The undergraduate program has benefitted from the clarification of its curriculum and now has in place a core group of committed and enthusiastic faculty advisors. Some faculty have volunteered to serve as mentors through the Freshman Seminars program.

HIGHLIGHTS OF THE PAST YEAR

Ellen Dunham-Jones was promoted to Associate Professor of Architecture. Qingyan Chen was promoted to Associate Professor of Building Technology. Bill Hubbard was appointed Adjunct Associate Professor. Wellington Reiter was appointed Associate Professor of the Practice of Architecture.

Visiting faculty included: Hasan Uddin-Khan in architectural design; Diane Ghirardo in History, Theory, and Criticism; and Joan Jonas, Visiting Artist. Lecturers were appointed for the particular skills they could offer to the curriculum: Michael Boucher, Carl Fasano, Daniel Greenwood, Paul Paturzo, Bashar Altabba, Vincent Camalleri, Aamir Aleem Durrani, Minhaj Kirmani, Richard Leber, Carl Rosenberg, Barry Webb, Dorothea Dietrich, Hélène Lipstadt, Barbara Broughel, and Julia Scher.

On leave in the fall was Julie Dorsey; on partial leave in the fall were Andrew Scott, Sibel Bozdogan, and Leila Kinney. On leave in the spring was Krzysztof Wodiczko.

Eric Dluhosch and Sandra Howell, two professors who made long-standing contributions to the department, completed their terms of appointment following their earlier retirements. Ritsuko Taho completed her contract in the Visual Arts Program. To our regret, our Aga Khan Professor, Attilio Petruccioli, offered a five-year rather than ten-year appointment as Professor of Practice, elected to take a professorship in Italy.

Professor Emeritus Albert Dietz died in June.

Searches are ongoing for a senior design position and a tenure-track position in building technology.

Krzysztof Wodiczko was awarded the prestigious Hiroshima Art Prize, given every three years to an artist whose work demonstrates high achievement in international contemporary art and has contributed to world peace. Jan Wampler and Dennis Frenchman were awarded the Irwin Sizer Award for Most Significant Improvement to MIT Education, for their Beijing Urban Design Studio. Wampler also was elected to Fellowship by the American Institute of Architects (AIA). The AIA 1997 Education Honors Program selected the submission by Reinhard Goethert, "Learning in the Field: Rebuilding Communities," for honorable mention. Goethert also received a grant from the Boston Foundation for Architecture for his program, "Neighborhood Architectural Explorers."

STUDENT AWARDS

Student Awards designated by the Department or Institute: The William Everett Chamberlain Prize for graduating BSADs for achievement in design (Javorka Saracevic, Lin-Ann Ching). The Sydney B. Karofsky '37 Prize for the outstanding Master of Architecture student with one further year of study (Benjamin Kou, Joel Turkel). The Francis Ward Chandler Prize for achievement in architectural design (Wolfgang Ungerer, Rodney Ziesemann). The Alpha Rho Chi Medal for leadership, service for the school and department, and promise of real professional merit (Lana Yoon). The AIA Certificate of Merit for second-ranked master of architecture student (Robert Clocker, Melanie Coo). The AIA Medal for the top-ranked master of architecture student (Scott Tulay). The SMArchS Prize (Talin DerGrigorian, Kevin Fellingham, Bryant Yeh). Caminos Memorial Fund Award (Kristin Little). The Imre Halasz Thesis Award (Scott Tulay, Rodney Ziesemann). The AIA Foundation Scholarships (Andrew Jonic, Jacob Kain, Juintow Lin). The Kristen Ellen Finnegan Memorial Award in History, Theory, and Criticism of Architecture (Nana Last). Faculty Design Award (Laura Bouwman, Isaac Persley). Schlossman Research Fellow (Nilay Oza, Hadas Steiner). Ann Macy Beha Travel Award (Rebecca Berry). Louis C. Rosenberg Travel Award (Li Lian Tan). Marvin E. Goody Prize (Gary Rohrbacher, Bryant Yeh, Greg Russell, Joel Turkel). Aga Khan Program Summer Travel Grant (Birgul Colakoglu). Robert Bradford Newman Medal for Merit in Architectural Acoustics (Max Chen). Tucker-Voss Award (Eric Nelson). Hyzen Pre-Dissertation Research Award (Adnan Morshed).

External Awards: Skidmore Owings & Merrill Foundation Traveling Fellowship in Mechanical/Electrical Building Systems Engineering (Andrea Whitsell). New England Society of Architectural Historians Travel Award (Thomas Beischer). Dibner Fellowship (Edward Eigen). Gerondelis Foundation Graduate Scholarship Grant (Irene Fatsea). College Art Association Travel Grant (Panayiota Pyla). Henry Luce Foundation/ACLS Dissertation Fellowship (Sarah Whiting). Henry Broomfield Rogers Fellowship (Ritu Bhatt). Social Science Research Council Grant (Brian McLaren). Fulbright Fellowship (Brian McLaren). Kate Neal Kinley Memorial Fellowship (Hadas Steiner). ASHRAE Graduate Student Grant-in-Aid (Xudong Yang, Jelena Srebric).

STUDENT AID

Competition for exceptionally talented and motivated students remains high. Developing the means to offer competitive packages to students choosing architecture, a field with long degree programs and low professional salaries, is a high priority. We are grateful for the recognition of this difficulty by the Institute.

SPACE: RENOVATION AND DEPARTMENT CONSOLIDATION

The goal of consolidating the department's teaching and support services continues to be met phase by phase. Although some studios and faculty offices, the Visual Arts Program, and the Indoor Air Quality Laboratory remain

in N51/52, the department benefitted from last year's move of the majority of studios and faculty to the Main Complex.

AGA KHAN PROGRAM FOR ISLAMIC ARCHITECTURE

Activities of the Aga Khan Program for Islamic Architecture of Harvard and MIT are reported separately in this volume.

PROGRAM ENROLLMENTS

A total of 261 students were counted in Course IV (as of 10/31/97): 70 undergraduates, 74 MArch, 51 SMArchS/SM without specification, 5 SMBT, 5 SMVisS, 30 resident PhD, 21 Non-Resident PhD, and 5 Special (non-degree) Students.

DEPARTMENT ACTIVITIES

The Department of Architecture Lecture Series brings outstanding scholars, practitioners, and artists to the School. In the fall, speakers were Andy Foster, Marc Treib, Bob Allies, Santiago Calatrava (who gave three lectures with accompanying seminars, co-sponsored by the Department of Civil and Environmental Engineering), and French practitioners Odile Decq and Bénoit Cornette, Jean-François Bonne, and Fréderic Borel (co-sponsored by The Catholic University and the University of Virginia). In the spring, speakers were Paul Shepheard, Muntadas, Douglas Kelbaugh, Diane Ghirardo, Anthony Vidler, and Françoise Choay. The Pietro Belluschi lecture was given by Renzo Piano. The Arthur H. Schein Memorial Lecture was given by Thomas Herzog. The first Felix Candela lecture (co-sponsored by Princeton University, The Structural Engineers Association of New York, and the MIT Department of Civil and Environmental Engineering) was given by David Billington. The faculty-to-faculty forum, initiated to introduce faculty to each other's work in research and in practice and to offer opportunity for exchange of talents and interests among them, hosted Nasser Rabbat and Jan Wampler.

Exhibits in the MIT Museum's Wolk Gallery included a continuation of "The Middle Passage Project," demonstrating new computing technologies working in concert with architecture to create a memorial to the passage of slaves to the new world; "The Work of Allies and Morrison," providing a sustained view of the work of this firm following a public lecture by Bob Allies; "Reflections: Drawings and Projects by Wellington Reiter," examining the concept of vessels, contemporary art and relationships to Piranesi by a faculty member. New this year, the department programmed the Compton Gallery with shows of the drawings of Michael McKinnell and Ada Karmi-Melamede and recent Master of Architecture theses. In conjunction with the accreditation visit, an extensive exhibit was organized to show work from current and recent studios and workshops.

The department publication, *Thresholds*, is now well established as a means to communicate to alumni and friends of the School something of the intellectual life here. The weekly newsletter, *PinUp*, offered a forum for debate and served to communicate in-house about activities within the department. The publication of the first two *Pietro Belluschi Lectures*, by Sverre Fehn and Sir Michael Hopkins, was well received. Publication of the next two lectures by Fumihiko Maki and N. Michael McKinnell is in preparation.

In the fall Hasan-Uddin Khan organized a symposium, "The Architecture/Landscape Pact: Pedagogical Initiatives," sponsored by The Graham Foundation. In the spring, the Department celebrated the 25th anniversary of the History, Theory, and Criticism program with a symposium, "Architecture, Art, and Cultural History: Refractions and Reflections."

CLOSING REMARKS

Our preparation for the review committees this year, including extensive exhibitions of student work, convinced us and numerous external observers that our core programs in architectural design are indeed operating at a distinctive and high level. The production and the recognition of our several advanced graduate programs was also gratifying.

The department is now settled into its newly renovated premises, but it is imperative that certain key elements left behind at our satellite building (N51-52) be reunited as soon as possible. Most notably this involves undergraduate design studios and the offices of many of the studio-teaching faculty.

We made some remarkable appointments of world-renowned architects as studio professors in coming years. These include Charles Correa, Frank Gehry, Ada Karmi-Melamede, and Fumihiko Maki. In the coming year we will be looking at the opportunity for synergetic relations among such visiting faculty and certain open lines, including that resulting from the loss of our Aga Khan Professor.

Financial aid for our graduate students, especially those in our professional M.Arch. program remains our greatest need, both in winning the best students for our program and in sending them forth without crushing debt.

More information about the Department of Architecture can be found on the World Wide Web at the following URL: http://architecture.mit.edu/

Stanford Anderson

PROGRAM IN MEDIA ARTS AND SCIENCES

For the 1997-98 academic year, the Program in Media Arts and Sciences (MAS) enrolled 131 graduate students. In addition, more than 200 undergraduates registered in Media Arts and Sciences classes or actively engaged in research activities at the Media Laboratory.

During the year, we continued to explore several options that would enable us to expand the scope of our undergraduate educational program. We are working with Institute committees and other departments (most notably Physics and Materials Science and Engineering) to develop a way for Media Arts and Sciences to offer an experimental freshman program. Our hope is that this effort will be a first step toward establishing a Media Arts and Sciences undergraduate program sometime in the near future.

MAS faculty members and students also contributed significantly to advancing the field of wearable computing when they co-hosted the first International Symposium on Wearable Computers (ISWC) in October 1997. This conference, organized by Carnegie Mellon University, Georgia Institute of Technology, and MIT, was sponsored by the IEEE Computer Society and held here in Cambridge. It brought together researchers, product vendors, research sponsors, and others interested in wearable computing, and resulted in the formation of a new IEEE Technical Committee on Wearables.

EDUCATION

The Program in Media Arts and Sciences received 254 applications during the 1997-98 academic year. From these, 55 new students (including 9 women) were selected and enrolled: 43 for the master's program, and 12 for the doctoral program. This represented a 31 percent increase over fall 1996 admissions.

The total MAS enrollment of 131 included 27 women, 3 underrepresented minorities, and 33 foreign students. Of the total, 79 were master's candidates, and 52 were doctoral candidates. Thirty-six advanced degrees were awarded during the year (26 SMs and 10 PhDs). Thirty-three graduate subjects were offered.

For 1997-98, the largest undergraduate presence at the Media Laboratory continued to be its UROP students, more than 240 of whom participated in research projects at the Media Laboratory. Many of these undergraduates pursued their undergraduate theses under MAS faculty supervision. In addition, the Program in Media Arts and Sciences offered eight undergraduate subjects, and four MAS faculty members and staff conducted freshman seminars or served as freshman advisors.

FACULTY AND STAFF

Brian Smith joined the Media Arts and Sciences faculty as an assistant professor in September 1997. Professor Smith comes to the lab from Northwestern University's Learning Sciences Program, where he explored the development and evaluation of an interactive video system for high-school classrooms.

Judith Donath, who recently completed her PhD working with Andy Lippman at the Media Laboratory, was named assistant professor in January 1998. Her work explores how identity is established in virtual environments, and how understanding "virtual identity" is essential for building vibrant online communities. Both Donath and Smith are involved in the lab's Digital Life consortium.

Alex Pentland, who heads the Media Lab's Perceptual Computing group and is academic head of the Program in Media Arts and Sciences, was promoted to full professor. Pentland's research focuses on giving computers perceptual abilities that allow them to function naturally with people. Toward this end, much of his research addresses recognition of human faces, gestures, and expression.

Aaron Bobick, LG Career Development Professor of Computational Vision who has been an assistant professor at the Media Laboratory since 1992, was promoted to associate professor. Professor Bobick's research spans human and machine vision, integration of perceptual information, and symbolic understanding of visual situations.

In addition to his promotion, Professor Pentland was named Toshiba Professor of Media Arts and Sciences. Marvin Minsky, who held the professorship since its establishment in 1989, is now Toshiba Professor Emeritus.

HONORS AND AWARDS FOR FACULTY AND STUDENTS

Professor Tod Machover was awarded the first annual DigiGlobe Prize in Germany. Sponsored by Deutsche Telekom and Focus TV, and described as the "Oscar for Digital Media," the DigiGlobe Prize was given to Machover to celebrate his creation of hyperinstruments–with special mention of the digital baton, sensor chair, and *Brain Opera*.

The Computer Clubhouse, a collaborative program of Boston's Computer Museum and the Media Laboratory won the seventh annual Peter F. Drucker Award for Nonprofit Innovation. The Clubhouse provides inner-city youths with the opportunity to develop their own computer animations, simulations, Web sites, robotic constructions, and musical creations. Mitchel Resnick, Fukutake Career Development Professor of Research in Education and co-founder of the Clubhouse, was among those who accepted the award in October 1997.

Professor Pattie Maes received the International Engineering Consortium award in October 1997, and was also named one of the 50 "cyber elite" in the October 1997 issue of *Digital Time*.

Professor Neil Gershenfeld was a finalist in the *Discover* magazine's ninth annual Discover Awards for Technological Innovation. He was selected for his work in quantum computing.

Chris Dodge, who received his master's degree in February 1998, won the grand prize at the 1997 ARTEC Media Art Biennale competition in Nagoya Japan. The award-winning installation was also featured at the Ars Electronica Festival (Linz, Austria), the World Wide Video Festival (Amsterdam) and ISEA '97 (Chicago).

Three MAS students received awards from *ID* magazine in June 1998 for their interactive media design. Peter Cho won gold for his *Type Me, Type Me Not* Web site; John Underkoffler won silver for *Nauticoloratura,* a visual mechanism for teaching and studying orchestral scores; and David Small and Tom White won bronze for *Stream of Consciousness: An Interactive Poetic Garden.*

Professor Rosalind W. Picard published a new book, *Affective Computing*, (MIT Press, 1997).

Alex Pentland

DEPARTMENT OF URBAN STUDIES AND PLANNING

The Department of Urban Studies and Planning (DUSP) continues its tradition of top-notch scholarship and teaching on cutting-edge city planning and urban development issues, while trying to address the challenge of keeping the cost of a professional education affordable to low- and middle-income students, whose starting annual salaries in the field average around $35,000, and whose debts average around that figure as well.

In October, the Department hosted a very productive meeting with our Visiting Committee. The Committee's report states: "It was the unanimous opinion of the committee that under the leadership of Professor Bish Sanyal, the faculty and students have together produced a record of achievement that has to be the envy of every planning school in this country." Despite this glowing praise, the Visiting Committee did identify the urgent need to address the funding crisis of the Master in City Planning program and the need for general MIT fund assistance to create an endowment for this and other critical programs. Following up on the Visiting Committee's recommendation, we are currently developing a strategic/business plan for the Department.

RESEARCH AND TEACHING ON URBAN PLANNING

The intellectual life of the Department is organized largely around the activities of the five Program groups, which reflect major areas of current planning practice: Design and Development; Environmental Policy; Housing, Community and Economic Development; International Development and Regional Planning; and Planning Support Systems (Information Technology). Some highlights of the past year include:

- Faculty and students of the City Design and Development Group organized and participated in the Boston Harbor Conference, sponsored by MIT and the Boston Globe. The Conference brought together community and national experts to debate how best to use this regional asset. As part of the program, students in the Boston Harbor Studio at MIT prepared proposals for the redevelopment of industrial waterfront sites on the Harbor. The results of the studio were presented to civic leaders and Harbor advocates. Twenty-two students and faculty of the group also participated in the fifth Beijing Urban Design Studio, held in China from June 9-July 11. The studio, which involved Chinese students and faculty, studied options for the redesign of an historic area surrounding the White Pagoda, Beijing's oldest structure, and presented alternatives to city officials. Continuing its collaborative program with the Department of Architecture, the group awarded five Urban Design Certificates to graduating Master's students.

- The Environmental Technology and Public Policy Program of the Environmental Policy Group (EPG) was in full swing this past year. EPG faculty examined changes in the regulatory system that might be most helpful in encouraging investment in and dissemination of "greener" technologies (for pollution prevention, pollution control and remediation). In response to a request from the US Environmental Protection Agency, ETP participants made presentations in Washington, DC and Boston. In May, ETP offered its first annual symposium reporting on the group's research. ETP faculty received a grant from the Alliance for Global Sustainability to develop a Europe-Japan-US follow-on to ETP's study of the impacts of regulatory flexibility on corporate decisions to innovate. EPG faculty also helped to facilitate at a special informal problem-solving session for the Climate Change negotiators headed to Kyoto, Japan. EPG faculty, in partnership with faculty at several other universities, was one of only 44 applicants (of the 250+ who applied) invited to submit a full proposal to the National Science Foundation in its search for a center of excellence on the study of risk. Decisions about the creation of 8 - 10 Centers for Risk Management will be made in late 1998.

- With funding from the Brookings Institution, the Housing, Community and Economic Development (HCED) group studied the impact of welfare reform through the lens of non-profit housing organizations in Boston. The group explored how the Metropolitan Boston Housing Partnership and several community development corporations are working to get their welfare-based tenants into training programs and thus into the labor force. The project has been tracking how families deal with the hurdles and opportunities presented by a rapidly shifting world of housing subsidies, and welfare and training programs that are blending together in the wake of devolution from Washington. In addition, under the creative direction of Professor Martin Rein, members of the HCED group have conducted a year-long seminar series on types of organizational networks as they impact a variety of institutions: police departments, industrial chains, community housing, military base closings and other settings where the concept of networking has significance.

- The International Development and Regional Planning (IDRP) group faculty continued a set of three major research and teaching activities during the past year, involving 6 to 12 graduate students and/or SPURS (Special Program in Urban and Regional Studies) Fellows in each. A year-long seminar analyzing successful cases of administrative decentralization was coupled with field studies during the summer in nine countries (Colombia, Cote d'Ivoire, Honduras, India, Pakistan, the Philippines, South Africa, Thailand, and Uganda). The students are currently preparing the reports from the seminar and field studies for a book manuscript. The fourth in a series of research projects in Northeast Brazil is underway with another group of faculty and students who are working on issues of social investment. The energy-conservation and pollution-reduction project in the coke-making plants in Shanxi Province, China, not only involves faculty and students from the IDRP group, but also from the Environmental Policy Group in the Department and from the Chemical Engineering Department at MIT, as well as from institutes in Switzerland, Japan, and China, as part of the Alliance for Global Sustainability. In addition, other faculty are working with students on issues of late industrialization outside the North Atlantic region and analyzing the rapid growth of motor vehicles in emerging countries.

- The Planning Support Systems (PSS) group's research and class projects have continued to focus on understanding urban spatial structure and prototyping information infrastructures that help in visualizing and debating urban futures. Usage of the original MIT Digital Ortho Browser website (http://ortho.mit.edu) has climbed steadily to 4,000+ hits per day. Numerous classes, design studios, government agencies, private firms, and citizens are using it to obtain customized, high-resolution snippets of digital orthophotos (corrected aerial photos) of greater Boston. Follow-up projects with other agencies are extending the original ideas to address image repositories of other geographic areas and to research interoperability issues in spatial data processing. Several other externally funded research efforts helped link class projects to eventual thesis work. These included studies of the spatial determinants of office market rents; welfare-to-work accessibility; urban 'respiration' (i.e. how land use planning can affect metropolitan air pollution patterns); and multimedia representational aides for transportation planning.

Faculty-led seminars and projects often cut across the different disciplines within the Department and provided some of the intellectual highlights of the year. In the fall, Professors Lloyd Rodwin and Bish Sanyal led an engaging faculty colloquium on "The Profession of City Planning: Changes, Successes, Failures, and Challenges (1900-2000)." Proceedings from the colloquium will be published in a book, which is likely to have a significant impact on the future of planning education in this country.

In the spring, with support from the W.K. Kellogg Foundation, the Department sponsored a one-and-a-half day symposium on "Advanced Technology and Low-Income Communities," building on several gatherings on the topic which the Department has hosted in the past few years. DUSP faculty continue to push the frontier of knowledge on this important topic to the future of cities.

We were fortunate to have in residence this year Martin Luther King Visiting Professor Ernesto J. Cortés, Jr. In addition to teaching lively courses on community organizing and civic engagement, Professor Cortés gave two public talks, one at MIT and one at annual American Planning Association conference held in Boston in April (see below). While in residence at MIT, Professor Cortés received the prestigious Heinz Family Foundation Award for public policy.

GRADUATE DEGREE PROGRAM

Our graduate programs enrolled 182 students this year. Of the total, 54% were women, 9% were students of color, and 37% were international students. The Department granted 51 MCP, 4 SM, and 6 PhD degrees.

Building on the success of the last couple of years, faculty continued to offer more for-credit offerings during the Professional Development Institute held in the Independent Activities Period (IAP). In addition to Introduction to Computers in Public Management II--required of all first-year Master's students--seven additional for-credit courses were offered this year: Financing Infrastructure; Management Fundamentals for Leaders in Non-Profit Organizations; The Environment, Manufacturing and Massachusetts Politics; Public-Purpose Real Estate; Representing the City: Introduction to Computer Graphics for Urban Design and Planning; Organizing for Change,

and Tagging: Public Graffiti or Private Art? These classes, combined with non-credit offerings, attracted over 300 students, alumni/ae and local professionals.

The Master's in City Planning program focused its efforts this year on strengthening the communication skills of our graduates. With a grant from the Ford Foundation, we are developing a new recruitment and internship program for promising graduate students of color.

Over the past several years, the PhD program has instituted a number of small changes to get students through the program faster and it seems to be working. Of the students who entered three years ago, all of them had finished their exams before the end of the fifth semester--an improved performance. This year, we instituted a requirement that students had to conduct an open colloquium in which they presented their dissertation proposals to their committees and other interested department members. These colloquia seem to be working well with good attendance and a good attitude so that students come away with a lot of constructive criticism. Students now have the option of completing three publishable papers in lieu of a dissertation.

STUDENT AWARDS

Our graduate and undergraduate students received many awards, from the Institute, national and international organizations, and the Department..

Julie Wagner won a Carroll Wilson Award. Shawn Escoffery received several awards, including: the Black Graduate Student Association, Outstanding Service to the Black Community; Black Student Union, Cultural Awareness Award; Graduate Student Council, Edward L. Horton Fellowship Award; L.U.Ch.A., Outstanding Service Award; and, Office of Minority Education, Outstanding Service Award. Two doctoral students won fellowships through the Center for International Studies: Brett Ballard won a Ford Development Grant, Mellon-MIT Program on Migration and NGOs and Rodrigo Serrano won a Ford Development Fellowship.

Richard Rosález was a Class of 1938 Scholar, an I. Austin Kelly III Essay Competition Winner, and received an Office of Minority Education, Certificate of Academic Excellence. Peter Siu and Eric Plosky were selected as Burchard Scholars, and Isela Rodriguez won a List Foundation Fellowship in the Arts. Kristin Little received a Council for the Arts Grant and a Horacio Caminos Memorial Fund Scholarship. The Hugh Hampton Young Fellowship went to Michael Fischer, while Jill Blockhus won the Ida M. Green Fellowship. Aya Okada won an Industrial Performance Center Doctoral Research Fellowship and Sumila Gulyani won an International Motor Vehicle Program Research Grant. The Kristen Finnegan Prize was awarded to Cherie Abbanat. Office of Dean of Students for Undergraduate Education, Multicultural Community Service Awards went to Gilbert Contreras, Shawn Escoffery, and Richard Rosález. Contreras also received the Office of Minority Education, Distinguished Service Award.

Outside of MIT, our students garnered local, national and international awards as well. Heeten Kalan was honored by the Ignacio Martin Baro Fund for Mental Health and Human Rights for his exemplary leadership in human rights. Margaret Super won an American Planning Association Private Practice Division Scholarship, while Susan Silberberg received the American Planning Association Charles Abrams Scholarship and the Association of Collegiate Schools of Planning Edward McClure Prize for Best Student Paper. Michael Fischer was awarded a Bush Foundation Leadership Fellowship and Otis Rolley, III won a Buttonwood Foundation, J. Marshall & J. H. Booker Graduate Scholarship. Raquel Gomes and Mônica Pinhanez received CAPES-Brazil Ph.D. Fellowships, while Lois Stanley won a Department of Housing and Urban Development Doctoral Dissertation Research Grant. Thomas Campanella received a Fulbright Research Grant. Michael Crow won a Garden Club Federation of Massachusetts Evelyn Cole Scholarship and Nicole Barnes was awarded a National Security Education Program Graduate Enhancement Fellowship. Inter-American Foundation Dissertation Fellowship Awards went to Octavio Damiani and Ann Steffes. Damiani also won a Regional Development Bank Fellowship Award. Anthony Ng was selected to participate in the National Congress for Community Economic Development Emerging Leaders Program. Aya Okada was awarded a Japan Foundation, Asia Center Research Fellowship and a Matsushita International Foundation, Doctoral Dissertation Fellowship. Sylvia Dohnert received an Inter-American Foundation, US Graduate Studies Fellowship (1996-1998). Joyce Coffee won a Philanthropic Educational Organization, International Chapter Sister Scholar Award. Sumeeta Srinivasan received a Lincoln Institute for Land Policy Dissertation Fellowship and

Alejandro Walters won a Social Science Research Council, International Dissertation Research Fellowship. Marco Magrassi won a University of Naples Fellowship Award.

Lisa Davis and Margaret Super were selected as Truman Scholars. Lou Baker, Beth Ann Burris, Shawn Escoffery, Otis Rolley III, and Katrina Tavanlar participated in the Woodrow Wilson/Public Policy and International Affairs Fellows program. Geraldine Campos, Ketsia Colinet, Gilbert Contreras, Eliza Edelsberg, Alma Flores, and Inés Soto were Fellows in the Department of Housing and Urban Development Community Development Work Study Program.

At our annual Commencement Breakfast, the Department presented a number of student awards. Susan Silberberg received the American Institute of Certified Planners Outstanding Student Award, as well as the Flora Crockett Stephenson Writing Prize. The Outstanding Contribution to the Intellectual Life of the Department award went to Anne Beamish. Laura London and Heather Hillman won the Departmental Service Award; Joyce Coffee, Kelly Davenport, Shawn Escoffery, Anthony Ng, Otis Rolley III, and Julie Wagner received Honorable Mention. Margaret Super won the Wallace, Floyd Award for City Design. The award for Outstanding MCP Thesis went to Susan Silberberg and Andrew Weaver.

ALUMNI/AE NEWS

Our alumni/ae continued the trend of increasing generosity during the fall telethon. Eighteen callers contacted 182 alumni/ae, who had a pledge rate of 69% and a gift upgrade rate of 37%. Alumni/ae also gave generously of their time. In addition to guest appearances in classes and presentations at luncheon seminars, sponsoring student interns and participating in the annual "Chase-A-Planner" exercise, alumni/ae shared their wisdom at each of the Program groups' alumni/ae career panels, which were very well received by students. More than 100 alumni/ae joined us at a reception at the American Planning Association annual conference, where they heard a very engaging talk by Martin Luther King Visiting Professor Ernesto Cortés, Jr. At the annual Association of Collegiate Schools of Planning meeting, the Department sponsored a reception for our alumni/ae who are academics and scholars. Our alumni/ae continue to report that they eagerly await our semi-annual journal, DUSP@MIT.now, and are loyal contributors to the alumni/ae update section.

UNDERGRADUATE PROGRAM ACTIVITIES

The Department's Undergraduate Committee focused its attention on efforts to increase the participation of our 28 undergraduate majors in Department-wide activities and on ways to broaden the impact of our programs on undergraduate life at the Institute. We sponsored dinner gatherings designed to help our undergraduates get to know one another and to meet more of our faculty, organized a joint forum with graduate students to discuss the merits of pursuing our 5-year SB/MCP degree, and supported a highly-successful Patriot's Day weekend study trip to Montreal, during which ten DUSP majors met with urban planning faculty at McGill University and toured the city.

More broadly, the Department continues its efforts to increase the visibility of the DUSP undergraduate program within the MIT community. Our plans to develop a new interdisciplinary Minor in Public Policy, to be targeted to those with majors in science and engineering, are going forward. In Spring 1998, we put together a committee comprised of faculty from DUSP and Political Science, to finalize a proposal that will be presented to the Committee on Curricula early in the 1998-99 academic year.

In the meantime, overall Course XI subject enrollments and subject ratings seem to be solid and increasing, indicative of growing interest among MIT undergraduates in these issues. In this regard, two new DUSP subjects seem especially promising--Professor Lawrence Bacow's 11.122J, Environmental Policy and Economics, and Professor Frank Levy's 11.126J, Economics of Education.

DUSP faculty once again led several very popular Freshman Advising Seminars (FAS). We now see even greater opportunities to use the FAS program to increase the visibility of the Department to MIT undergraduates, and are taking action to make this happen. In 1998-99, DUSP will offer five Freshman Advising Seminars with the over-arching theme of "The US and the World." The theme reflects the Department's belief that to be innovative and effective in professional practice in the 21st century, incoming students must develop a new mindset appropriate for the new times. MIT students must become knowledgeable about the changing role of the United States in an increasingly integrated world economy and political, technological, and civic culture. This new mindset will need to

appreciate the complex interconnections among economic transactions, political relationships, and technological discoveries, as played out in cities, regions and nation-states. The individual seminars will examine the international dimensions of such diverse areas as environmental treaty negotiation, transportation planning, race relations, leadership, and urban quality. Students and faculty from the various seminars will be brought together for a series of joint dinner meetings with distinguished speakers. In addition, it is our plan to integrate the skills and international perspectives of the Department's mid-career SPURS Fellows (see below) into the activities of these Freshman Seminars.

The DUSP-based MIT Teacher Education Program (TEP) has just completed its fourth full year. Over this period, 74 students have enrolled in 11.124, Introduction to Teaching and Learning Mathematics and Science, the initial course toward completing Massachusetts Teacher Certification. The first student completed certification requirements through TEP in June 1995 and in the last three years, 16 more students have completed certification and are now teaching in public middle or high schools, mostly in the Boston area. Others who have completed the program have gone on to become graduate students in schools of education. Over the past two years these have included Harvard, Stanford, University of California-Berkeley, and Columbia. In addition, two students have entered the Peace Corps.

In recognition of the program's success, Provost Moses authorized a new position in DUSP for a faculty member to join the teaching staff of TEP. After a careful search (which is currently underway), we look forward to the successful candidate being on board in September 1998. In addition, the impending arrival of Dr. Ceasar McDowell as Director of the Department's Community Fellows Program (see below) will add another strong voice to the study of urban educational reform. Dr. McDowell's presence, together with the new TEP appointment and Frank Levy's new class on the "Economics of Education," should enable the Department to develop a solid program of research, teaching, and neighborhood outreach in the area of urban education. With this enlarged staff and broader set of institutional commitments, TEP faculty expect to certify, on average, 10 students each year in the future. In numbers, this will put MIT near the top in math and science teacher education among local programs. More information about the TEP program can be found on the World Wide Web at the following URL: http://web.mit.edu/teacher-ed/www/

FACULTY ACHIEVEMENTS

The Department is proud of the many honors garnered by Professor Lawrence Bacow, including his appointment as Chancellor of MIT, his selection as Associate Director of the Center for Environmental Initiatives and his appointment as the Lee & Geraldine Martin Professor of Environmental Studies. In other appointments, Assistant Professor Vicki Norberg-Bohm was named Co-director of the Program for Environmental Education and Research (PEER).

A number of faculty won awards, both at MIT and from national and international organizations. Professor of the Practice of Urban Design Dennis Frenchman won the Irwin Sizer Award for Most Innovative Teaching (along with Architecture Professor Jan Wampler) for the Beijing Urban Design Studio. Lecturer Meenu Tewari won the Graduate Student Council Teaching Award for the School of Architecture and Planning. At the Association of Collegiate Schools of Planning annual conference, Associate Professor Lawrence Vale won the Chester Rapkin Award for Best Professional Paper and Professor Emeritus Lloyd Rodwin won the Distinguished Planning Educator Award. The Heinz Family Foundation gave one of its five awards for civic and academic achievements to Martin Luther King Visiting Professor Ernesto Cortés, Jr. Research Associate Reinhard Goethert was named to the United Nations Center for Human Settlements Scroll of Honor for his work with the DUSP/Architecture Special Interest Group in Urban Settlements (SIGUS).

Several class projects were featured in the media. Students in 11.018, Adjunct Professor Paul Levy's class, Solving the Infrastructure Crisis, are required to work as teams to evaluate and recommend solutions to infrastructure problems in the Boston metropolitan area. Three students did a project documenting the lack of street signs in downtown Boston and made a proposal to solve the problem. The *Wall Street Journal* New England edition did a story on their presentation, prompting the Mayor to announce a comprehensive program to install street signs throughout the city. There was follow-up coverage by the *Boston Globe* and Channels 5 and 56.

Lecturer Karl Seidman's students in 11.438, Economic Development Planning, were featured in a local Lawrence, Massachusetts paper for a presentation they made to city officials and community residents recommending initiatives to revitalize the downtown area. Similarly, a local Wilmington, Massachusetts paper covered a public meeting about the Lowell street Corridor, where student teams from Lecturer Terry Szold's class 11.360, Community Growth and Land Use Planning, outlined a detailed plan for redesigning that area.

In faculty development, Timothy Riddiough was promoted to Associate Professor. Dennis Frenchman was appointed Professor of the Practice of Urban Design. Paul Smoke was appointed Associate Professor of the Practice of Development and Planning. The Department hired Jennifer Davis, who will join the faculty as Assistant Professor of Infrastructure Planning in the fall (as reported last year) and Eran Ben-Joseph, who will also arrive this fall as Assistant Professor of Landscape Architecture.

After an extensive national search, the Department is pleased to have selected as the new head of the Community Fellows Program, Associate Professor of the Practice of Community Development Ceasar McDowell (see below).

On a sad note, we report the passing of Professor Emeritus Donald A. Schön in the fall.

INTERNATIONAL CONNECTION

The non-degree Special Program for Urban and Regional Studies (SPURS) hosted fourteen Fellows from Brazil, Bolivia, Colombia, Georgia, Korea, India, Italy, Japan, Myanmar, and the Netherlands. Their work focused on decentralization, environmental planning, international development, transportation, and urban renewal and historic preservation. The SPURS weekly luncheon seminars, attended by Fellows, students and faculty in DUSP, brought prominent regional and international scholars from a variety of fields who lectured on important development issues and discussed policy options with Fellows, faculty and students.

COMMUNITY OUTREACH

The domestic counterpart, the Community Fellows Program (CFP), brought together seven Fellows from communities of color to work on projects ranging from the introduction of web-based programming in two inner-city Boston high schools, to developing a plan for publishing written materials in the Wampanoag language for tribes around New England, to evaluating a 25-organization collaborative providing services to African-American youth. In addition to individual projects, the CFP also sponsored a seminar series, introduced a Saturday Web Design training program for Latino, Asian and Black young people, and hosted a series of meetings of a Women of Color in Development Research group.

After a year-long search, the CFP hired Dr. Ceasar McDowell as its new Director. Professor McDowell is a national leader in research and writing on the intersection of race, technology and education. He brings to the Community Fellows Program both a strong national perspective and deep roots at the local level in communities across the country. With the change in leadership of the Community Fellows Program and advances in information technology, the Department is well positioned to devise new ways to develop the intellectual capacity of communities and to help them address their various needs through innovative use of information technology.

RESEARCH FUNDING

Faculty raised over $900,000 in grants and contracts for the following projects: Professor Joseph Ferreira, Jr. received funding from the US Department of the Interior for $38,950 to conduct research on "Improved Tools for Utilizing Digital Orthophoto Metadata." He is also doing collaborative work with the National Resources Conservative Service of the US Department of Agriculture on "Spatial Data for Distributed and Interoperable GIS." For this project, Professor Ferreira was funded for $337,835. Professor Karen Polenske did a study on the nature and cost of infrastructure provision for stimulating development of economically distressed areas. The project was funded by the Economic Development Administration in the amount of $105,000. For research on the energy use and pollution generated by households in townships and villages in China, Professor Polenske received funding for $75,000. The New Jersey Institute of Technology awarded Professor Bacow a $7,500 grant for "Understanding Risk-Sharing Mechanisms for Brownfields Redevelopment." Professor Frank Levy received seed funding for $25,000 from Ford Motor Company for the design of two "Community-of-Practice" web sites. Professor Lawrence Susskind was awarded $35,000 in seed funding for research on "Regulatory Flexibility." For the third funding cycle, the Department received $90,000 from the federal Department of Housing and Urban Development to support

minority and economically disadvantaged graduate students and received a new grant from the Ford Foundation for $199,100 for recruitment and development of a new internship program for minority graduate students.

More information about the Department can be found on the World Wide Web at the following URL: http://web.mit.edu/dusp/www/

Bish Sanyal

CENTER FOR ADVANCED VISUAL STUDIES

The Center for Advanced Visual Studies (CAVS) offers an art-based platform for collaborations between artists, scientists, and technologists. These are typically built around projects undertaken by resident Fellows, who also conduct seminars and supervise undergraduate participation. An emerging mission of the CAVS is the exploration of the digital arts as a common ground for collaborative projects. Our goal is the creation of important art that could not or would not be possible except at MIT.

In the Fall of '97, the CAVS moved into newly built quarters on the third floor of Building N52, for which Centerbrook Architects and Planners, of Essex, Connecticut, served as architects. Digital arts hardware and software have been installed and debugged, providing a powerful substrate for further work by the Fellows and visitors to the Center. The new conference room was inaugurated by Prof. Terry Knight for her course on "Design and Computation."

Activities of Fellows and affiliated Faculty during 1997-98 included:

- Professor Emeritus Otto Piene (Director Emeritus) coordinated a world-wide logo design competition for the city of Stuttgart, Germany, as part of its "S-21" redevelopment program. First Prize was won by Prof. John Maeda, a former CAVS student now teaching at the Media Laboratory.

- Professor Krzysztof Wodiczko received the fourth Hiroshima Art Prize from the city of Hiroshima, Japan. This prize, which is awarded only every three years, recognizes Prof. Wodiczko's public arts pieces, which incorporate a range of interactive and video elements alongside more traditional elements, and are particularly concerned with social change that contributes to world peace.

- Professor Terry Knight received an MIT HASS grant in support of her research in design and computation.

- Elizabeth Goldring received an award from the Charlotte Moorman Fellowship Fund, in recognition of her contributions as a woman artist, especially in the area of making art accessible to the visually impaired.

- Gloria Brown-Simmons pursued a new NASA-sponsored research program on "creative visualization" as a tool to permit artists to use scientific data as a starting point for interactive aesthetic explorations.

Other projects were taken on within the Center by MIT colleagues Prof. Tod Machover, who developed components of his new "Meteor" interactive musical piece there, Kent Larson, who works on large-scale architectural visualizations, and Ron MacNeil, who is exploring artistic uses of high-resolution electronic image projection systems.

Two new Fellows will be selected this year for two-year appointments, continuing the ramp-up toward full operation of the Center. Two new seminars are scheduled as CAVS-based academic activities. An exhibition of art-science-technology projects is being planned as a showcase for contemporary work at CAVS and elsewhere in this rapidly developing field.

More information about the CAVS can be found on the World Wide Web at this URL: http://cavs.mit.edu

S.A. Benton

AGA KHAN PROGRAM FOR ISLAMIC ARCHITECTURE

The Aga Khan Program for Islamic Architecture (AKPIA), administered jointly by Harvard University and the Massachusetts Institute of Technology, was established in 1979 to promote research and teaching and develop information resources in Islamic art, architecture, and urbanism. The central office for the AKPIA program is located at MIT and has responsibilities to both Harvard's and MIT's program. Due to MIT's responsibilities regarding both sites this report will include information on both portions of the program. His Highness The Aga Khan has given each institution an endowment that will permanently support instruction, research facilities, and student aid in those disciplines. It is intended that the study of Islamic architecture, visual arts, urban design, conservation, and urban rehabilitation will continually respond to the cultural and educational needs of a diverse Muslim world.

The MIT-based AKPIA central office continued to strengthen the program's visibility through outreach communications and publications in 1997-98. This was highlighted by the resumption of the AKPIA Newsletter and the publication of proceedings from the 1995 conference on "Typological Process and Design." Three volumes of AKPIA conference proceedings are underway.

ACADEMIC PROGRAMS

Students joining the SMArchS program, concentrating in Architectural Studies of the Islamic World, in 1997-98 were Nandini Bagchee, Markus ElKatsha, Deeba Haider, Saman Mahmood, and Nilay Oza. Georgiy Levashov and Minakshi Mani graduated in June. Tuition and living expenses for the SMArchS students at MIT were funded in whole or in part by AKPIA funds.

Students focused on both practical and theoretical issues concerning the architectural characteristics of non-western societies. Students compared traditional Islamic architectural forms and structures with those developed after the spread and application of Western ideas during modern times. They considered appropriate responses to climate, building materials, and building technology as well as the socio-cultural attitudes and values that directly relate inhabitants to their environment.

AKPIA doctoral students active in the History, Theory and Criticism Program (HTC) were Shirine Hamadeh, Pani Pyla, Kishwar Rizvi, Lara Tohme, and Maha Yahya. Tuition support and stipends for the doctoral students in residence at MIT were funded by the AKPIA-endowed scholarship fund. Talin Der-Grigorian and Yonca Kosebay graduated from the HTC program with the SMArchS degree.

AKPIA courses for fall 1997 were the studio "Architecture and Urban Context: Traditions, Conflicts, Changes. The Dead Cities of Syria—Can They Live Again?" offered by Attilio Petruccioli and Reinhard Goethert; "Special Problems in Non-Western Architecture—Reading the Islamic City in Regions of Persia, India and Central Asia," offered by Professor Petruccioli and Renata Holod of the University of Pennsylvania; and "Religious Architecture and Islamic Cultures" and "Orientalism and Representation," both offered by Associate Professor Nasser Rabbat.

In spring 1998, Attilio Petruccioli and Research Associate Shakeel Hossain taught "Sacred Symbolism and Representation in the Architecture and Urbanism of the Indo-Islamic Culture." Professor Rabbat taught "The Architecture of Cairo" and "Issues in Islamic Urbanism."

ACTIVITIES

The fall MIT lecture series included talks by Vivek Nanda (Univ. of Cambridge), Samer Akkach (Univ. of Adelaide), Doris Abouseif (Harvard's Graduate School of Design), Abdul Rehman (Univ. of Technology and Engineering, Lahore, Pakistan), Harvard Aga Khan Professor Gülru Necipoglu, Shawkat Toorawa (Univ. of Mauritius), and Claudio D'Amato. In addition, in October, students who received AKPIA travel grants or participated in AKPIA fieldworks made presentations on their summer research. The semester concluded with a roundtable on the "Dead Cities of the Limestone Massif in Syria."

In the spring, Professor Petruccioli and Shakeel Hossain introduced a thematic lecture series in conjunction with their course on Indo-Islamic architecture and urbanism. Speakers for this series included Loyal Rue (Harvard Center

for the Study of World Religions), Edwin Bryant (Harvard), Samina Qureshi (Sheppard and Qureshi Associates), Rochelle Kessler (Harvard's Sackler Museum), Jan Pieper (Univ. of Aachen), Omar Khalidi (MIT), Mahvash Alemi (Univ. of Pescara, Italy), Frank Korom (Univ. of New Mexico), Peter Chelkowski (New York University), Catherine Asher (Univ. of Minnesota), Gulzar Haider (Carleton Univ. of Canada), Noman ul-Haq (Rutgers Univ.), and Hasan-Uddin Khan of MIT. The lecture series and course wrapped up with a roundtable entitled "The Sacred in Contemporary Architecture and Urbanism," featuring Rupinder Singh and Kazi Khaleed Ashraf along with Hossain.

Other spring lecturers at MIT included Said Mouline of the Moroccan Ministry of Housing, who presented a roundtable on "Preserving the Urban Moroccan Heritage;" Dwight Reynolds (Univ. of California, Santa Barbara), who presented "A Living Oral Tradition from the Arab World;" visiting scholar Valerie Gonzalez (Univ. of Marseille-Luminy), who spoke on the "Problem of Representation in the Art of the Alhambra;" Alpay Ozdural (Eastern Mediterranean Univ., North Cyprus), who spoke on "A Practical Method of Teaching Geometry to the Architect-Artisan in the Medieval Islamic City;" and Francoise Choay (Sorbonne), who lectured on "Preservation of Urban and Architectural Heritage: A Societal Problem" and participated in a roundtable on urban preservation and historic value with MIT faculty.

EXHIBITIONS

An exhibition curated by AKPIA Research Associate Shakeel Hossain, "The Ephemeral, the Transient, the Static: Ritual Architecture and Urbanity," traveled to the University of Pennsylvania after stops last year at the Milan Triennial 19th International Exposition and MIT; The University of Pennsylvania also presented another Hossain-curated exhibit which included drawings and photographs by Attilio Petruccioli entitled "The City of Sun and Water: Fathpur Sikri."

FIELDWORK

Twelve MIT students and three Harvard students participated in the summer 1998 fieldworks organized by Professor Petruccioli, Harvard Visiting AKPIA Scholar Abdul Rehman, and AKPIA SMArchS graduate Zarminae Ansari. Students elected either of two architectural surveys of the landscapes, fabrics and bazaars of the historic centers of Fez, Morocco or Peshawar, Pakistan, and then joined together for a summer school of landscape in Anghiari, Italy. The Anghiari session consisted of courses in theory and practice of analyzing the landscape, conducted by Prof. Alessandro Giannini, Professor Emeritus of the University of Genoa. MIT and Harvard students were joined in the courses by students from the School of Architecture of Ferrara (Italy), the School of Engineering of Lahore (Pakistan), and the School of Architecture of Rabat (Morocco).

Birgul Colakoglu, PhD student in Design and Computation, is conducting research in Sarajevo with a summer 1998 AKPIA travel grant.

FACULTY ACTIVITIES

Over the past year Aga Khan Professor and Acting Director Attilio Petruccioli attended several conferences, symposia and seminars, including: "Fourth International Seminar on Urban Form," (Urban Morphology Research Group), Univ. of Birmingham, United Kingdom; "V Incontro di Studio," (International Center for the Study of Regional and Urban Evolution), Pienza, Italy; "Transformations of Middle Eastern Natural Environments: Legacies and Lessons," (Council on Middle East Studies), Yale University; "Culture and Identity of the Mediterranean, Memory and Making," (Forum for Mediterranean Cultures), Jerusalem; the Fifth Colloquium on Architecture and Behavior—"Architectural Knowledge and Cultural Diversity," Ascona; "Islam and Ecology," (Center for Study of World Religions), Harvard; and "New Town: Morphogenesis and Development," (International Seminar on Urban Form), Paris. Professor Petruccioli lectured at the University of Pennsylvania and the University of Lund, Sweden. Professor Petruccioli's article, "Analisi del processo di parcellizzazione nello sviluppo urbano, Il caso di Boston," co-authored with Paolo Carlotti, appeared in the January-February 1998 issue of *Paesaggio Urbano*. Professor Petruccioli edited the recently published AKPIA conference proceedings "Typological Process and Design."

Associate Professor Nasser Rabbat is currently working on a book tentatively entitled, *Visual Echoes in a Textual Culture: Representation of Art and Architecture in the Medieval Arabic Literature,* concerning art and architecture in the medieval Middle East and their social, cultural, and historical contexts. In 1997-98, he gave lectures at UCLA, New York University; the University of St. Andrews, Scotland; the American University of Beirut, Lebanon; The

Dar al-Athar al Islamiyya, Kuwait; and Granada, Spain. He also participated in several symposia at MIT and Harvard University.

Associate Professor Sibel Bozdogan is completing her book, *Modernism and Nation-Building: Turkish Architectural Culture in the 1930s.*

Visiting Associate Professor Hasan-Uddin Khan was one of three plenary speakers at "Islam and Ecology," a conference held in May at Harvard's Center for World Religions and supported in part by the Aga Khan Trust for Culture. Professor Khan spoke on "Architecture of Islam: Responsibility and the Natural Environment." Professor Khan's book *International Style: Modernist Architecture from 1925 to 1965* was published this spring.

OUTREACH

The AKPIA newsletter is being published again after several years of dormancy. 1800 copies were distributed throughout the Aga Khan research network. Proceedings from the conference on "Typological Process and Design" were published and distributed. The proceedings for the XIXth-Century House and Bukhara conferences are expected to appear in print by fall 1998.

In September the Program held a reception to welcome new students and AKPIA colleagues and revived the tradition of presenting an orientation for SMArchS students. AKPIA also undertook a major effort to locate AKPIA alumni in preparation for the Program's 20th Anniversary celebration, to be held in 1999-2000.

LIBRARY RESOURCES

AKPIA Rotch Library of Architecture and Planning librarian Omar Khalidi presented his exhibit on designed mosques of North America at the Sultan Qaboos University in Muscat, Oman in April at the invitation of the United States Information Service. To inaugurate the display he spoke to a large audience of ministers, architecture and engineering faculty. Khalidi also travelled to Karachi, visiting Dawood College of Engineering and Technology, and discussed library collaboration with the National College of Art in Lahore.

Visual archivist Ahmed Nabal continues to plan and design the Aga Khan Program Archives' Visual Images internet-accessible database. It will be accessible through the MIT libraries' Aga Khan webpage. The two Rotch libraries' Aga Khan website collections on Islamic architecture and mosques in the US are frequently consulted. They were published in *The Scout Report for Social Sciences*, November 4, 1997 and will be included on an educational CD-ROM to be issued by Houghton Mifflin for distribution without charge to middle schools throughout America.

Library activities during the year included exhibits featuring 19th-century photographs of Palestine from the Alwan Collection, Mamluk revival architecture from Egypt, Saudi Arabia, India, Bosnia and the Moroccan city Ghadames. A significant set of some 130 survey maps of the walled city of Hyderabad, Deccan, India was jointly copied for their collections by MIT and the University of Pennsylvania through the courtesy of Professor Leonard at the University of California, Irvine.

HARVARD: ACADEMIC PROGRAMS

Students in the PhD program in Harvard's Department of Fine Arts were Persis Berlekamp, Mark DeLancey, Ahmet Ersoy, May Farhat, Rebecca Foote, Oya Pancaroglu, Alka Patel, Leslie Poe, Leslie Schick, Alexis Sornin, Barry Wood, and Zeynep Yurekli.

Harvard Aga Khan Professor Gülru Necipoglu offered the proseminar "Issues in Ottoman Architectural Culture" and co-taught with Henri Zerner "Art and Visual Culture: Introduction to the Historical Study of Art and Architecture." Assistant Professor David Roxburgh offered two half-courses, "Art of the House of Tamerlane (1370-1506)" and "Islamic Pilgrimage."

ACTIVITIES

Professor Necipoglu sponsored a number of speakers for the "Friends of Islamic Art Lecture Series." Post-doctoral Research Fellows Barry Flood, Nebahat Avcioglu, Anatol Ivanov, and Nurhan Atasoy lectured in their areas of specialization. This series also included the following distinguished speakers: Klaus Kreiser, Tulay Artan, Ebba

Koch, Serpil Bagci, Said Mouline, Renata Holod, and Serafin Moralejo. Other post-doctoral Research Fellows were Abdul Rehman and Ruba Kanaían.

Professor Necipoglu is completing her book on the 16th-century Ottoman architect Sinan and his patrons. In October she participated in an international project for "Portraits of Ottoman Sultans" in Istanbul, presenting the paper "Word and Image in Portraits of the Ottoman Sultans" and discussed publication of the project next year. In November she attended the annual conference of Middle East Studies Association (MESA), and served as a discussant of a panel organized by David Roxburgh, "Literature and Architectural History." In February she participated as a discussant in Princeton Institute for Advanced Study workshop organized by Oleg Grabar and Michael Cook, "Geometry and Islamic Visual Culture," and was invited to make critical closing comments. In April she participated in a conference on Ottoman law organized at the Harvard Law School by Cemal Kafadar and Frank Vogel, as discussant of paper by Tulay Artan, "Ottoman Law, Material Culture, and Conspicuous Consumption." Her article "The Suburban Landscape of Sixteenth-Century Istanbul as a Mirror of Classical Ottoman Garden Culture" appeared in *Gardens in the Time of the Great Muslim Empires: Theory and Design,* Attilio Petruccioli (Leiden, 1997).

Professor Roxburgh attended several conferences this year and presented papers at three. He also organized and chaired the aforementioned MESA panel on "Architecture and Literary Texts." Throughout the year Professor Roxburgh's main research and writing focus has been on his sourcebook, *Writing Art Histories Under the Safavids: The Album Preface.*

LIBRARY RESOURCES

During 1997-98 AKP Cataloguer, Jeff Spurr, worked on developing an automated cataloguing system for the Visual Collections and online cataloguing of visual materials, starting with Islamic manuscripts. The librarians undertook a year-long special project to identify publications on Islamic art and architecture amidst the library's backlog of printed materials awaiting full cataloguing. They selected materials that had no records of holdings at other American libraries. This project created new access for local users and for outside scholars and institutions.

They acquired several rare materials: pre-World War I photographs of Central Asia, including a fine album of 54 photographs, largely of Samarkand, taken by G. Pankratyev (ca. 1894-1904); 20 loose snapshots of Samarkand and Tashkent (early 20th c.); three large-format albumen prints of Samarkand; and an important full run of the early Egyptian architectural periodical al-'Imarah.

Jeff Spurr continued organizing and providing access to the Fine Arts Library archive of early photographs of the Middle East from the Harvard Semitic Museum. He supervised the conservation, reformatting and rehousing of visual and audio documentation on Iran in the Baroness Ullens Archive. He also continued to coordinate the Harvard College Library's effort to help rebuild the collections of the National and University Library in Bosnia.

Librarians collaborated in the following exhibitions: "Diverse Cultures, Diverse Formats: A Celebration of the 35-year History of the Harvard College Library Middle East Division, 1962-1997," Widener Library, Harvard University, Oct.-Nov. 1997; "Holy Land: American Encounters with the Land of Israel in the Century before Statehood," National Museum of American Jewish History, Philadelphia, Jan. -Jul. , 1998; and "Expanded Visions: The Panoramic Photograph," Addison Gallery of American Art, Phillips Academy, Andover, Jan. -Apr., 1998.

Andras Riedlmayer presented a series of lectures last July at the Central European University in Budapest as part of a course, "Cultural Heritage in Danger;" he consulted with colleagues at Bosnian cultural institutions and libraries; and organized a panel on the problems of underserved cultures and languages in art libraries at the annual meeting of the Art Libraries Society of North America in March.

Attilio Petruccioli

CENTER FOR REAL ESTATE

The Center for Real Estate (MIT/CRE) was founded in 1984. The mission of the center is to improve the quality of the built environment through education and research and by facilitating communication among members of the real estate industry worldwide. To this end, it carries out research and teaching programs in the field of real estate development, investment, and management. It also provides a forum for the exchange of information and the discussion of issues by real estate professionals from around the world. The center's principal activities include an 11-month professional degree program leading to a Master of Science in Real Estate Development and a research agenda of issues relating to the planning, development and management of real estate, including its financial performance.

EDUCATION

Thirty-one members of the thirteenth class of MIT/CRE graduates received their SM degrees in Real Estate Development in October, 1997. Another student completed his thesis and received his degree in February, 1998. The 36 members of the incoming Class of 1999, which includes six joint degree candidates, were selected from a strong applicant pool in March. The number of applicants was about a third greater than in the previous year. The new class of seven women and 29 men includes seven international students and at least two others who have worked abroad for significant periods of time. The average age of class members is 29 years. Eight incoming students already hold advanced degrees ranging from law, business and structural engineering to economics, planning, and public administration. This is not counting the joint degree students.

The center is supporting two Ph.D. candidates in the Department of Urban Studies and Planning and has offered a full fellowship to an outstanding MSRED applicant, an architect from Nairobi, Kenya who will enter in the fall.

There were no major changes to core courses this year, though course content continues to evolve as the real estate industry changes. In the upcoming year, course 4.453 Building Technology in Real Estate Decision Making will be revised due to the resignation of the instructor, Lecturer Leonard Morse-Fortier.

Three 1997 graduates of the MSRED program were jointly given the Ralph Adams Cram Award by the School of Architecture for their report on the relationship between financing and design of sports stadiums. The report, called "Field$ of Dream$," is a compilation of their individual thesis work on football, baseball and basketball facilities. The center gave its Charles H. Spaulding award for outstanding professional achievement to Patrick Kennedy, MSRED 1985, principal of Panoramic Interests in Berkeley, CA. Kennedy was awarded the semi-annual honor for developing innovative mixed-use residential projects in downtown Berkeley.

RESEARCH

In March, the center hosted a day-long focus group on the strategic information needed for real estate decision making. Taking part were more than 20 senior executives from real estate investment firms and a number of center faculty. A report on the session by W. Tod McGrath, Lecturer in Urban Studies and Planning, will be available from the center as a working paper.

Four working papers were published this year by the center. One was a proceedings of the May, 1997 members' meeting on the growth of the public markets as a source of capital for real estate companies. In a second paper on real estate cycles, William C. Wheaton, Professor of Economics, concluded that real estate investment is not a uniform sector within the economy and that investment performance can be fundamentally different across property types. Timothy J. Riddiough, Assistant Professor of Urban Studies and Planning, co-authored a paper on the performance of foreclosed commercial mortgages to see how the actual results compared to market pricing. He found that losses were consistent with observed loan spreads, and that the default timing and loss recovery predictions made by option-based approaches to debt valuation were supported. In his paper on risk-sharing mechanisms in the redevelopment of "brownfields," Lawrence S. Bacow, Martin Professor of Environmental Studies in the Department of Urban Studies and Planning, concluded that the largest obstacle to redevelopment of contaminated sites is skepticism in the marketplace, and that the best way to combat this problem is the redevelopment of such sites by a knowledgeable end-user.

For a second year, the center hosted visiting scholar, Henry Pollakowski, a housing economist and editor of the *Journal of Housing Economics*.

PROFESSIONAL EDUCATION

The thirteenth summer of professional development courses brought almost 500 attendees to campus in June, July and August of 1997, a twenty percent increase over the previous summer. Attendees enrolled in nine courses, most of which ran near capacity. The demand for finance courses was so strong that an extra section of Fundamentals of Real Estate Finance, taught by Tod McGrath was scheduled for August to accommodate the overflow from the July course, and the Capital Markets I course was moved to a larger classroom. Demand for the center's 1998 Summer Institute courses continues strong. Enrollment by the end of June exceeded the total enrollment for 1997, with the real estate finance courses in great demand. New courses for 1998 include one on corporate real estate services presented by Sandra Lambert, Lecturer in the Department of Urban Studies and Planning, based on her research of the last few years. She also reprieved a reorganized version of negotiation skills for real estate practitioners which has not run for a few years.

MEMBERSHIP

Income from membership held virtually steady as the center closed the year with 78 supporting members (including 11 international members). This represents a net loss of two over the previous year. With leadership from Blake Eagle, Chairman, the center added 8 new members but lost 10 as industry consolidation led to unanticipated changes. In addition to annual fees, many members supported the center in non-financial ways by providing case study sites, lecturing in class, and supporting student thesis work. Again this year, Robert Danziger, retired Chairman of member firm Northland Development, organized and led a well-received occasional seminar called Real Deals, in which guest speakers from the industry dissect a specific real estate transaction in detail.

The center hosted two members' meetings. The December meeting on "Financing Real Estate Development: The Next Cycle" featured center Director William C. Wheaton as the dinner speaker. He discussed his recent research on how market cycles for different real estate products differ. He concluded that development may be coming but there is less need to worry about overbuilding in this cycle. The morning program included speakers representing sources of equity and debt and potential developers, both public and private. Sam Zell, whose Equity Office had just acquired center member Beacon Properties, was the only speaker who cautioned that the time was not yet right for new development. The other speakers warned of risks, particularly overlending by banks and mortgage conduits loosening underwriting standards in pursuit of more business, however, all were pursuing development in spite of the risk. The May meeting focused on the hot topic of the consolidation of the real estate industry and asked the question, "Is Bigger Better?" The evening speaker, industry expert, Christopher Vellturo, Ph.D. Economics '90, described the current anti-trust environment and how it might affect a planned merger. The morning speakers all described the benefits of size, particularly in the eyes of investment analysts and stock pickers, an influential audience now that so much of the industry's capital is coming from Wall Street. Economies of scale, opportunities for branding, the need to provide global services to clients and the possibilities of becoming the dominant provider of a particular real estate product in a regional submarket were some of the advantages cited.

ADMINISTRATION

This has been a very stable year for center administration. Chairman Blake Eagle, Director William Wheaton and Associate Director Kathleen MacNeil all expect to extend their tenures through the upcoming year.

Classroom renovations are planned for the center's Blakeley Lecture Hall. A space change request has been submitted. The plan is to raise funds during the year ahead and carry out the construction in August of next year.

Information about center programs and activities is published on the Web (http://web.mit.edu/cre/www/). This has become the primary source of inquiries from the public about the MSRED program, professional development courses, and working papers.

William C. Wheaton

MEDIA LABORATORY

In the past few years, the Media Laboratory has become increasingly focused on new and unpredictable ways to integrate a world of electronic bits with our familiar world of atoms. Last October we took the idea one step further when the Lab hosted *Wearables*, a major one-day symposium on the future of wearable computing. On that day, some 1,500 attendees were treated to a preview of cyberfashion: what will happen when computing leaves the desktop and is embedded in hats that send e-mail, vests that offer simultaneous translations, and earrings that are cellular phones.

If nothing else, this brief look at cyberfashion reminded us just how far we've come since "computation" meant a bulky computer sitting on an office desk. Each year, the Media Laboratory seeks to find creative new ways to make the newly emerging digital world more livable: from sensors that can tell a car's airbag when–and when not–to release; to intelligent agents capable of recommending which tomato plants will grow best in your garden; to "affective" computers capable of using "emotional intelligence" to respond to their users. But with the enormous progress comes a new concern: the growing gap between the digital "haves" and "have nots"–especially among the world's children.

During the past year, the Media Laboratory has undertaken several pioneering initiatives to help ensure that children throughout the world–from those who use a computer on a daily basis to those who don't know what a computer is–all have access to the vast opportunities offered by an online world. As a first step toward this, in July 1997 the Media Lab hosted some 200 activists, educators, politicians, and technologists from 45 countries who met for a *World Workshop on the Digital Future of Children, Learning, and Developing Nations*. The gathering, jointly sponsored by the 2B1 Foundation and the Media Laboratory, explored ways to build an imaginative, global network of children.

Later in 1998, the lab is undertaking an even more ambitious effort: *Junior Summit '98*, which will seek to give children everywhere a voice in shaping the world they will inherit. The summit will begin in August 1998 with an online forum involving approximately 1,000 children, ages 10 to 16. It will culminate in a week-long gathering at the Media Lab in November, where children from around the world will have an opportunity to formulate their ideas and present the results to corporate leaders and political dignitaries.

RESEARCH ACHIEVEMENTS

A sampling of 1997-98 Media Laboratory research accomplishments includes:

Electronic Paper, which combines all the great attributes of paper, but adds the benefits of digital technology. Imagine, for example, real paper that can display video images, or a desktop printer that can print out a working Tamagotchi™ electronic toy.

Lazy Fish, the newest development in electronic field sensing technology, where a miniature electronics board (only 1.5"x2.5") will eventually allow the user to interact even with everyday objects with just a wave of the hand.

Affective Computing, which will give "emotional intelligence" to computers, making them more "reasonable" when it comes to interacting with people. Tomorrow's affective computers will be able to sense what delights or frustrates you, or even figure out if it's a good time to interrupt.

A *holo-haptic interface system*, which combines computational haptics and electronic holography in a major step toward the development of an interactive, holographic workstation that operates in real time.

Project Lighthouse, a pioneering educational initiative in Thailand, which focuses on developing hands-on, immersive learning environments to explore how the computer and other technologies can be used to radically change the way we learn.

The first experimental implementation (with Dr. Isaac Chuang of IBM) of a working *quantum computer*, which solved a problem in fewer steps than a classical computer.

Structured Audio technology, which is capable of delivering the most complex, high-quality digital sounds quickly and at lower bandwidths, without losing quality. This pioneering technology will soon become part of MPEG-4, the world's first international standard for sound synthesis.

A *Smart Mousepad*, which can "see" an electronically tagged item placed on its surface, and then call up an appropriate Internet site in response.

Development of small, wearable *Bio- and GeoPaks*, which "wire" people to provide critical health or environmental feedback. These were put to the test during Everest Extreme Team Expedition in May 1998, when climbers wore these packs to provide feedback on heart rate, blood oxygen level, and body temperature, as well as weather conditions.

The development of a *Luminous Room* system, which turns an ordinary architectural space into an interface between people and digital information–pictures, text, or even live video. The first application of this system turns an ordinary tabletop into an optical workbench for designing holographic images.

Creation (with NearLife Inc. and Boston's Computer Museum) of the *Virtual Fishtank*, a major $1-million exhibit at the Computer Museum, which incorporates the latest advances in 3-D computer modeling, animation, and sensor technology. Visitors design their own artificial fish and then watch them interact in a giant virtual tank. This exhibit helps demonstrate how complex patterns arise from simple rules in many different situations–whether fish tanks, traffic jams, or economic markets.

Audio Spotlight, which uses ultrasound to project audio to highly specific locations, so that a person standing only a few feet away from someone else can be listening to an entirely different broadcast, with no distraction.

SPONSORS

In Fiscal Year 1998, the Media Laboratory's research volume grew to $15.5 million–a 14 percent increase over last year. Some 86 percent ($13.4 million) of this funding came from corporate support. An additional 8 percent ($1.2 million) came from U.S. government agencies (NSF and the Department of Defense), with the remaining 6 percent ($850,000) coming from Department of Defense subcontracts through other universities.

New directed research sponsors included: ASCII Corporation, which supported Professor Michael Hawley's Black Boxes project; Duracell, which supported Professor Joseph Jacobson's work on printed electronics; Honda R&D, which supported the Spatial Imaging group's work on developing computer-generated holograms for automotive CAD; Nortel, which provided a grant for research scientist Joseph Paradiso's work on new sensors for telecommunications; and Procter & Gamble, which supported research related to product usage and tracking.

The Media Laboratory initiated one new consortium in FY' 98: **Toys of Tomorrow** (TOT), a five-year research program to explore ways that the digital revolution will transform the world of toys and play. TOT focuses on inventing a new generation of toys–and creating new forms of playing, learning, designing, and storytelling. In the past, new technologies were born in the workplace, and ended up in toys. In the future, toys will be the trendsetters, setting the standards for a digital infrastructure that really works–and really plays. As of June 30, 1998, TOT sponsoring companies include: Acer Incorporated; Bandai; Deutsche Telekom AG; Energizer; Intel; International Olympic Committee; LEGO Futura A/S; Mattel, Inc.; Motorola, Inc.; Nickelodeon; Polar Electro Oy; and Tomy Company, Ltd.

New sponsors joining the lab's three ongoing consortia include:

Digital Life: Acer Incorporated; Avid Technology; France Telecom/CNET; and Honeywell, Inc.

News in the Future: General Motors Cyberworks; The SABRE Group; The National Library of Medicine; and the International Olympic Committee.

Things That Think: Avery Dennison Corporation; The Charles Stark Draper Laboratory, Inc.; Mattel, Inc.; Minolta Co., Ltd.; and Unisys Corporation.

New members of the lab's Media Technology Group (MTG) include: ADVO, Inc.; GeoPartners Research, Inc.; Shiseido; and Storage Technology Corporation.

Finding increased support for the Media Laboratory's graduate students has been a high priority during FY '98. Toward this end, the lab was pleased to announce the addition of IBM Media Lab Fellows. The six students selected for these fellowships were: Joey Berzowska, Peter Cho, Raul Fernandez, Jon Orwant, David Small, and Paul Yarin.

AT&T also continued to support the laboratory through funding for students. The following were named AT&T Media Laboratory Fellows for 1998: Nelson Minar, Alexandros Moukas, Deb Roy, Mukesh Singh, and Alan Wexelblat.

Interval Research Corporation Fellows for 1997-98 were: Matt Gorbet, Matt Grenby, Rehmi Post, Brent Ridley, and Warren Sack.

The following students were named 1997-98 Motorola Fellows: Pascal Chesnais, Rich Fletcher, Kwin Kramer, Nuria Oliver, Rob Poor, and Matt Reynolds.

Mitsubishi Electric Research Corporation renewed its fellowship program, supporting three students this year: Ravikanth Pappu, Wendy Plesniak, and Brygg Ullmer.

1997-98 Telecom Italia Fellows were: Rick Borovoy, Lenny Foner, Rob Guttman, Reed Kram, and Flavia Sparacino.

Eastman Kodak Company continued to support Phillip Tiongson as the 1997-98 Kodak Fellow, and in the spring of 1998, Tom White was named the M.M. Chanowski Fellow.

In Fiscal 1998, the Media Laboratory received close to $3 million in gifts of equipment:

Digital Equipment Corporation gave two gifts of laptops, PCs, monitors, workstations, servers, network switches, and other miscellaneous equipment valued at more than $1.9 million.

Hewlett-Packard Company gave a recipient-enhanced grant of laptops, palmtops, digital cameras, and other equipment, as well as test equipment for Professor Neil Gershenfeld's laboratory, for a total value of $238,000.

Canon donated seven copiers worth $242,000.

Motorola, Inc. gave the lab more than 200 StarMax computers valued at $149,000.

AMP, Inc. provided the lab with a gift of $163,000 worth of fiber optic cables.

Electro Sales provided Professor Joseph Jacobson with electronic equipment valued at $94,000.

Mitsubishi gave the lab 21 monitors worth $74,000.

Intel provided five computers worth $52,000 to Professor John Maeda.

Sony provided Professor Alex Pentland with equipment worth $13,000.

PERSONNEL

NEW APPOINTMENTS

Alexandra Kahn joined the lab as press liaison in November 1997, following the departure of Valerie Eames Minard. Ms. Kahn had been working in communications and public relations for high-technology companies for the past 12 years, most recently as public relations specialist for Softbank Services Group.

John Henriques joined the laboratory as fiscal officer in October 1997. He came to the laboratory from MIT's Information Systems, and previously served as a financial manager for the Commonwealth of Massachusetts and the Boston Housing Authority.

V. Michael Bove, Jr., formerly associate professor in the Program in Media Arts & Sciences, was appointed principal research scientist in the lab's Object-Based Media group, effective July 1997.

Ronald MacNeil, principal research associate, moved from the Media Laboratory to the Department of Architecture.

In March 1998, Scott Gunn assumed a one-year research associate appointment to work on the Junior Summit '98.

Steven Smith joined the laboratory as a research specialist in the Spatial Imaging group in October 1997, replacing Michael Klug, who left the lab to start his own business. Mr. Smith came to the lab from a long career as a commercial holographer.

The laboratory appointed one new technical staff member and extended the appointment of another during 1997-98: Fred Donovan joined as systems/network engineer in April 1998, replacing Matthew Trunnell. Erik Trimble's appointment as systems/network engineer in the Vision and Modeling group was extended from January 23, 1998 through January 22, 2001.

NEW VISITORS AND AFFILIATES

Hisashi Aoki from Toshiba Corporation was appointed research affiliate for the period March 1, 1998 to September 30, 1999.

Patrick Hughes from British Telecom Laboratories was appointed research affiliate for the period June 1, 1998 to May 31, 1999.

Henry Strub from Interval Research was appointed visiting scientist for one month beginning April 28, 1998.

Paul Rankin from Philips Research Laboratory was appointed visiting scientist for two months beginning January 13, 1998.

RETIREMENTS AND RESIGNATIONS

After more than 20 years at the Media Laboratory, Richard Bolt retired from his position as senior research scientist in December 1997. Valerie Eames Minard, who served as the laboratory's press liaison for the past six years, resigned to relocate. Laureen Chapman, the lab's financial coordinator, left in January 1998 after ten years of service.

PROMOTIONS

There were several promotions of sponsored research administrative staff members during FY '98: Ellen Hoffman was promoted to associate director of publications for the Communications and Sponsor Relations group; Jacqueline Karaaslanian was promoted to program manager in the Epistemology and Learning group; and Felice Napolitano Gardner was promoted to executive coordinator for Mr. Bender's office, and project coordinator of the News in the Future Consortium in July 1997.

Several members of the Lab's support staff were also promoted to sponsored research administrative staff positions: Kristin Hall was named financial coordinator for the Things That Think consortium; Betty Lou McClanahan became project coordinator for C++, a new car consortium to be announced in the summer of 1998; and Melissa Yoon is now assistant fiscal officer in the Finance and Administration group.

More information about the Media Laboratory can be found on the World Wide Web at the following URL: http://www.media.mit.edu/

Nicholas Negroponte

MEDIA LABORATORY SPONSORS

RESEARCH CONSORTIA

Digital Life (DL)
Acer Incorporated
American International Group, Inc.
Avid Technology
Bell Canada
Bertelsmann AG/BMG Entertainment
Bonnier/Marieberg
Citibank N.A.
Dentsu
Eastman Kodak
Ericsson
France Telecom/CNET
Fuji Xerox Co. Ltd.
Hakuhodo Incorporated
Honeywell, Inc.
Hong Kong Telecom IMS Ltd.
Hughes Electronics
Intel
Kodansha Ltd., Publishers
LEGO Futura ApS
MediaOne
Merrill Lynch
Minnesota Mining & Manufacturing Co.
NIKE, Inc.
Nortel
OMRON Corp.
Panasonic Technologies, Inc.
Perot Systems Corporation
Philip Morris Companies, Inc.
Philips Research Laboratories
Riverland Holding
R.R. Donnelley & Sons Company
SAIC/Bell Communications Research
SAP AG
Saritel S.p.A.
Seiko Epson Corporation
SGS Thomson Microelectronics
Shingakusha
Siemens Nixdorf Information Systems.
Sonera
Southwestern Bell Technology Resources Inc.
Tandem Computers, Inc.
Tele Danmark
Televisa s.a. de c.v.
3Com Corporation
TOPPAN Printing Co., Ltd.
Viacom International
WPP Group plc
Xerox Corporation

News in the Future (NiF)
ABC, Inc.
Advance Publications, Inc.
Alma Media
BellSouth Enterprises, Inc.
The Chronicle Publishing Company
Corporation for Public Broadcasting
Eastman Kodak
Editoriale L'Espresso S.p.A.
Gannett Co., Inc.
General Motors Cyberworks
Grupo Clarín
Grupo Estado
Hearst Corporation
International Business Machines
International Olympic Committee
JCPenney
Johnson & Johnson
McCann-Erickson Worldwide
The National Library of Medicine
NY Times/Globe
The SABRE Group
Sun Microsystems
Tribune Company

RESEARCH CONSORTIA (cont.)

Things That Think (TTT)
American Greetings Corporation
AMP, Inc.
Analog Devices, Inc.
Artificial Life, Inc.
ASCII Corporation
AT&T Corp.
Avery Dennison Corporation
Becton Dickinson and Company
Brother Industries, Ltd.
Creative Technology, Ltd.
Deutsche Telekom AG
The Charles Stark Draper Laboratory, Inc.
EDS
Federal Express Corporation
The Gillette Company
Hewlett-Packard Company
Interval Research Corporation
Karstadt AG
The LEGO Group
Levi Strauss & Co.
Lord Corporation
MasterCard International
Mattel, Inc.
Microsoft Corporation
Minolta Co., Ltd.
Motorola, Inc.
National Semiconductor Corporation
NIKE, Inc.
Nokia Corporation
Oki America, Inc.
The Procter & Gamble Company
SEGA of America, Inc.
Sensormatic Electronics Corp.
Siemens AG
Steelcase Inc.
Swatch AG
Symbol Technologies, Inc.
Telia Research AB
3Com Corporation
Trimble Navigation Limited
Unisys Corporation
United Technologies Corporation
VISA International
Volvo
Walt Disney Imagineering
YAMAHA Corporation

Toys of Tomorrow (TOT)
Acer Incorporated
Bandai
Deutsche Telekom AG
Energizer
Intel
International Olympic Committee
LEGO Futura A/S
Mattel, Inc.
Motorola, Inc.
Nickelodeon
Polar Electro Oy
Tomy Company, Ltd.

MEDIA TECHNOLOGY GROUP

ADVO, Inc.
Canon Inc.
GeoPartners Research, Inc.
Goldman, Sachs & Co.
Nippon Columbia Co., Ltd.
J. Sainsbury plc
Scitex Corporation, Ltd.
Shiseido
Storage Technology Corporation

RESEARCH CONTRACTS

ASCII Corporation
BT
Central Intelligence Agency
Department of the Army
Department of Transportation
Deutsche Telekom Berkom GMBH
Duracell
Hewlett-Packard
Honda R&D Co., Ltd.
International Business Machines
LEGO Futura ApS
Microsoft Corporation
National Science Foundation
Nortel
Office of Naval Research
University of California, Berkeley
University of Maryland

SPECIAL FUNDS

AMP, Inc.
ATR Media Integration & Communications Research Laboratories
AT&T Corp.
Bay Networks, Inc.
Canon Inc.
M.M. Chanowski
Digital Equipment Corporation
FORE Systems, Inc.
Hewlett-Packard
Interlego A/S
Interval Research Corporation
Mitsubishi Electric
Motorola, Inc.
Silicon Graphics, Inc.
Telecom Italia
Toshiba

Brain Opera
Ars Electronica Center
Calouste Gulbenkian Foundation
Heller Werkstatt
Kravis Center for the Performing Arts
Lincoln Center for the Performing Arts
NTT Data

ENDOWMENT AND NAMING GRANTS

Rudge and Nancy Allen
Asahi Broadcasting Corporation
AT&T Corp.
Armand and Celeste Bartos
Alex Dreyfoos, Jr.
Fukutake Publishing
Interlego A/S
LG Electronics, Inc.
Misawa Homes
NEC
Schlumberger
Sony
Toshiba
Philippe Villers
Muriel R. Cooper Memorial Professorship
DDP Digital Publishing, Inc.
Origin/Media Lab BV
Sarah Dickinson Memorial Fund

SCHOOL OF ENGINEERING

The 1998 Academic Year saw many important events that contributed to the School's position as the premier academic center for education and research in engineering in the United States. The School is committed to moving forward on several fronts to redefine engineering education and to establish new areas of leadership in engineering research.

Several initiatives are emerging as the focus of the developing long-range plan of the School. These are: a new emphasis on integration and synthesis in engineering, especially in the context of the interface between engineering systems, management and the social sciences; pioneering the development of the field of bioengineering, defined as the interface between modern biology and the traditional engineering disciplines; and the development of new modes of engineering education, leveraging the application of information technology.

The initiative in bioengineering is being spearheaded by the formation of the new Division of Bioengineering and Environmental Health (BEH) in the School of Engineering, which will be officially formed on July 1, 1998. The BEH Division will be a faculty-bearing unit that includes the faculty of the former Division of Toxicology and focuses on education and research at the interface between engineering and modern biology. The first co-directors of BEH will be Professors Steven Tannenbaum and Douglas Lauffenburger. Its firsts academic programs will include the undergraduate minor in biomedical engineering, a doctoral program in toxicology and a new doctoral program in bioengineering. Research in bioengineering is supported through the Biotechnology Process Engineering Center (BPEC), an Engineering Research Center supported by the National Science Foundation since 1984, and the Center for Biomedical Engineering (CBE).

The School of Engineering also developed a major initiative in engineering systems with special emphasis on faculty, education and research programs at the interfaces between engineering, industry, management and social sciences. This initiative was coordinated by Professor Daniel Roos who was appointed as the first Associate Dean for Engineering Systems in the School of Engineering. Professor Roos took responsibility for the coordination and development of education and research programs at these interfaces and formed the Engineering Systems Council composed of leaders in these thrusts. A proposal for the formation of the Division of Engineering Systems within the School of Engineering has been presented to the MIT administration and will be acted on this fall.

The School of Engineering is committed to pioneering the development of research and educational collaborations that will help define a modern technologically-based university in the century ahead. The School is currently engaged or is about to engage, in several large-scale programs that will pioneer the application of communications technology in education and research. Two of these are described briefly here.

First, new modes of professional engineering education are actively being developed. The System Design and Management (SDM) program, leading to a Master of Engineering degree continues to grow with 58 students entering in January 1998 and 50-58 additional students expected in 1999. The SDM program is joint with the Sloan School of Management and is the latest of the successful joint programs developed at the interface of management and engineering. The majority of the students in the SDM program elected to use the distance education option in which a significant portion of their subjects are taken at a distance using video-conferencing and web-based resources. Through a collaboration between the SDM program, the Center for Innovation in Product Development (CIPD), Xerox Corporation, Ford Motor Company, and the National Science Foundation, a new track in the SDM program is being developed that emphasizes product development. This track is being developed in collaboration with Rochester Institute of Technology and the University of Detroit at Mercy which will offer SDM degrees as well. This joint program is a new model for collaborative education between MIT and other universities in the United States and world-wide.

A large program of collaborative engineering education is about to be launched with the two universities in the Republic of Singapore, the National University of Singapore (NUS) and Nanyang Technological University (NTU). These programs will feature MIT/NUS/NTU collaboration in professional engineering education offered through degrees at the two Singaporian universities and joint research, including supervision of traditional doctoral students from those two universities. The program will explore the application of information technology for delivery of education and for enhancing research collaborations.

Educational innovation also is underway within our traditional undergraduate programs. The Department of Mechanical Engineering continues the revamping of its curriculum. The Department of Aeronautics and Astronautics has completed a very comprehensive strategic planning exercise and is in the process of making significant changes in their undergraduate program as a result. Educational innovation by our faculty also was highlighted in several notable awards (see below).

The School of Engineering moved forward in capital fundraising in 1998. Most notable was the campaign to build the new complex of buildings to house computer information and intelligence sciences at MIT, or the CIIS complex. With a leadership gift from Ray and Maria Stata and a magnificent gift from Alex Dreyfoos leading the announced donations pledges totaling $78.7 million are in hand. The project to construct an approximately 325,000 g.s.f. facility on the site of Building 20 is currently in schematic design with Frank O. Gehry and Associates as the architect.

Each year faculty of the School of Engineering receive many honors in recognition of their research and service. This year was no exception. Several very notable awards are mentioned here. Four members of the faculty of the School of Engineering were among the 54 inductees in the National Academy of Engineering: Professors Edward Crawley, Head of the Department of Aeronautics and Astronautics, Professor John Heywood, of the Mechanical Engineering Department, Professor Jerome Salzer of the Department of Electrical Engineering and Computer Science and Professor James Fay of the Department of Mechanical Engineering. Professor Robert S. Langer received the Lemelson Prize for his contributions to research and innovation in pioneering controlled drug release technology. Mr. Timothy Berners-Lee, Director of the WWW Consortium in the Laboratory of Computer Science, won a prestigious MacArthur Prize for his development of Internet protocols.

AWARDS

The Bose Award for Excellence in Teaching was presented to R. John Hansman, Jr. of the Department of Aeronautics and Astronautics. Professor Hansman excels as a teacher introducing a strong "hands on" aspect of engineering education. The Junior Bose Award was presented to Assistant Professor Douglas Hart of the Department of Mechanical Engineering.

The Ruth and Joel Spira Awards for Teaching Excellence were presented this year to Professor Duane Boning of the Department of Electrical Engineering and Computer Science, Professor Kent Hansen of the Department of Nuclear Engineering, and Professor David Trumper of the Department of Mechanical Engineering. The Spira awards were established with a gift from Mr. and Mrs. Joel Spira to honor outstanding teachers in the three departments listed above.

Henry Ford II Scholar Award - This award is presented to the senior in the School of Engineering who has attained the highest academic record at the end of the third year and who has exceptional potential for leadership in the profession of engineering and in society. The recipient this year was Ms. Lisa A. Poyneer, '98 of the Department of Electrical Engineering and Computer Science.

Reinhold Rudenberg Memorial Fund - This prize is awarded to students based on their senior theses in the area of energy conversion.

Awards this year went to Mr. Benjamin A. Douts for his thesis titled "Non-Contact Transmission of Electrical Power and Data" and Mr. Holly Gates for his thesis titled "Linear Tracking and Positioning System." Both of these students are from the Laboratory for Electromagnetic and Electronic Systems. Two other awards went to Mr. Sigfrido Delgado for his thesis titled "Creation of an Infrastructure for Hydrogen-Powered Systems," and Mr. Jason S. Nogueira, SB '97 for his thesis titled "A Guide to Designing and Optimizing Small Photovoltaic Systems." Both of these students are from the Department of Mechanical Engineering.

ENGINEERING COUNCIL

On July 1, 1997 Professor Jeffrey P. Freidberg was named as head of the Department of Nuclear Engineering. On July 1, 1998 Professors Steven R. Tannenbaum and Douglas A. Lauffenburger will become co-directors of the newly formed Division of Biomedical. Professor Daniel Roos joined Engineering Council as Associate Dean for Engineering Systems.

ENGINEERING INTERNSHIP PROGRAM

In 1997-98, Karl Reid SB '84, SM '85 was appointed EIP Director in January 1998 after a five month vacancy created by the departure of Laura Robinson to another Institute position.

In 1997-98, EIP placed 17 sophomores with eight member companies, down from 27 sophomores in 1997. The program placed a total of 53 interns at 12 member firms.

The main objectives in the coming year are to increase the number and broaden the type of participating companies, publish new print materials, and automate the student application, scheduling, and company matching process using the web. Moreover, we will continue to raise the appeal and visibility of the EIP to students well in advance of the February deadlines in order to increase the pool of applicants.

In 1998, we focused on maintaining our partnerships with the EIP companies and improving the communication flow to returning interns. We also previewed the EIP to freshmen during department orientations, one year before they are eligible to join EIP.

The main objectives in the coming year are to increase the number and broaden the type of participating companies, publish new print materials, and automate the student application, scheduling, and company matching process using the web. Moreover, we will continue to raise the appeal and visibility of the EIP to students well in advance of the February deadlines in order to increase the pool of applicants.

MINORITY INTRODUCTION TO ENGINEERING, ENTREPRENEURSHIP AND SCIENCE

In 1997-98, Karl Reid SB '84, SM '85 was appointed the new administrative director of MITES. The program officially added entrepreneurship to its name after the successful pilot of the EntrePrep initiative in 1997.

During the summer of 1998, 58 underrepresented minority high school rising seniors completed the six week residential program, equaling the 1997 class size.

We received 233 applications this year. One new corporate sponsor and one additional foundation supported the MITES '98 session. Approximately 40 guests attended a fundraising reception hosted by Merrill Lynch in New York City.

Twenty-one faculty, graduate students, alumni and corporate guests spoke to the students about their experiences this summer.

We enhanced the EntrePrep curriculum in the 1998 session. This year, the students utilized MIT-developed technologies to develop and present business plans that were judged by local entrepreneurs.

Of the 58 students who attended MITES 1997, 46 applied to MIT, and 43 were accepted. Twenty-two of the accepted students will attend MIT.

To mark the 25th year of MITES in 1999, plans are underway to hold a reunion, conduct a comprehensive survey of MITES graduates, develop a long-term funding model, and begin evolutionary curriculum changes to reflect Institute-wide science and engineering curriculum changes.

Robert A. Brown

DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

The academic year 1997-98 was a rebuilding and refocusing year for the department. In the wake of the retirement of eight senior faculty in June 1996, the Department prepared a detailed extensive strategic plan. The result was a reaffirmation of our focus on the intellectually and industrially robust field of aerospace, coupled with a commitment to redirect the intellectual basis of the Department to set and serve the directions of this industry. The new vision of the department which emerges is one which stands on three broad disciplinary bases: the traditional engine and airframe disciplines; the disciplines of real time system critical aerospace information engineering; and the disciplines required to architect and engineer extremely complex systems.

During AY 97-98 our strategic plan was embraced by the administration and corporation, and we began implementation. Searches for three faculty in the aerospace information area were conducted, and an important relationship was developed with the Electrical Engineering and Computer Science. We launched a reform of our educational programs intellect to make the conception, design, implementation and operation of systems the engineering context of our education. Other Implementation teams focused on education, research and our System Architecture and Engineering thrust.

One faculty member was added, Professor J.P. Clarke in Humans and Automation. Professor Sheila Widnall returned to the faculty after serving four years as the Secretary of the Air Force. Professor Daniel Hastings is on leave as the Chief Scientist of the Air Force. Student enrollment at both the undergraduate and graduate level was steady, and research activities increased markedly.

UNDERGRADUATE PROGRAM

Undergraduate Enrollment over the Last Twelve Years

	85-86	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98
Sophomores	106	120	96	103	75	76	61	33	36	36	30	46	40
Juniors	92	103	118	94	87	61	62	60	31	37	31	23	33
Seniors	106	98	105	130	104	104	73	66	66	38	37	29	24
Totals	304	321	319	327	266	241	196	159	133	111	98	98	97
% of Women	18%	16%	19%	21%	25%	23%	27%	28%	32%	31%	29%	26%	30%
% of Under. Min.	11%	10%	N/A	14%	18%	20%	14%	12%	23%	19%	16%	18%	22%

GRADUATE PROGRAM

A total of 235 applications were received for the Fall, 1998 term. Out of this, 127 were admitted and 58 accepted the offer of admission. Enrollment for Fall, 1997 included 124 S.M., 63 Doctoral., 2 EAA, 10 MEng degree candidates for a total of 211. Total minority students: 9 (3 Doctoral., 5 S.M., 1 MEng). Total women students: 31 (6 Doctoral, 24 S.M., 1 MEng.). In the Spring, 1998 term we received 17 applications. We admitted 7 and 4 enrolled. One women applied, 1 was admitted, 1 enrolled. Zero minority applications were received. Enrollment for Spring, 1998 included 119 S.M., 63 Doctoral, 2 EAA, 12 MEng for a total of 196. Total women: 29 (8 Doctoral, 21 S.M.). Total minority: 8 (2 Doctoral, 4 S.M., 2 MEng.).

Degrees Awarded	S.M.	EAA	Doctoral.	MEng	Total
Summer (Sept. 97)	11	0	1	2	14
Fall (Feb. 98)	18	0	8	0	26

Spring (June 98)	25	0	5	6	36
Total	54	0	14	8	76

FUNDING	FALL, 1997	SPRING, 1998
MIT Fellows/Tuition Awards	13	9
Outside Fellowship	15	14
Staff Appointments		
(Draper Fellow, RA)	148	148
Teaching Assistants & Fellows	7	5
Engineering Internship Program	0	0
Other Types of Support		
(Employer, Foreign, Self)	34	28
TOTAL	217	204

FACULTY NOTES

Prof. Edward Crawley became a member of the National Academy of Engineering.

Prof. Dan Frey received an R&D 100 award for a set of analytical techniques useful in analyzing variation in machining processes.

Prof. Steven Hall has been named the first Raymond L. Bisplinghoff Fellow. The fellowship was endowed by the Raymond L. Bisplinghoff Fund, established in 1994 to honor Professor Bisplinghoff, former Head of the Department and Dean of the School of Engineering.

The fund was established to promote leadership and innovation in aeronautics and astronautics research and education by providing initiation funds to outstanding mid-career faculty in the department who exemplify Dr. Bisplinghoff's spirit of exploration.

During his three-year fellowship, Professor Hall will investigate innovative teaching methods and the use of technology to improve classroom effectiveness. He plans to conduct a trial of selected technologies, and if the results are favorable, to develop a plan to move the technology into the department's teaching program. Professor Hall received the SB (1980), the SM (1982) and the ScD (1985) from MIT in aeronautics and astronautics. His main research interests are the control of flexible structures, andhelicopter rotor dynamics, especially using piezoelectric actuators.

Prof. R. John Hansman received the 1998 Bose Award for Excellence in Engineering Education, and the FAA Excellence in Aviation Research Award for NASA/FAA Joint University Program (with Princeton and Ohio Univ).

Prof. Paul Lagace received the L. P. Coombes Award from the Institute of Engineers in Australia, and delivered the L. P. Coombes Lecture in July, 1997.

Prof. James Paduano received the 1997 Best Paper Award from the Controls and Diagnostics Committee of the International Gas Turbine Institute, for the paper "Active Stabilization of Rotating Stall and Surge in a Transonic Single Stage Axial Compressor", ASME Paper 97-GT-411, by H.G. Weigl, J. D. Paduano, L. G. Frechette, A. H. Epstein, E. M. Greitzer, M. M. Bright, and A. J. Strazisar.

Prof. Jaime Peraire received three awards:
D.Sc. from the University of Wales, UK, July 1997.
NASA Exceptional Award for work on "STARS - Structural Analysis Routines", October 1997.
First recipient of the International Association for Computational Mechanics (IACM) "Young Investigators in Computational Mechanics" Award, May 1998.

Prof. Thomas Sheridan was awarded the Rufus Oldenburger Medal (for contributions in control engineering) by ASME (American Society of Mechanical Engineers) during the current period.

Prof. Mark Spearing was appointed to the Esther and Harold E. Edgerton Assistant Professorship in May. He was also re-elected as Chairman of the AIAA Materials Technical Committee.

Prof. Sheila Widnall received the Goddard Award from the National Space Club, elected Vice President of NAE, elected to the Board of the Sloan Foundation and selected honorary member of IEEE.

Prof. Larry Young received the Koetser Foundation Prize in Zurich, Switzerland in May 1998, for his contributions in Brain Research, and gave a public lecture to over 200 people there on the subject of Human Space Exploration. He was mentioned in the Tages Anzeiger (Switzerland's largest daily paper) for his achievements, and received an award of sFr 10,000 (about $7000.00).

The Weiken re-convention this year saw the initiation of the National Space Biomedical Research Institute and Consortium of 7 universities organized to perform NASA's basic Biomedical Research paving the way for further human exploration of space. It contains research by several MIT members as well as Harvard Medical School and Prof. Young is the Director of this consortium with HQ's at Baylor College of Medicine in Houston, TX.

MASSACHUSETTS SPACE GRANT CONSORTIUM

The Massachusetts Space Grant Consortium now includes MIT (Lead), Tufts University, Wellesley College, Harvard University, Boston University, University of Massachusetts, Worcester Polytechnic Institute Marine Biological Laboratory, Fice College Astronomy Department, and the Charles Stark Draper Laboratory. The Wright Center at Tufts is responsible for education of pre-college teachers in space science and engineering, through summer workshops. The Program continues to support undergraduate research through the MIT Undergraduate Research Opportunities Program. It increased the number of companies involved in placing students for summer employment in the aerospace industry, supported students for the summer at the NASA Space Academy, and offered graduate fellowships. It sponsored a popular undergraduate seminar subject on "Modern Space Science and Engineering" with emphasis this year on humans in space with guest speakers from our industrial affiliates, and academic affiliates. The annual public lecture this year was given by Dr. John M. Logsdon of the Space Policy Institute.

MASSACHUSETTS SPACE FORUM

The fourth meeting of the Massachusetts Space Forum was held in November, 1997. The goal of the Massachusetts Space Forum is to favorably influence national planning and to stimulate regional cooperative activity in space education and business opportunities. Over 50 leaders from academia, industry and government attended the workshops and the luncheon presentation by Mr. Robert Zubrin.

The next Space Forum is tentatively scheduled for early Fall 1998.

RESEARCH HIGHLIGHTS

ACTIVE MATERIALS & STRUCTURES LABORATORY

The Active Materials and Structures Laboratory (AMSL) focuses on the development of innovative technologies for active control of aerospace systems. Research has covered a broad range of disciplines including materials science, structural mechanics, structural dynamics, control, and solid state actuation systems. The laboratory has coordinated multidisciplinary research programs ranging from fundamental materials microstructure investigations to helicopter control systems feasibility studies. Major research thrusts in 1997/1998 were: development of micro hydraulic solid state transducers resulting in a DARPA funded program to develop micro-solid state energy harvesting mechanisms; development of new micromachining processes for fabricating silicon carbide components; development of new compositions, single crystal ceramics, synthesis techniques and damage models for active ceramic materials suitable for high actuation and sensing functions, and further work on the development of distributed structural acoustic control techniques. Fundamental research was motivated by a variety of ongoing applications programs. AMSL, a member of the Smart Structures Rotorcraft Consortium with Boeing and McDonnell Douglas, has continued to work on developing actively controlled helicopter rotor blades for vibration and noise reduction. Also a member of the Active Fiber Consortium together with Midé Technologies, CeraNova Corp., ACX Inc., Boeing, and the Naval Undersea Warfare Center, AMSL has further improved the modeling and manufacturing techniques of active fiber composites. The laboratory also continued to advance applications projects in the active control of structural

acoustics: far field radiated sound from panels and cylinders, as well as control of interior noise in aircraft. Recently Westinghouse Corp. awarded AMSL a grant to investigate the active vibration control of torpedo radiated noise. The laboratory facilities available were: active material and device characterization; static and dynamic structural testing; structural acoustic testing; hover test stand, and real time control.

INTERNATIONAL CENTER FOR AIR TRANSPORTATION

The objective of the International Center for Air Transportation is to improve the safety, efficiency and capacity of domestic and international air transportation and its infrastructure, utilizing information technology and systems analysis. The principle new thrust of ICAT over the past year has been in advanced Air Traffic Management. The activities in this area have ranged from evaluations of future operational concepts for the US National Airspace System; preliminary design of decision aids to improve airport departure rates; development of conflict and collision alerting; evaluation of Collaborative Decision Making between ATC and airlines; evaluation of analytical models of ATM systems and conducting fundamental human performance studies of pilot and controller interactions. ICAT has also continued to work in the areas of cognitive systems and decision aids for flight critical cockpit systems. This work includes advanced alerting systems, human understanding of advanced flight automation systems and other flight safety topics. ICAT has also developed and flight tested a single antenna GPS attitude determination system.

Over the past year, ICAT received the first FAA Excellence in Aviation Award as part of the NASA/FAA Joint University Program in Air Transportation with Princeton and Ohio University. ICAT has also participated in the FAA National Center of Excellence in Operations Research with the MIT Operations Research Center and the University of California at Berkeley.

FLUID DYNAMICS RESEARCH LABORATORY

The FDRL is active in research concerning computational, analytical and experimental issues in fluid dynamics and aerodynamics. Current research projects include: the development of a "distributed flow simulation environment" capability; aerodynamics of subsonic, transonic, and hypersonic vehicles; the development of tools for aerodynamic design; distributed visualization; computational and experimental approaches to active flow control; an experimental investigation into roughness-induced boundary layer transition; the development of micron-sized shear-stress, pressure and velocity sensors for measurement and control of high Reynolds number, sub- and supersonic aerodynamic flows; analysis and simulation of the mechanics of fluids in micron-sized geometries, including fluid mechanics of a micro-gas-turbine engine; the development of theoretical models for the dynamics of near-wall turbulent flows.

GAS TURBINE LABORATORY

The "micro engines" (shirt button sized gas turbine engines) project has expanded to include about 40 faculty, staff, and students from three departments representing a diverse set of engineering disciplines. This multidisciplinary project is device oriented and has the aim of producing MEMS (Micro-Electro-Mechanical-Systems produced with integrated circuit manufacturing techniques) based gas turbine engines for power production and airplane propulsion, micro compressors for analytical instruments, and rocket engines for spacecraft and micro-launch vehicles.

Professor Ian Waitz and his students have demonstrated an innovative technique for reducing the noise generated by jet engine turbomachinery. They have achieved a 10 decibel reduction in the tonal noise of a test fan in the MIT Blowdown Compressor Facility, a level of large practical significance. NASA now plans to build a large scale version of the MIT invention and test it in a national windtunnel.

Professors James Paduano, Alan Epstein and their students have demonstrated active stability control on a full scale jet engine, showing for the first time that with active feedback stabilization, an engine can be safely operated in a normally unstable regimes.

Professor Jack Kerrebrock showed that his new approach to turbine cooling, evaporative cooling, will work at heat flux levels approaching those encountered in modern jet engines.

Professor James Paduano, his collaborators, and students, have won the best paper award from the American Society of Mechanical Engineers International Gas Turbine Institute. This is the seventh award the laboratory has received from the ASME since 1990.

LEAN AEROSPACE INITIATIVE

The LAI project, initiated in September 1993 is a consortium of sixteen aerospace companies, fourteen U.S. government agencies, labor and MIT with the vision "To significantly reduce the cost and cycle time for military aerospace products throughout the entire value chain while continuing to improve product performance." Research is being conducted by twenty faculty from the Schools of Engineering and Management, twenty-one graduate students from Courses 2, 15, 16, TPP, TMP and SDM, and six research staff members from the Center for Technology, Policy and Industrial Development. This year, LAI expanded in scope to include the space sector (satellites and launch systems) in addition to the previous airframe, engine and avionics/missiles sectors of the original Lean Aircraft Initiative. The Lean Enterprise Model (LEM), an organized compilation of LAI research findings and other related information, was reworked and released as a web based product. Further information on LAI can be found **at http://web.mit.edu/lean/.**

LEAN SUSTAINMENT INITIATIVE

The Lean Sustainment Initiative (LSI) is a joint Air Force Material Command (HQ AFMC/LGL), Air Force ManTech, and MIT project. LSI was started in May, 1997. During the first year of LSI, the project baselined the current Air Force logistics and sustainment system, assessed the status of key initiatives to bring about major performance improvements and identified high-payoff opportunities for implementation of lean concepts. The project also established the necessary first step for defining research directions and priorities leading to fundamental longer-term changes. The research agenda has incorporated the specific expectations expressed by the leadership of the Air Logistics Centers (ALCs), within the context of characterizing the current logistics system. The current system is defined broadly to encompass both the organic base and the support infrastructure associated with it; this includes the commercial sector providers of contract repair services, service parts logistics, and transportation and distribution services engaged in sustainment support for the Air Force. Primary research focus was concentrated on the organic repair base.

MAN VEHICLE LABORATORY

MIT is one of the seven institutions in NASA's new National Space Biomedical Research Institute, headquartered at Baylor College of Medicine. Professor Larry Young of MIT is NSBRI's first Director. Dr. Charles Oman (XVI/CSR) and Professor Richard Cohen (VI/HST) lead NSBRI's multi-investigator, multi-institutional Neurovestibular and Cardiovascular research programs, respectively. Professor Newman is collaborating in a bone biomechanical modelling project. NSBRI supports a total of five new MVL research projects. Education and outreach activities are planned during the coming year. In the area of aerospace technology, an Advanced Dynamic Load Sensors Experiment has been conducted on the MIR space station to assess the impact of human space activity on the space station (Prof. D. Newman). Results indicate that microgravity disturbances on ISS will be less than previously thought. A new anthopmorphic robot has been acquired for research on the biomechanics of EVA. Dr. Oman's experiment on human visual orientation was successfully conducted on the STS-90 "Neurolab" mission flew in April, and represented the first use of virtual reality technology in space. Dr. Andy Beall played a major role. A follow on experiment using the Human Research Facility virtual reality suite on the International Space Station is now also in development, in collaboration with colleagues from France and Canada. Meanwhile, ground based research continues on human spatial orientation in real and human factors. A FAA flight and simulator research on cockpit displays for vertical navigation has been conducted, in collaboration with the Volpe Research Center (Dr. C. Oman). A new NASA project on advanced displays and controls for virtual microgravity simulation has been initiated (Drs. Oman and Beall).

SPACE POWER AND PROPULSION LABORATORY

The Space Power and Propulsion Laboratory (SPPL) is a part of Space Systems Laboratory (SSL) which focusses on interactive problems related to the propulsive and power generating systems of spacecraft. The Propulsion activity has continued to focus on various aspects of Electric Propulsion and space mission planning.

Our very small (50W) Hall thruster, has been subjected to a first series of performance tests at the Air Force Phillips Laboratory, in California. Results are being analyzed. A new trust balance has been fabricated for use in the

Astrovac facility in Bldg. 33, and is in final assembly; this will allow in-house testing and design iteration on our small thrusters, beginning with the 50 w. Hall thruster.

Theoretical work has continued on alkali-seeded hydrogen arcjets, which offer high efficiency potential at moderate specific impulses. Two-dimensional model results confirm the favorable characteristics previously found using simplified 1-D analysis, and open the way for consideration of laboratory tests of the concept.

A study was completed of the potential of microfabricated ion engine clusters for powering very small satellites, and of the performance and economic benefits of local clusters of such satellites to replace larger single satellites. The micro-ion engines were found to be unattractive due to their unfavorable performance scaling.

Hall thruster PIC models have been extended and refined, and were applied to guide design efforts and data evaluation at BUSEK, Inc. A program of experimental probing of internal plasma properties in Hall thrusters was completed in cooperation with the Air Force Phillips Laboratory at Edwards AFB, CA. Detailed comparisons are being conducted between these data and the 2-D model predictions. Our previously developed code to analyze the effects of Hall thruster plumes on spacecraft has been extended to allow it input thrust exhaust profiles to be directly provided by the 2-D Hall thruster code.

The Laboratory is participating in an advisory capacity in the design of a bare tether demonstration mission that will fly in 1999 as a secondary Delta payload. The mission grew out of theoretical studies by Prof. Martinez-Sanchez and visiting professors J. Sanmartin and E. Ahedo on a novel design containing a long bare section for electron capture. A related ongoing activity is the development of a particle simulation code that will analyze the capture of electrons from the ionosphere by the bare tether, in the presence of the plasma reactive velocity and of the Earth's magnetic field.

In collaboration with the Draper Laboratory, a new Health monitoring system for large liquid propellant rockets has been developed. The system is a model-based algorithm capable of distinguishing between sensor and plant failures, and it uses data from sensors that monitor the engine's thermodynamic data. An extension is underway to incorporate vibration data, which have faster and much less damped dynamics.

SPACE SYSTEMS LABORATORY

Submicron Dynamics and Thermal Snap Response of Deployable Truss Structures

The hunt for Earth-like planets orbiting other is one of the primary objectives of NASA_s Origins Program, which will launch a number of space-based observatories, starting early in the next decade. Due to the size constraints imposed by the payload bay of carrier spacecraft, these telescopes will undoubtedly require some form of on-orbit deployment mechanism, including joints or hinges which will introduce non linearity to the structure. The success of the Origins missions will hinge on whether positioning of the optical elements can be maintained to within fractions of the viewing wavelength. Consequently, any minute disturbance will pose a serious threat to the stability of the precision optical systems. Acquiring a better understanding of the effects of damping and structural nonlinearities on the submicron-level dynamics is therefore essential to the telescope design.

The overall objective of the ongoing research is to perform an experimental and analytical investigation of the microdynamics of deployable truss structures. Specifically, the main goal is to characterize the dynamic response of such nonlinear structures at sub-microstrain levels of mechanical and thermal excitation. In the case of mechanical excitation, the response will be characterized in terms of modal parameters (the natural frequency and damping ratio). The response to thermal excitation will be characterized in the time and frequency domains.

Distributed Satellite Systems

The goal of the program in Distributed Satellite Systems (DSS) is to identify the functions within spacecraft and between spacecraft that can benefit from distribution. Over the past several decades, the computer industry has evolved from using large, expensive mainframes for solving computationally intensive problems to using smaller, cheaper, more adaptable distributed sets of workstations collaborating to solve equivalent sized problems. Likewise, DSS will demonstrate how distributed arrays of smaller, cheaper spacecraft can achieve the same missions as current larger, more expensive, monolithic spacecraft with improved performance at lower cost.

To achieve this goal, the DSS program employs systems analysis concurrently with experimental work. Presently, U.S. Air Force space missions are being classified according to how much they might benefit from distribution, and metrics for evaluating DSS designs are being developed. All experimental work is done with the DSS Testbed. Phase I of the Testbed, which demonstrated the capability to perform acoustic interferometry, has been completed. Phase II of the Testbed, which will demonstrate achieving function with a distributed system of "satellites," is currently being designed with construction to begin later in the summer. Future milestones include developing software for controlling distributed satellite systems, designs of actual DSS missions, and a possible space flight experiment.

NASA: Advanced Spacecraft Architectural Concepts
The goal of the ACRP is to develop Advanced Spacecraft Architectural Concepts (ASAC) using Modular & Multifunctional units (MMSC). Functions conventionally provided by various specifically designed single function components are integrated into standardized modules. Given spacecraft functionality requirements and technical specifications, the spacecraft can then be built by assembling these basic modules together. Interfaces among these modules can also be standardized to allow easy assembly as well as flexibility for the spacecraft design.

To achieve this goal, the ASAC project moves forward in three phases. Phase I, which has already been completed, included a review of current NASA spacecraft architectures, identification of spacecraft missions and subsystems that could benefit from the MMSC concept, and requirements definition. Phase II, currently underway, consists of designing the MMSC modules and developing the interfaces and protocols between modules. Phase III will culminate with a full end-to-end design of a NASA science mission using MMSC concepts developed in Phases I and II.

Active Acoustic Load Launch Alleviation
The MIT Space Systems Lab (SSL) is teamed with Air Force Phillips Lab and McDonnell Douglas Aerospace on the Active Acoustic Launch Load Alleviation (AALLA) project. The goal of the project is to reduce the acoustic loads on spacecraft during launch by controlling the transmission and reflection of sound through the payload fairing. If successful, this research could significantly reduce the loads that account for more than 40% of first-day spacecraft failures.

An impedance matching control method is being developed for this project. This method is unique in that it only requires knowledge of the fairing structure and local acoustic coupling. In addition, sensors are only required on the fairing, not on the payload where they may interfere with deployment or performance. Currently, research at MIT is focused on proving the impedance matching concept through experiments in an acoustic test chamber.

Precision Space Telescope Testbed
The MIT Space Systems Laboratory has designed and constructed a testbed whose structural dynamic response is similar to that of proposed next generation space telescopes: the Space Interferometry Mission (SIM) and the Next Generation Space Telescope (NGST). The research goal is to address challenges faced by NASA's Origins Program telescopes in areas related to dynamics and control, and to ensure that the results are applicable to these missions.

The testbed is designed to be as satellite-like as possible, and is neutrally stable at its axis of rotation to enable a one-axis slew maneuver. A reaction wheel assembly mounted at the bottom of the spacecraft bus section is used to slew the testbed. Disturbances traceable to those anticipated for the next generation space telescopes are engendered by the reaction wheels. The testbed's performance is measured with an optical system, which simulated the optical train of the space telescopes.

Dynamics and Control Analyses of Space-based Interferometers
Interferometry provides the means for significant advances in astronomy. In order to ensure that stringent performance and stability requirements are satisfied, future structurally connected space borne interferometers will rely heavily on modeling and analysis efforts conducted during early design phases. Work is underway to support the Jet Propulsion Laboratory (JPL) in developing modeling and analysis tools that can be applied to the proposed Space Interferometry Mission (SIM) and validated on the JPL Micro-Precision Interferometer (MPI) testbed and the MIT Origins testbed. Specific areas of work include: (1) reaction wheel disturbance modeling, (2) disturbance,

sensitivity, and uncertainty analysis methodologies, (3) system optimization techniques, (4) organization of complex, integrated models, and (5) uncertainty model creation from experimental data.

Middeck Active Control Experiment Reflight

The MIT Space Systems Laboratory (SSL) and Lockheed Martin Missiles and Space have teamed up to refly the Middeck Active Control Experiment. MACE was originally flown on STS-67 in March 1995 with the objective of goal exploring approaches to achieving high precision pointing and vibration control of future spacecraft and satellites. MACE Reflight, slated for launch in late 1999, will extend the results of the original experiment.

Advanced nonlinear modeling and control techniques will be demonstrated on the test article for MACE Reflight. Extensive ground testing will preceed the on-orbit experiments to validate models and controller designs. Currently MACE hardware and software are updated to accommodate different control design techniques. Research focuses on two major areas; firstly the modeling of nonlinear multibody flexible structures, and secondly the isolation of disturbances caused by reaction wheel imbalances.

TECHNOLOGY LABORATORY FOR ADVANCED COMPOSITES

Over 45 students were involved in TELAC during AY 97/98 including 16 graduate students, over 20 UROPers, and a number of students in 16.621/2 who performed their projects in TELAC. Five students finished their master's theses in the laboratory during this period and one doctorate was completed. In addition, the laboratory was host to a visiting faculty member, Pin Tong of the Hong Kong University of Science and Technology, for a brief period in the late spring and to several visiting international students through the year. The laboratory issued a total of 14 reports during this period including a number accepted for publication in journals and proceedings. Laboratory personnel participated in conferences at the national and international level giving a total of 9 presentations. Included in these was an invited briefing to the Aeronautics and Space Engineering Board of the National Research Council given by Mark Spearing. The new approach to the design of composite structures which has been developed by the laboratory faculty over the past several years was further described with a focus on failure and durability. This approach continues to be presented and discussed around the country and the world and is continuing to receive widespread acceptance and support. Of note in this regard was a panel hosted by Paul Lagace and Mark Spearing at the International Conference on Composite Materials in July of 1997 where several world-renowned experts discussed the current drawbacks, needs, and the future of the failure of composites. Over 300 people participated in this discussion. A paper based on the discussion is being developed. Mark Spearing also participated in a panel discussion on fatigue life prediction of composites at the AIAA Structures, Structural Dynamics, and Materials meeting in the spring. The faculty continue to build further on this overall thrust and have currently acquired early sponsored work in this general area. Important progress was made in a number of research areas throughout the year. These include the development of mechanism-based models for the elevated temperature fatigue of titanium-graphite hybrid composite laminates; the initiation of work on the damage tolerance of composite sandwich structures used in secondary aircraft structures; early work investigating the reliability of solder and adhesive joints under piezo-loading; the development, implementation, and testing of a piezoelectric wafer attachment for model high-speed composite compressor blades for aircraft engines; further development of integrated fire damage modeling; a completion of the modeling of the degradation of polymer matrices exposed to high temperatures and the verification of such by experiments; further modeling and associated experiments for the combined effects of thermo-hydro-mechanical cracking of composite laminates; the development of a cryogenic thermal cycling facility; the development of models for the charging of composite spacecraft structures; and the completion of experimental and numerical work to better understand composite shell response to transverse loadings which simulate damage-causing impact events. Once again, a significant event during the year was the "Student Symposium on Composite Materials" held for the third time this year with continued participation by and between the students working on composites at Virginia Tech and those in TELAC at M.I.T. This year the event went back to Virginia Tech and was held in late May after a postponement in March due to a New England snowstorm which prevented travel. This year, the University of Maryland was invited to participate on a trial basis and Professor Tony Vizzini and two of his students attended. Tony is a graduate of the laboratory and earned his doctorate with Paul Lagace in 1986.

WRIGHT BROTHERS WIND TUNNEL

The primary test activities fell into two classes. The first is the use of the wind tunnel for educational purposes. In the past year there were no 16.621-16.622 projects.

The second were commercial use of the wind tunnel as described below.

- Sanders Associates: Evaluation of aerodynamic braking
- Environmental Protection Agency: Calibration of stack gas pressure and flow angle probes over a realistic Reynolds number range.

The Wright Brothers Wind Tunnel is the only privately owned pressurized wind tunnel in the United States. This feature gave use to an extended program with the Environmental Protection Agency to calibrate their smoke stack probes at the same Reynolds number as encountered in use. That is, the Reynold's number in a hot stack gas can be simulated by testing in air at low pressures.

The commercial testing used 104 wind on hours this year.

DEPARTMENT AWARDS

UNDERGRADUATE

The student chapter of the American Institute of Aeronautics and Astronautics (AIAA) awarded the department's undergraduate teaching award to Prof. Winston R. Markey. Prof. Paul A. Lagace received the chapter's departmental advising award. Both Markey and Lagace are prior recipients of the teaching and advising awards. Prof. Mark Drela received the Sigma Gamma Tau Honor Society Graduate Teaching Award.

The following undergraduates were inducted this academic year into the Sigma Gamma Tau Honor Society. They are: Keith Amonlirdviman, Marc V. Berte, David A. Carpenter, Mark A. Kepets, Ching-Chieh Lu, Jacob Markish, Brian D. McElwain, Philip J. Ogston, Sumita Pennathur, Bradley M. Pitts, Jeffrey G. Reichbach, and Julie A. Wertz. The following were elected officers: Scott A. Uebelhart - President, Stephanie J. Thomas - Vice President, Jonathan K. Wong - Secretary, and Marshall D. Brenizer - Treasurer.

Senior Takayuki Kohata was invited to join the Xi Chapter of the Phi Beta Kappa Society for his excellence in academic achievements.

The David J. Shapiro Memorial Award was given to --David A. Carpenter, a sophomore from Tyler, TX, for support and enhancement of scientific/technical studies" at the Imperial College of Science, Technology and Medicine, London, England; Phillip E. Reich, a junior from El Cajon, CA, "for support to pursue research on flight control and stability systems" at the European Space Agency, Noordwijk, Holland; Tyra E. Rivkin, a junior from Hoffman Estates, IL, "to design, analyze, construct, and test airframe configurations to provide a better understanding of MAV (Micro Aerial Vehicles) aerodynamic qualities;" and a team of three students -- freshman Bernard F. Ahyow of Irvine, CA, sophomore Jacob Markish of Chelmsford, MA, and junior Philip J. Ogston of Kalamazoo, MI, "to design, build, and fly a high speed electric powered model aircraft in the 1998-1999 AIAA/Cessna/ ONR Student Competition."

The Apollo Program Prize was given to Sean C. Tytler, a senior from Plantation, FL, "in recognition of his Undergraduate Research Opportunities (UROP) contributions to the definition of an artificial gravity research program, as part of the further human exploration of space."

The Yngve K. Raustein Award is given this year to Sumita Pennathur, a sophomore from Foxborough, MA, "whose enthusiasm and outstanding achievement in Unified Engineering, while simultaneously pursuing her life-long love of music, exemplifies the spirit that Yngve brought to Unified Engineering."

The Andrew G. Morsa Award was presented to seniors David M. Matsumoto from Kapolei, HI, and Alvar Saenz-Otero from San Jeronimo, Mexico "for demonstrated ingenuity and initiative in the application of computers to actively stabilize and control a tethered grapple."

The Thomas B. Sheridan Award (shared with Mechanical Engineering) was recently established by Prof. Tom Sheridan to recognize "creativity in the improvement of human-machine integration or cooperation". The award was presented for the first time by Prof. Sheridan himself to junior Keith Amonlirdviman "for creativity in the

development of a distributed simulation facility, including a unique simulation control interface, which integrates cockpit and Air Traffic Control simulators to enable interactive studies of pilot and controller decision aids."

The newly-established Pratt & Whitney Award "for outstanding achievement in the design, construction, execution, and reporting of an undergraduate experimental project" was given to Paraag M. Dave of Sutton-Surrey, UK, and Kelvin B. Khong of Bukit Batok, Singapore. Messieurs Dave and Khong are exchange students from Imperial College, London, England.

The Admiral Luis De Florez Prize's recipients are senior Seth Kessler of Farmington Hills, MI, and junior Thaddeus B. Matuszeski of Washington, D.C. "for the conception, design, equipment design and acquisition, and execution of cryogenic tests of composite materials in direct support of the X-33 program". Seniors Erik S. Bailey of Reading, PA, and Todd S. Harrison of Hattiesburg, MS, also shared the prize "for the design, construction, and testing of a novel load cell, and its application to low-speed airfoil experiments."

The James Means Memorial Award recognizes excellence in flight vehicle engineering and in space systems engineering. This spring, students teamed up to work on the X-Prize Competition -- the first international prize to promote the development and flight of vehicles able to provide low-cost commercial transport of humans into space. The department's Means award was given to junior Keith Amonlirdviman of Chicago, IL "for creation of an outstanding trajectory simulation program to study X-Prize vehicle mission and design configurations and for excellence in the aerodynamic design of the X-Prize vehicle." Senior Christopher E. Carr of Seattle, WA, also received the Means award "for leadership in developing the business plan as a key driver for the X-Prize vehicle design."

The Henry Webb Salisbury Award was given to seniors Takayuki Kohata of Yokohama-Shi, Japan, and Christopher S. Protz of Panama City, FL, "for achieving academic excellence in the Department of Aeronautics and Astronautics."

OTHER AWARDS

Mr. Nicholas Savoulides, a senior from Athens, Greece, was awarded the John F. McCarthy Jr. '50 Memorial Scholarship; and Ms. Viengvilay Oudonesom, a junior from Houston, TX, received the General James H. Doolittle Memorial Scholarship. Ms. Adriane J. Faust, a senior from Ellicott City, MD, completed her second year as the recipient of the James E. Cunningham '57 Memorial Scholarship

GRADUATE TEACHING FELLOWSHIPS

Fall 1997

Anand Karasi	Edward Taylor Teaching Fellow
Reid Noguchi	Raymond Bisplinghoff Teaching Fellow
Jennifer Rochlis	Judy Resnik Teaching Fellow
Micail Tryfonidis	Charles Stark Draper Teaching Fellow

Spring 1998

Anand Karasi	Edward Taylor Teaching Fellow
Reid Noguchi	Raymond Bisplinghoff Teaching Fellow
Jennifer Rochlis	Judy Resnik Teaching Fellow

FUTURE PLANS

The department has now established its strategic direction and refined the implementation plans for new thrusts in System Engineering and Architecture, Information Engineering, the Engineering Context of Education, Research and Educational Program. The next year will focus intensely in recruiting the faculty to implement this new vision, implementing the action plans, and forging relationships with industry necessary to accomplish our goals.

Robert A. Brown

DEPARTMENT OF CHEMICAL ENGINEERING

The academic year 1997-98 was one of high productivity. We again were number one amongst chemical engineering departments in the *U.S. New and World Report* academic survey. We graduated 44 doctoral candidates which is the highest record in six years, together with 44 M.S. students totals 88 advanced degrees. A record research dollar volume of over $22 million was reached to support department research activities.

The Department of Chemical Engineering and the Department of Materials Science and Engineering combined their administrative units last year into a single Administrative Service Organization (ASO), directed by Ms. Elizabeth Cooper. The ASO has moved to its new and permanent quarters located centrally between the two departments at the 4th floor junction of buildings 16 and 8. The shared functions were expanded to include computer support services.

The department's total undergraduate enrollment stands at 317 students with approximately 100 students per graduating class with an equal balance of men and women. Preregistration for the next year indicates that our class size will continue at the same size.

The graduate student enrollment is stable at 218 students with 167 in the doctoral program and 51 master's students, most of who are in the David H. Koch School of Chemical Engineering Practice. This year we received 435 applications for our graduate program, offered admission to 72 students and had 46 accept our offer. The yield of 63% is the highest of any chemical engineering department.

The David H. Koch School of Chemical Engineering Practice has continued to develop an international flavor with sites in Japan, Germany and France during the past year. In addition, it has served as a model for initiation of a program in Thailand.

The Biotechnology Process Engineering Center (BPEC) has moved from building 20 to the fourth floor of Building 16 into newly renovated facilities and is now fully contiguous with the department. We completed consolidation of Chemical Engineering faculty and students into contiguous space. Prof. Daniel I.C. Wang, the founder of the Center, is retiring as the Director and Prof. Douglas Lauffenburger will assume the BPEC directorship.

Two new faculty have joined the department this year: Professors William Green and Bernhardt Trout. In addition, Dr. Kenneth Beers, a recent graduate from the University of Wisconsin has accepted our offer and will join us as an assistant professor following a post doctoral period at the ETH in Zurich. Prof. Edward Merrill, who continued to teach in the polymer area after his retirement two years ago will retire from teaching at the end of this academic year after a distinguished teaching career.

Our faculty has continued to distinguish themselves during the past year. Professor Robert Brown was named as MIT's next Provost. Three of our faculty have been promoted to associate professor with tenure; these are: Professors Linda Griffith, Gregory Rutlege and Jackie Ying. Amongst the many awards received by our faculty this year are the Lemelson-MIT Prize for Invention and Innovation awarded to Prof. Robert Langer who also gave the Killian Award Lecture this year. Prof. Jack Howard was awarded the Doctor Honoris Causa at the University of Haute-Alsace in Mulhouse, France; Prof. Paul Laibinis received a Camille Dryful Teacher-Scholar Award.

UNDERGRADUATE EDUCATION

For the year 1991-92, sophomore enrollment was 96, juniors 72, seniors 58, total 226: 1992-93 sophomores 95, juniors 89, seniors 81, total 265; 1993-94 sophomores 115, juniors 90, seniors 84, total 289; 1994-95 sophomores 108, juniors 104, seniors 100, total 312; 1995-96 sophomores 118, juniors 101, seniors 103, total 322; 1996-97 sophomores 87 juniors 121, seniors 110, total, 318; 1997-98 sophomores 97, juniors 90, seniors 130, total 317.

Enrollment has leveled off at about 100 students per class, and we continue to have balanced classes of about equal numbers of men and women. UROP activity remains high, with about one-third of our students participating each term. Much of this activity is in the biomedical and biochemical areas.

We are continuing our sophomore advising seminars, patterned after the very successful Freshman Seminars. Our sophomores meet with their advisors one per week in the fall term to explore what Chemical Engineering is about and to get to know each other. Advising loads, as well as teaching loads, remain heavy due to our very high student-to-faculty ratio.

Our Senior curriculum, featuring the Integrated Chemical Engineering subjects 10.490 and 10.491, was honored this spring by vote of the students in an Institute-wide competition with the award of the Big Screw. The criterion for this award is some mixture of amount learned and time spent, and the Department is pleased to have our efforts on behalf of the students so recognized.

GRADUATE EDUCATION

In the 1990-91 year, Masters enrollment was 59, Doctoral enrollment was 164, total 223; 1991-92, Masters 37, Doctoral 164, total 201; 1992-93 Masters 51, Doctoral 159, total 210; 1993-94, Masters 62, Doctoral 147, total 209; 1994-95, Masters 64, Doctoral 166, total 230; 1995-96, Masters 56, Doctoral 169, total 225. 1996-1997 Masters 64; Doctoral 162; Total 226; new numbers Masters 51, Doctoral 167, Total 218.

The total for 1997-98 includes 62 foreign students, 50 female students, and 10 minority students (not including Asian Americans). Graduate admissions data suggests that graduate enrollment will remain in the low 200s for the next several years.

A total of 34 students participated in the David H. Koch School Of Chemical Engineering Practice School Program during the 1997-98 sessions. This has been a year of flux for the Practice School with the closing of old operations and opening of new stations, at both domestic and international locations. The Dow Station continued year-round operations at the Freeport, TX, site, but will be closing at the end of Summer 1998 at our request because of restrictions placed on the placement of foreign nationalities at the Station. The Dow station is to be replaced by a station at GE Plastics in Mt. Vernon, IN, beginning in Fall 1998. The Merck operations in West Point, PA, ended with the Fall 1997 session, to be replaced by a station at Rhone-Poulenc Central Research facilities in Lyon France. Summer stations were established at Koch Refining Company in Corpus Christi, TX, and at Bayer in Leverkusen, Germany. We also returned to the Mizushima facilities of the Mitsubishi Chemical Corporation in Japan following our very successful operations there last year. The new emphasis on international stations highlights the recognition of the importance of globalization in today's economy, and provides selected students with an exposure to alternative corporate cultures. These stations provided a wide variety of excellent projects and opportunities for the students. Dr. Chris Quinn (Dow) and Dr. John Friedly (Merck, Rhone-Poulenc, Mitsubishi) continued to serve as station directors, while Dr. Barry Johnston, a Senior Lecturer in the Chemical Engineering Department and former Dow Station Director, assumed responsibility for the Koch and Bayer summer stations. Chemical Engineering graduate students Hilton Pryce-Lewis and Alejandro Cano-Ruiz, were appointed as Assistant Station Directors at the Koch and Mitsubishi stations, respectively. Professor T. Alan Hatton continues to direct the Practice School from Cambridge. The Chemical Engineering Practice School program established last year in Thailand for the training of Thai engineers for the local industries has had a successful start; MIT faculty have served in an advisory capacity to assist in the development of this program, which is independent of MIT.

FACULTY NOTES

Professor Robert Armstrong gave a keynote lecture at the XIIth International Congress on Rheology in Quebec in August. Later in the year he gave a keynote lecture at the 50th Annual Conference of the Society of Imaging Science and Technology. He also gave a seminar to the Department of Chemical Engineering at Clemson University and the Department of Macromolecular Science of Case Western.

Professor Paul I. Barton gave an invited lecture at Aspen World, Boston, October 1997. He advised the Dow Chemical Company Materials Science Technical Advisory Board on the topic of flexible plants.

Professor Janos M. Beer has been reappointed to the National Coal Council, the Advisory Council of the Secretary of Energy. He has been awarded the degree of Doctor Honoris Causa by the Technical University of Budapest, Hungary.

Professor Daniel Blankschtein was an invited plenary speaker at the "Advanced Technology Conference Europe" held in London in April 1998 and was also an invited speaker and session chairman at the 12th International Symposium on "Surfactants in Solution" held in Stockholm in June 1998. Professor Blankschtein received the 1998 Outstanding Faculty Award from the graduate students of the Department.

Professor Howard Brenner was an Invited Lecturer at the "Mechanics of Nonlinear Materials" Symposium held in Banff, Canada, as well as at the "13th Canadian Conference on Fluid Mechanics" in Vancouver, Canada. This was in addition to seminars presented at the University of Michigan, University of Florida, Columbia University and Princeton University. He also served as Chair of the Awards Committee of the National Academy of Engineering and organized and chaired the John Happel (MIT, 1929) 90th Birthday Festschrift Symposium held in New York City.

Professor Robert A. Brown continued to serve as Dean of Engineering at MIT throughout the academic year 1997-1998 and will become Provost at MIT effective August 1, 1999. He was elected to the Executive Board of the Engineering Dean's Council of the ASEE and served on the InternationalAcademic Advisory Panel (IAAP) to the Government of Singapore. Bob also served as chair of the first "Frontiers of Engineering," meeting sponsored jointly by the US National Academy of Engineering and the German Reseach Association. The meeting was held in Dresden, German in May 1998. Professor Brown also gave the Founders Lecture at the University of Wisconsin in 1998.

Professor Robert E. Cohen presented an invited lecture at the International Conference on Rubbery Materials in Calcutta India in December of 1997. The topic of the lecture was the use of rubbery to toughen thermoplastic materials. In October of 1997 Prof Cohen won the Best Paper award for a lecture delivered at the Society of Plastics Engineers Regional Technical Meeting in Montreal, Canada. In the area of assisting K-12 education in science and technology, Professor Cohen was named to the Board of Trustees of the Advent School, a small, private K-6 school in the Beacon Hill neighborhood of Boston. He was also elected to the Board of Directors and named Scientific Advisor to the William and Mary Greve Foundation of New York City.

Professor Charles L. Cooney continues to serve as the Executive Officer of the Department. He was chair of the Institute Committee on Corporate Relations, a member of the Council on Industrial Relations and on the Board of the Community Services Fund. He is the Director of the Consortium for Advanced Manufacturing of Pharmaceuticals (CAMP) an industry consortium jointly run with Purdue University to support research on pharmaceutical manufacturing. He was elected to the Board of Astra AB in Stockhom.

Professor William M. Deen completed his graduate textbook, Analysis of Transport Phenomena, which was published by Oxford University Press in February. He gave a seminar in the Department of Chemical Engineering of the University of Texas at Austin.

Professor Karen K. Gleason was an invited lecturer at the Materials Research Society in San Francisco, the Electrochemical Society Meeting in San Diego and the Advanced Metalization and Interconnect Systems for ULSI Applications, also held in San Diego. Other invited lecture were given at the Semiconductor Safety Association, the Federation of Analytical Chemistry and Applied Spectroscopy and at Tokyo Electron Limited (Japan). In August 1998, she will be chairing the Gordon Conference on Diamond Synthesis in Oxford, UK.

Professor William H. Green joined the faculty, and presented invited lectures at the California Institute of Technology, the University of California at Los Angeles, Wayne State University, and the Naval Research Laboratory. His research on chemical kinetic simulations attracted industrial interest, leading to collaborations with Dow, Exxon, and Ford.

Professor Linda G. Griffith gave the ASAIO lecture last spring at the American Society for Artifiical Internal Organs, and was co-chair of the Keystone Symposia on Tissue Engineering in January. She is the PI on a newly-funded $4.5M grant from DARPA to develop tissue-based biosensors; the project involves several faculty from Toxicology, the School of Engineering, the Whitehead Institute, and Harvard Medical School. She is continuing to work with an MIT graduate to commercialize her novel approach for creating in vitro vascularized tissue for

applications in vitro drug metabolism and toxicology testing, and high-throughput screening. She was also promoted to Associate Professor with tenure.

Professor Paula T. Hammond presented her work on SAMs as Templates for Patterned Ionic Multilayer Films as an invited speaker at the Organic Thin Films Gordon Conference. Her work in this area was featured last fall as an article in The Chemical and Engineering News, and has also been featured in Young Scientist. Prof. Hammond gave invited talks at the 5th NSF Materials Chemistry Workshop, and also took part in a special NSF Workshop on Materials Design and Processing at the Nano and Mesoscales through Self Assembly. She has chaired sessions for the Polymers (East) Gordon Conference, as well as the AIChE Annual Meeting, and has given numerous invited talks at universities and companies.

Professor Jack B. Howard continued to serve as Director of the Center on Airborne Organics which, in July, held a Symposium on "Fine Particles in the Atmosphere". He served on a NASA panel evaluating the design for research facilities on the International Space Station. He was inducted into the University of Kentucky Engineering Hall of Distinction and was awarded Doctor Honoris Causa at University of Haute-Alsace in Mulhouse, France.

Professor T. Alan Hatton continued to serve as Director of the School of Chemical Engineering Practice at MIT, and as a member of the Advisory Board of the Chemical Engineering Practice School program of the King Mongut University of Technology Thonburi in Bangkok, Thailand. He served on the organizing committee of the Engineering Foundation Conference on Separation Technology (October, 1997), and was Vice Chair and Discussion Leader of an NSF Workshop on 'Materials Processing at the Nanoscale Through Self-Assembly' in January, 1997. He is Co-Chair of the 73rd ACS Colloid and Surface Science Symposium to be held at MIT in June 1999 (with Professor Laibinis), and of the second Engineering Foundation Conference on 'Structured Fluids and Interfaces' to be held in January 2000. Invited talks were given at the Department of Chemical Engineering, National University of Singapore, Singapore (September 1997), the Symposium on 'The Energy Industry of the 21st Century: Impact on the Chemical Industry', Tarragona, Spain (October 1997), the Engineering Research Foundation Conference on 'Separation Technology'in Davos, Switzerland (October 1997), and the Osaka University Macromolecular Symposium in Osaka, Japan (June 1998). Professor Hatton served as the US Editor for Colloids and Surfaces A, and on the editorial board of Current Opinion in Colloid and Interface Science, and was appointed to the editorial boards of The Journal of Clean Products and Processes, and of Separation Science and Technology.

Professor Klavs F. Jensen was elected as Chair of the Materials Engineering and Sciences Division of the American Institute of Chemical Engineers for 1997. He was an invited lecturer at the International Conference on Computational Physics and the Materials Research Society Meeting, as well as workshops on multiscale modeling of materials processing and microfabricated chemical systems. He continues to do collaborative research with M.G. Bawendi (Chemistry) on quantum dot synthesis and devices, and Martin A. Schmidt (EECS) on microfabricated chemical systems.

Professor Paul E. Laibinis received a Camille Dreyfus Teacher-Scholar Award in 1998 for his research accomplishments and teaching developments. He was an invited speaker at the Engineering Foundation Conference "Surface Characterization of Adsorption and Interfacial Reactions II" and presented invited lectures at Northwestern University, Lehigh University, Wayne State University, and various industrial laboratories. Professor Laibinis serves on the Editorial Board of the journal Colloids and Surfaces A.

Professor Robert S. Langer was awarded the Lemelson-MIT Prize for Invention and Innovation and the The Nagai Foundation Tokyo International Prize. He gave the following named lectureships: Wagner Lectures (University of Michigan), Ewing Halsell Foundation Lecture (University of Texas), Marcus Memorial Lecture (Washington University), Joseph Stokes, Jr. Lecture (University of Pennsylvania), William J. Rashkind Memorial Lecture (American Heart Association), Leah Lowenstein Lecture (Boston University School of Medicine). Dr. Langer gave the 1998 National Science Foundation Engineering Distinguished Lecture and The Ford Motor Company Distinguished Lecture. He gave the Keynote Lectures at the Society of Biomaterials, Keystone Symposia on Tissue Engineering and Wound Healing, and the IBC Tissue Engineering Conference. Dr. Langer gave Plenary Lectures at the Annual Meeting of the American Association of Pharmaceutical Scientists and the National Research Council Forum on the Promise and Dilemna of New Materials.

Professor Douglas Lauffenburger, also Director of the MIT Center for Biomedical Engineering, is serving as President of the Biomedical Engineering Society. In this past academic year he presented the Britton Chance Distinguished Lecture in Biomedical Engineering at the University of Pennsylvania and the keynote presentation at the annual Houston Conference on Biomedical Engineering.

Professor Gregory C. Rutledge was promoted to Associate Professor withTenure effective July 1, 1998. Over the past year he organized the secondMultidisciplinary Workshop on Molecular Modeling of Polymers, sponsored by the American Chemical Society, and served as co-chair for the Workshop on Multiscale Materials Modeling, sponsored by the Institute of Theoretical Physics. He also co-taught an ACS short course on molecular modeling of polymers. He presented seven invited lectures to academia and industry and, with two graduate students, received the Best Paper Award of the Plastics Analysis Division of the Society of Plastics Engineers at their annual technical meeting in Toronto. Prof. Rutledge continues to serve on the editorial advisory board for Polymer.

Professor George Stephanopoulos served as the 1997 Chairman of AIChEís CAST (Computing And Systems Technology) Division, and he launched as Founding Editor (with Prof. John Perkins of Imperial College) the Process Systems Engineering Series, Academic Press (Series of Advanced Monographs and Textbooks). He was a keynote speaker at the NATO Advanced Studies Institute on ìNonlinear Model-based Controlî, and he gave seminars at the Chemical Engineering Departments of (i) Kyoto University, Kyoto, Japan, (ii) University of Missouri-Rolla, (iii) California Institute of Technology, (iv) UCLA, (v) UC-Davis, (vi) University of Toronto, (vii) University of Rhode Island, (viii) University of Massachusetts, Amherst, and (ix) Lehigh University. He was the keynote speaker at (a) the IFAC DYCOPS-5 (Dynamics and Control of Chemical Processes) International Conference, (b) the IFAC LSSí98 (Large-Scale Systems) International Conference, and (c) a symposium organized by Rohm and Haas Company. During 1997 he organized the Technical Advisory Board of Mitsubishi Chemical Corporation for the companyís Petrochemical and Pharmaceutical Divisions. The software system, BatchDesign-Kit, developed in Professor Stephanopoulosí Laboratory for Intelligent Systems to support batch process development in the pharmaceutical, agricultural and specialty chemicals industries, was licensed by Hyprotech Ltd for world-wide marketing and distribution. He continued his association as Honorary Fellow with the Institute of Chemical Engineering and High Temperature Processes, Patras, Greece.

Professor Gregory Stephanopoulos gave the plenary lecture at the 7th intern'l conference on computer applications in biotechnology, Osaka, May 31-June 4, 1998, a keynote address at the ACS-RAFT meeting in San Diego, Nov. 15-18, 1997, and invited lectures at the 6th Cell culture conference (San Diego, Feb7-12, 1998), at the BIO98 symposium of the Tokyo Institute of Tech. (Tokyo, June 5), and at the Foundations of computer aided process applications conference in Snowbird, July 5-10, 1998. He also published a book on Principles and Methods of Metabolic Engineering and launched a new journal on the same topic, Metabolic Engineering, both published by Academic Press.

Professor Bernhardt Trout joined the faculty in January, 1998. He has received a seed grant joint with Professor Jeff Tester and Professor Ken Smith, from the Department of Energy for computational work on hydrate formation. He is the PI on the project. He has given invited lectures at the New England Catalysis Society conference and at Mobil Technology Company.

Professor Daniel I.C. Wang was a keynote lecturer at the Recovery of Biological Products held in Tucson, AZ in October, 1997. Professor Wang delivered this lecture entitled "Awakening of the Dragon: Biotechnology in the People's Republic of China." Professor Wang also delivered the opening lecture at the Biochemical Engineering Conference X at Kananaski, Canada, in May 1997 entitled "The Role of Biochemical Engineering in the New Biotechnology." Professor Wang also participated in the MIT Industrial Performance Center's project where he led the biotechnology team resulting in the book entitled "Made By Hong Kong" which was published in April, 1997. Professor Wang was appointed as the Chairman of the Biotechnology Strategic Review Board in April , 1997 for the Republic of China. Professor Wang has also been invited to be on the International Advisory Committee of the Biotechnology Research Institute of the Hong Kong University of Science and Technology.

Professor Jackie Ying received a Union Carbide Innovation Recognition Award in 1998 for her research in the synthesis of novel nanostructured catalysts. She delivered 12 invited lectures at various international

conferences and national meetings during the past year, including the 4th International Conference on Nanostructured Materials in Stockholm and the 9th World Ceramics Congress and Forum on New Materials in Florence. She was named the Ernest W. Thiele Lecturer at University of Notre Dame, and was an invited seminar speaker at Tsinghua University, ...cole Polytechnique FÈdÈrale de Lausanne, Lehigh University and Rutgers University. Prof. Ying was recently elected to serve as the Chair of the Ceramics Area for the American Institute of Chemical Engineers (AIChE), and appointed to the Editorial Board of Journal of Nanoparticle Research. She guest edited a special volume on "Sol-Gel Derived Materials" for Chemistry of Materials and a special volume on "Advanced Ceramic Processing" for the AIChE Journal.

RESEARCH HIGHLIGHTS

BIOTECHNOLOGY PROCESS ENGINEERING CENTER

Integrating molecular cell biology and chemical engineering approaches toward effective production and delivery of biotechnology-based therapeutics is the central theme of BPEC as an NSF Engineering Research Center. A new thrust has been added in the area of therapeutic gene biotechnology, or "gene therapy". The work in this thrust is aimed at understanding fundamental principles underlying enabling breakthroughs in effective gene delivery vehicles. One major facet of this thrust is stem cell culture engineering, to learn how to expand cycling stem cells in culture bioreators to ultimately serve as gene transfection targets to be reimplanted into patients. A second facet is solving problems inherent in retroviral expression, such as instability and silencing. A third facet is creation of synthetic molecular-conjugate vehicles for plasmid delivery into cells either in vitro or in vivo, overcoming barriers currently limiting efficiency. The fourth facet is regulation of delivered transgenes by means of small-molecule control of transcription and translation.

This therapeutic gene biotechnology thrust complements the previously-established thrust in therapeutic protein biotechnology, which emphasizes advances in mammalian cell culture engineering and protein stability, formulation, and delivery. Major facets of this ongoing thrust include strategies for maximizing cell productivity and minimizing cell death in bioreactors, preventing oxidative damage to proteins, understanding issues in protein folding versus aggregation, and inventing novel delivery modes.

BPEC comprises more than a dozen investigators from the Departments of Chemical Engineering, Biology, and Chemistry and the new Division of Bioengineering & Environmental Health.

MICROFABRICATED CHEMICAL SYSTEMS: MICROREACTORS

Microfabricated chemical systems have applications both for microanalysis and chemical production. For industrial applications, they offer improved chemical performance in terms of conversion and selectivity, distributed point-of-use chemical manufacturing, and shorter development time from laboratory to commercial production. Moreover, the increased surface-to-volume ratio and heat and mass transfer characteristics introduce the potential for improved process conditions generally not accessible in conventional reactors because of the danger of thermal runaway reactions. Microfabrication could change chemical plant design from classical scale-up to ìscale-outî by replication. Conventional reactor scale-up entails going from laboratory scale to a single large reactor unit through a series of costly laboratory experiments, pilot plant stages, and simulations. Scale-out should be less expensive and faster since each reactor in the scaled-up unit would behave as it did in individual reactor testing. Microreactors may also be useful in process development as test platforms for new catalysts and process chemistry. These experiments could either form the basis for subsequent scale-out, or provide chemical kinetics data essential for scale-up to large process units.

In collaboration with Professor Martin A. Schmidt (EECS), Professor Jensenís laboratory is exploring fabrication, testing, integration and scale-up of microfluidic systems for chemical processing, specifically, reaction systems involving highly reactive compounds. As part of this effort, micro-reactors for high temperature gas-phase reactions, as well as for fast liquid- and gas-liquid phase reactions, are being developed. Another major focus is the development of packaging and control strategies for the scale-up of individual micro-reactors into large numbers of reactors operating in parallel to produce chemical products in larger volumes. The group has fabricated prototype micro-reactors for partial oxidation reactions with on-chip flow sensors, heaters and temperature sensors. Micro-reactor operation was demonstrated for model reaction systems, specifically, the oxidation of hydrocarbons and ammonia over a platinum catalyst. Investigations of ignition and extinction behavior, as a function of heater and

inlet gas composition, showed that efficient heat transfer and free-radical quenching characteristics arising from the small dimensions, provided for new and safer operation regimes relative to conventional reactors.

The group uses its previous experience with modeling conventional chemical reactors, as well as semiconductor fabrication processes at both the wafer and feature scale level, to develop two- and three- dimensional finite element simulation tools for microchemical systems. These methods have been constructed with the dual objectives of evaluating micro-chemical reactor performance relative to that for conventional reactor designs, and providing design tools for micro-chemical reactor experiments. Ongoing efforts include microreactors for screening of catalysts for liquid phase and gas phase processes. Alternative fabrication techniques to silicon microfabrication are also being pursued, including fabrication of polymer and ceramics based systems.

POLYMER RESEARCH

The newest frontier in the fields of polymer and materials science is the exploration and manipulation of self-assembly - the natural tendency of some materials to self-arrange due to thermodynamic driving forces and non-covalent secondary interactions. The basis of the Hammond research program is the molecular design and synthesis of self-assembling polymeric systems, and the variation of chemical structure and processing of these systems to control their order and function on both a nanoscopic and microscopic level. These materials include block copolymers, dendrimers, and ultrathin polymer films.

The Hammond group has demonstrated a new technique for patterning polymer thin films using the manipulation of surface functionality and the layer-by-layer adsorption technique. This work was the first to show that by altering the surface functionality within a pattern, and the adsorption conditions of polyelectrolytes, one can actually vary the places in the pattern where polymer adsorbs. This development has been well received, and presents promising technical significance in electro-optical, microelectronic, and biosensor applications. The group is currently taking advantage of this regional control of deposition to build up complex, multi-component, three dimensional microstructures on the surface. Recent highlights include the use of this method to form micron scale electroluminescent patterned diodes.

Dr. Hammond's group has also designed several new liquid crystalline multiphase polymers, and completed morphological and property studies which have contributed to the understanding of the role of the liquid crystalline mesophase in LC micro- phase segregated polymer systems. Recently, it has been demonstrated that LC order can directly influence the block copolymer morphology, and that this influence may actually be "designed into" the block copolymer by varying the LC volume fraction and the overall molecular weight. This new area of research presents a new approach to stabilized liquid crystalline display materials, and could lead the way to new elastomeric piezoelectric and mechano-optic materials.

Finally, the Hammond research group has begun explorations of dendrimeric hyperbranched polymers as membranes and delivery systems. The approach is to use linear/dendrimer diblock copolymer with amphiphilic properties. In this case, self-assembly of two different types is being actively pursued: polymer thin films formed at the air-water interface using Langmuir-Blodgett technology, and the self-assembled structure of bulk block copolymer films, which form nanoscale domains.

DEPARTMENTAL AWARDS

The Chemical Engineering Department's annual Awards Ceremony was held on Monday, May 11, 1998 in Gilliland Auditorium with Professor and Department Head Robert C. Armstrong presiding. The following awards were presented:

In conjunction with the Student Financial Aid Office, an Amoco Foundation Undergraduate Scholarship was acknowledged for recipient Todd C. Bailey, a senior from Somerville, MA; the James E. Cunningham '57 Scholarship to Celeste M. Nelson, a senior from Denver, CO; and the John H. Dessauer Scholarship to Alisha L. Sieminski, a senior from Everett, WA.

Merck Fellowships were acknowledged for recipients Lisa Y. Hwang, a junior from Duncanville, TX and Benjamin D. Martens, a sophomore from Concordia, MO. A host of honors were noted for Robert B. Gray, a senior from Columbia, SC, including his recent awarding of a Marshall Scholarship.

The Dow Chemical Company Outstanding Junior Award recipient was Kevin T. Musselwhite, a junior from Madison, MS, for his balanced record of achievement in academics and campus professional and social organizations, as well as work experience.

The Robert T. Haslam Cup was awarded to Eric D. Nelson, a senior from Brookline, MA, for outstanding professional promise in chemical engineering.

The Roger de Friez Hunneman Prize, the oldest prize in the department (begun in 1927), was awarded to Weiyang Cheong, a senior from Singapore, in recognition of outstanding scholarship and research.

The Edward W. Merrill Outstanding Teaching Assistant Award was presented to Andrey Zarur, a graduate student from Mexico, for excellence in teaching in an undergraduate subject. A second place award went to Rebecca L. Carrier, a graduate student from Bolton, CT.

Chemical Engineering Department Special Service Awards were given to David M. DeWitt, a graduate student from Albuquerque, NM, Ann E. Schmitz, a graduate student from Marquette Heights, IL, and Samantha L. Lavery, a senior from Livonia, MI, for their unselfish contributions to the success of departmental activities.

The Chemical Engineering "ROCK" Award for outstanding athletics, as voted by the graduate students of the department, went to S. Patrick Walton, a graduate student from Cambridge, MA and David M. DeWitt (see above). 1998 was the 25th offering of this prestigious award!

The Outstanding Employee Award was presented to Emmi L. Snyder, an Administrative Secretary in the Chemical Engineering Departmental Headquarters, for her exceptional service to the departmental faculty, staff, and students.

The Outstanding Faculty Award from the graduate students was presented to Professor Daniel Blankschtein. Undergraduate students in the department presented an Outstanding Faculty Award to Professor C. Michael Mohr.

Individual Accomplishment Citations were presented to Jean Francois Hamel, Research Engineering and Lecturer, and Joan A. Chisholm Administrative Secretary, for their outstanding contributions to departmental life. Hamel and Chisholm were recipients of the third offering of this special award, and each received a personalized citation signed by the Department Head.

Robert C. Armstrong

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

The Strategic Plan of the Department of Civil and Environmental Engineering (CEE) is founded on three pillars: infrastructure, environment and information/ management systems. Three interdisciplinary groups align themselves with the above problem-driven foci: Engineering Systems, Engineering and Environmental Mechanics, and Environmental Systems. Over the last six years the Department has been re-aligning its human resources to respond to the Strategic Plan. There have been five new hires in both the Engineering Systems Group and the Environmental Systems Group, and two new hires in the Engineering and Environmental Mechanics Group. A third offer is outstanding in this last group. The Department is rich in energetic, outstanding young faculty. For the first time in over a decade we appropriately cover important programs in construction management and information systems.

Our Plan also spells out a set of long-term goals and short-term action items. They form the basis of the annual budget plan. We completed all the short-term action items of this budget cycle:

- All faculty salaries have been "hardened" or budgeted 100% over the 9-month academic year.
- The Department opened a new track in the Master of Engineering Program (M.Eng.): High Performance Structures. It successfully graduated 12 students this year. The rest of the program is doing well, even with softness in the environmental market. A total of 32 students graduated this year. We expect 35 next year.
- CEE has moved aggressively into the development of WEB-based delivery of education products. Many of our courses are now available in and managed through the Internet.
- The undergraduate Civil Engineering curriculum was redesigned and the new curriculum has been in development throughout the year. The transition into the new program begins with the Fall term of 1998.
- The Environmental Engineering Science undergraduate degree has also been revisited. Curriculum development will begin next year.

Our Long Term goals include: (1) stabilizing research funding and secure fellowship support for graduate students; (2) rebuilding the faculty according to our plans; (3) increasing undergraduate enrollment; and (4) developing a unified environmentally friendly building for all of CEE. Currently CEE groups are housed in both Building 1 and Building 48. Some progress in the conceptualization and the definition of a new building has been achieved. We firmly believe in this concept.

Research budgets are stable but not growing. Fellowship funds have increased somewhat and a new generous grant from the Ralph M. Parsons Foundation has been very helpful. A lot more needs to be done. The faculty has been re-built well, as previously mentioned. Undergraduate enrollment is our biggest problem, as discussed below.

UNDERGRADUATE EDUCATION

As stated above, a major effort has resulted in revitalized curricula for our two undergraduate programs. The new curricula are characterized by a design series that unifies all years of study, focusing on creativity, team work and open-ended problems. There will be plenty of hands-on experiences. All students will take a limited number of fundamental subjects, where lectures and laboratories are unified. Students can then specialize (and do part of their design requirements) in mechanics (structures, materials, geotechnical), systems engineering, and environment. Alternative customized tracks will also be possible. The idea is to provide flexibility without sacrificing depth in areas of interest.

This past year we also embarked on significant publicity efforts to reach the MIT freshmen and undergraduate population. Although the events were very successful, the ultimate outcome has been extremely disappointing. The stagnation of last year is now a definite drop in undergraduate enrollment in the Department (Table 1). Most departments at MIT, except EECS, are facing similar problems attracting students. In our case the problem is also consistent with the experience of similar departments in comparable institutions. Our undergraduates (and graduate students) are getting excellent job offers in these times of economic boom. Some graduate students received high six-figure salaries. But the reality is that normal salaries are not as competitive as those possible in computer sciences and other areas of technology growth. This relative disadvantage is compounded by what we perceive as the biased view that the Institute projects to potential applicants and incoming freshmen. This bias is reinforced by a community that is being dominated by one department and by placement services that short-change the less popular disciplines. We are working with the Admissions Office and the Placement Office on these and other issues.

Next year we will be initiating a Summer Internship Program that will guarantee a relevant summer job to all our majors at the end of their sophomore and junior years.

GRADUATE EDUCATION

As previously mentioned the M.Eng. (a result of our Strategic Plan) is doing well and the new track, High Performance Structures, graduated its first class.

Overall graduate education remains healthy. The attached Tables provide enrollment data and the history of graduate degrees granted.

This year we received over 3,500 inquiries, a 13% increase over last year. This translated to 508 applications, again an increase of 11% over last year. Next September we expect a class of about 102 new graduate students, a yield of about 50%. The incoming class is 56% foreign, up from 41% last year. The applicant pool was 64% foreign, up from 61% last year. While this is consistent with MIT and our increased focus on international activities, it also raises concerns about the interest of US citizens in graduate studies and the professions we represent.

FACULTY NOTES

Professors Kevin Amaratunga, Charles Harvey and Martin Polz joined the faculty this year. Professor Amaratunga specializes in information technology, particularly on issues of data compression and image representation. Professor Harvey is a groundwater hydrologist, a graduate from Stanford and recently a professor at Harvard. Professor Polz is a microbiologist, a graduate from Harvard, who brings expertise in microbial ecology and microbial degradation of pollutants.

Dr. Eric Adams received the 1998 Frank E. Perkins Award for Graduate Student Advising and will be assuming directorship of the Department's Masters of Engineering Program beginning July 1998.

Professor Kevin Amaratunga has been appointed Rockwell International Career Development Professor.

Professor Cynthia Barnhart was awarded tenure.

Professor Moshe Ben-Akiva and his research team at the Intelligent Transportation Systems (ITS) Program have enjoyed a successful year. Last year their traffic simulator won *Discover Magazine's* award for technological innovation. This year the work has been highlighted in *Technology Review*, *Scientific American* and ABC's *Prime Time.*

Professor Rafael Bras was awarded the 1998 Clarke Prize, presented annually for demonstrated excellence in the fields of water science and technology. Established in 1993 by the National Water Research Institute to honor one of its co-founders, Athalie Richardson Irvine Clarke, the prize exemplifies the highest contributions by an individual actively engaged in the discovery, further development, improvement or understanding of water science and technology. Professor Bras was also selected to be the Horton Lecturer of the American Meteorological Society. The lecture will be given at the annual meeting next January.

During this reporting period Professor Oral Buyukozturk presented five plenary keynote lectures in major international conferences. He joined the editorial board of the *Journal of Computer-Aided Civil and Infrastructure Engineering* and is editing a special volume on advanced infrastructure technologies. Professor Buyukozturk was a co-organizer of a major international conference on corrosion held at MIT in July 1997.

Professor Ismail Chabini was one of three of our young faculty members receiving NSF's prestigious Career Awards. He co-developed a new subject: Traffic Networks: Flow Modeling and Control.

Professor Sallie Chisholm has been on sabbatical this year. She was recently re-appointed Professor of Biology at MIT.

Professor Jerry Connor successfully launched our new track in the Master of Engineering: High Performance Structures.

Professor Patricia Culligan was promoted from Assistant to Associate Professor without tenure this year. She was recently elected to the international advisory board for the European Union's network of geotechnical centrifuges for environmental research.

Professor Herbert Einstein received the Mueller Award from the International Society for Rock Mechanics (ISRM), which represents the 42 national member societies. The Mueller Award consists of the Mueller Lecture which is given every four years at the International Congress of the ISRM. It is the highest honor of the ISRM and thus of rock mechanics worldwide. Professor Einstein has also led the efforts to implement a new civil engineering undergraduate curriculum. He is now Chair of the US National Committee on Rock Mechanics (National Research Council) and is still VP North America and First Vice President of the International Society for Rock Mechanics.

In November of 1997, Professor Elfatih Eltahir received the very prestigious Presidential Early Career Award for Scientists and Engineers in ceremonies at the Executive Building in Washington, D.C. This recognition carries significant research support. Professor Eltahir was promoted to Associate Professor without tenure.

Professor Dara Entekhabi led a group of the 10 leading hydrologist in an effort to develop a prospectus for the hydrologic sciences. The group assembled at MIT to draft priority science questions and observing modeling needs in the millennium. The prospectus calls for a Second International Hydrological Decade.

Professor Philip Gschwend has been on sabbatical leave.

Professor Harry Hemond was appointed Deputy Director of the Center for Environmental Health Sciences (CEHS) and Program Director-elect of the CEHS Superfund Basic Research Program at MIT.

Professor Eduardo Kausel successfully led our participation in the Mid-Atlantic Earthquake Center.

Professor Steven Lerman has served as Associate Chair of the Faculty and in June, 1998, will become the Chair-elect. He continues as Director of the MIT Center for Educational Computing Initiatives, the research arm of the Center for Advanced Educational Services. Professor Lerman is currently teaching a satellite video course that originates at MIT and is distributed by the PBS Business Channel and the National Technological University to over 200 students in North America. This course, entitled Internet Commerce, is intended for middle-level executives.

Professor Ole S. Madsen has accepted an appointment as an Adjunct Professor in the Civil Engineering Department at the National University of Singapore. He has also continued his involvement, as External Advisor, in the European Commission's multi-institutional/national project on Fluxes Across Narrow Shelves. On the home front, Professor Madsen has been active in Institute committees as member of CAP and the CUP subcommittees on the Communication Requirement and the Plus/Minus Grading System.

Professor David Marks is the Director of the new MIT Center for Environmental Initiatives. Marks maintains his role as Co-Chair of the MIT Council on Environment and is finishing up his leadership of the CEE Masters of Engineering Program.

Carl Martland received the Distinguished Transportation Researcher Award from the Transportation Research Forum in recognition of lifetime achievements in transportation research.

Professor Dennis McLaughlin, H.M. King Bhumibol Professor of Water Resource Management, met with the King of Thailand in February 1998 to discuss Thai water resource issues.

Professor Chiang C. Mei served on the International Panel for reviewing the environmental impacts of the controversial storm barrier proposed for Venice Lagoon. On July 8, 1998, the panel reported to the Italian Minister of Public Works, Dr. Paolo Costa, and endorsed the Mobile Gates Design for flood protection.

Professor John Miller received NSF's prestigious Career Award.

Professor Heidi Nepf was elected to the governing body of the American Society of Limnology and Oceanography. She produced a second series of educational cable television programs on groundwater pollution, air pollution, and surface water pollution, with funding from the National Institute of Health.

Professor Feniosky Peña-Mora has successfully completed the first offering of a nine-month new subject called Distributed Laboratory for Information Technology in Large-Scale Engineering Systems, a subject used by the Master of Engineering in Information Technology as the project class. Professor Peña-Mora received membership to the Editorial Board for the ASCE *Journal of Computing in Civil Engineering*.

Professor Dan Roos was appointed Associate Dean of Engineering for Engineering Systems.

Professor Sarah Slaughter received the 1998 Best Paper Award from the *Journal of Architectural Engineering* and is a member of the Board on Infrastructure and the Constructed Environment, National Research Council.

Professor Joseph M. Sussman won the Department's Effective Teaching Award for 1997 . He was re-elected for a three-year term to the ITS America Board of Directors, where he serves as Chairman of the ITS Awareness Panel. He continues as Chairman of the Transportation Research Board's congressionally-mandated committee to oversee the Federal Railroad Administration's research and development program, and was appointed Chairman of a TRB panel to critique the federal research and development program in transportation.

Professor Bettina Voelker won the Henry L. and Grace Doherty Professorship in Ocean Utilization.

Professor Andrew Whittle was awarded a Walter L. Huber Civil Engineering Research Prize by ASCE. He will receive this award at the ASCE National Convention in Boston in October 1998.

Professor John Williams was appointed Associate Director of the Systems Design and Management Program.

Professor Nigel Wilson organized and chaired the Seventh International Workshop on Computer-Aided Scheduling in Public Transport held at MIT in August 1997 with more than 100 attendees from more than a dozen different countries.

Professor Shi-Chang Wooh also received the prestigious NSF Career Award. He has been appointed associate editor of the journal *Experimental Mechanics*. His work on non-destructive evaluation continues to produce patented technology.

RESEARCH HIGHLIGHTS

The Department looks forward to close collaboration with School initiatives in Bio-Engineering and in Engineering Systems. The former is consistent with our long history of collaboration with the Toxicology group of MIT which is now part of the new Division of Bio-Engineering. The latter overlaps and is consistent with our thrusts in Engineering Systems. CEE faculty member Daniel Roos heads that initiative for the School.

CEE sees itself as a Hub Department and actively pursues interdisciplinary research via associated centers and other units and groups at MIT. Our international activities in Malaysia, Thailand, Singapore and Argentina, most in collaboration with the Technology and Development program headed by CEE faculty member Fred Moavenzadeh, have suffered because of economic uncertainties but we are continuing to pursues avenues of international engagement. The new Center for Environmental Initiatives headed by CEE faculty member David Marks has provided opportunities through the Alliance for Global Sustainability and other programs. Other efforts in environmental research are found in the Center for Global Change Science, the Joint Program on the Science and Policy of Climate Change, the Center for Environmental Health Sciences, and the Woods Hole Oceanographic Institution. CEE faculty are major leaders or actively participate in all these activities. The Center for Transportation Studies, directed by Professor Yossi Sheffi, remains a focus of our research efforts. Professor Moshe Ben-Akiva leads a major and very successful effort on intelligent transportation systems. Professor Nigel Wilson and Mr. Fred Salvucci run a major research and education program in collaboration with the University of Puerto Rico which

revolves around the development and building of a subway system for the city of San Juan. It is a model to be emulated nationwide.

DEPARTMENTAL AWARDS AND OTHER SPECIAL RECOGNITION

Winners of the Richard Lee Russel Award for outstanding seniors entering graduate studies in Civil and Environmental Engineering were Deborah Cheng '98, Nora A. Humphrey '98 and Heileen Hsu '98.

Katie J. Adams '98 received the Steinberg Prize given to an undergraduate with an excellent academic record and an interest in construction management.

Steven C. Belin '99 won the Leo (1924) and Mary Grossman Award in recognition of high scholastic standing and interest in the field of transportation.

Teaching assistant Freddi-Jo Eisenberg (G) received a Graduate Student Council Teaching Award for excellence in teaching, particularly with respect to the teaching of and interaction with graduate students.

James P. Habyarimana '98 and Heileen Hsu '98 were elected to Phi Beta Kappa.

Bridgette A. Burnell '98 was awarded second place in the S. Klein Prize for Scientific and Technical Writing for *Environmental Pesticide Exposure*.

Adriana T. Guzman (G) won the William L. Stewart Jr. Award presented to students who have made outstanding contributions to extracurricular activities and events during the preceding year at MIT.

Siva Dirisala (G) won an Oracle MAP Award presented by Larry Ellison, CEO of Oracle, giving him a position and 6 months touring Oracle to decide where in the company he wants to work.

Niranjan Krishnan (G) received The International Air Cargo Association Inaugural Annual Research Paper Competition Award for his paper entitled, *Large Scale Logistics Service Design: Models, Algorithms and Applications.*

Fang Lu (G) was runner-up for the Milton Pikarsky Memorial Award - 1997 C.V. Wootan Award for the best transportation master's thesis, given by the Council of University Transportation Centers.

More information about the Department of Civil and Environmental Engineering can be found on the World Wide Web at the following URL: http//web.mit.edu/civenv/.

Rafael L. Bras

Table 1
Department of Civil and Environmental Engineering
Enrollment 1991-1998

Year	Faculty	Undergraduate Students	Graduate Students	Yearly Total
1997-98	37	102	299	401
1996-97	34	107	305	412
1995-96	39	114	290	404
1994-95	35	120	285	405
1993-94	37	134	301	435
1992-93	37	119	280	399
1991-92	36	113	304	417

Table 2
Department of Civil and Environmental Engineering
Graduate Degrees 1991-1998

Year	M.Eng.	Master of Science	Civil Engineer	Ph.D./Sc.D.	Yearly Total
1997-98	34	103	1	24	162
1996-97	30	92	0	20	142
1995-96	21	98	1	22	142
1994-95	N/A	93	1	33	127
1993-94	N/A	101	1	21	123
1992-93	N/A	83	3	23	109
1991-92	N/A	80	3	29	112

DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

During the past several years the Department has completed the implementation of its Master of Engineering (M.Eng.) program as the one that is recommended for undergraduate students who wish to pursue a career in engineering. Those who stop at the bachelorís level are well prepared for entry-level engineering positions or for further study leading to careers in a variety of professions such as law, medicine, or public service. Those who continue on to the doctorate are well prepared for a career in research, teaching, scholarship, and other occupations where one has to understand what things are like on the frontiers of knowledge.

The M.Eng. program is a five-year program leading to the simultaneous award of bachelorís and masterís degrees. At this time about two thirds of the Departmentís undergraduates continue to receive the M.Eng. degree. The curriculum is seamless between the traditional disciplines of electrical engineering and computer science, and is also as seamless as possible between undergraduate and graduate study.

Undergraduate enrollment in computer science has grown dramatically in the past few years. Traditionally one third of the EECS undergraduates majored in computer science, and two thirds in electrical engineering. Recently the statistics have shown that more favor CS. However, th emost interesting trend is that now more than half the students elect to pursue a new undergraduate program which retains greater breadth at the junior level, and does not require the student to designate either EE or CS. These trends are expected to continue. The Department must be prepared to shift the balance of its faculty to more closely approximate student interest. We will find this easier than many other universities where EE and CS are in different departments.

Overall enrollment in EECS continues to be high, and the students continue to be extraordinarily well qualified academically.

For the past two decades our computer science faculty and graduate students have had their offices and laboratories in a building that is off campus. This geographical barrier has tended to impede collaboration between CS faculty and those on campus, and has worked against the notion that the fields of EE and CS are really closely related and, indeed, can best be thought of as a single discipline. We are currently raising the money necessary to erect a new complex of buildings on campus, adjacent to one of the laboratories housing many EECS faculty. The computer-science laboratories currently off campus (the Laboratory for Computer Science and the Artificial Intelligence Laboratory) will move into this complex, along with the Laboratory for Information and Decision Systems. Construction is planned to begin in 1998.

UNDERGRADUATE PROGRAM

Enrollment of undergraduates averaged 1070 in 1997-1998 with about 18 percent in the Electrical Engineering Program, 42 percent in the Computer Science Program, and 40 percent in the Electrical Engineering and Computer Science Program. From the Class of 2000, 340 students were enrolled in Course VI, down slightly from the preceding year. About 350 students from the Class of 2001 have so far selected Course VI, with only 13 percent choosing 6-1, 50 percent 6-2, and 37 percent 6-3.

The Master of Engineering (M.Eng.) program entered its fourth year with 260 students.

The following prizes and awards were won by our students:
The Ernest A. Guillemin Thesis Competition for outstanding performance on a Master of Engineering thesis in Electrical Engineering was won by Everest W. Huang of Cambridge, MA, Qiang Wu of Cambridge, MA, and Anthony J. Accardi of Cambridge, MA.

The David Adler Memorial Prize for outstanding performance on an Undergrduate Thesis in Electrical Engineering was presented to Leaf A. Jiang of Cambridge, MA.

The Charles and Jennifer Johnson Thesis Prize for outstanding performance on Master of Engineering thesis in computer science were awarded to Jonathan R. Santos of Piscataway, NJ.

The Morris Joseph Levin Award-Best MasterWorks Oral Thesis Presentation Prize was awarded to Craig Abler of Cambridge, MA, and Susan Dacy of Cambridge, MA.

The William A. Martin Memorial Thesis Prize for outstanding performance on a Master of Engineering thesis in computer science was presented to Andrew F. Stark of Cambridge, MA.

The George C. Newton Prize for the best undergraduate laboratory project was awarded to Eric Cosman, Jr. of Boston, MA.

The Robert A. Fano UROP Award was given to Dennis J. Evangelista of Cambridge, MA, and Christopher R. Laughman of Cambridge, MA.

The Northern Telecom/BNR Project Awards were made to James M. Montgomery of Boston, MA, John C. Whaley of Boston, MA, and Hur Koser of Cambridge, MA.

The David A. Chanen Writing Award was given to Jonathan P. Pearce of Cambridge, MA.

The Reinhold Rudenberg Memorial Fund Award was given to Holly G. Gates of Tehachapi, CA, and Benjamin Dous of Seven Valley, PA.

GRADUATE PROGRAM

In September, 1997 there were 783 graduate students enrolled in the department. About 26 percent of the total were foreign nationals. The department supported 447 Research Assistants and 112 Teaching Assistants. In addition, there were 144 fellowships including 41 National Science Foundation Fellows, and 27 Department of Defense Fellows. The remaining students had industrial or foreign support or were using their own funds.

During 1996, the department awarded 105 Master of Science degrees, 7 Electrical Engineer degrees and 69 Doctoral degrees.

The department received 1741 applications for the 1996-97 year, a slight decrease from 1995. The applications continue to be generally excellent and 268 were admitted for 1996 (February, June and September), of whom 123 registered in September.

A number of awards were made to graduate students for excellence in teaching. O. Patrick Kreidl of Somerville, MA, received the Carlton E. Tucker Award and Lon E. Sunshine of Framingham, MA, received the Harold L. Hazen Award. The Frederick C. Hennie III Awards for excellence in teaching were presented to James C. Hoe of Cambridge, MA, and Sean C. Warnick of Cambridge, MA. Kathleen E. Wage of Cambridge, MA, Patrick J. LoPresi of Brighton, MA, and Matthew Secor of Cambridge, MA, were promoted to Instructor-G in recognition of their demonstrated teaching ability and service to the department.

VI-A INTERNSHIP PROGRAM

The Department's VI-A Internship Program is now in its 81st year but may now be seeing competition from the on-campus M.Eng. program as evidenced by a decrease in the number of applications. This year 120 students applied during the annual Orientation and Selection process and 58 applicants were selected as members of the incoming VI-A class. To compare, in 1997 147 students applied and 80 were selected while in 1996 161 students applied and 80 were selected. Since the last Report, approximately 17 students have withdrawn from the VI-A Program mainly because these students felt the opportunities with the on-campus M.Eng. program better matched their needs. However, most VI-A students find this program to be a professionally rewarding supplement to their on-campus learning and report great satisfaction with their internship experiences. If enrollment continues to decline in the near future, it may be necessary to decrease the number of participating VI-A companies.

Four new companies have joined the VI-A program this year: Linear Technologies, Milpitas, CA; Motorola Information Systems Group, Mansfield, MA; Sanders—a Lockheed Martin Co., Nashua, NH; and Synopsys, Inc., Mountain View, CA. These were four participating companies which did not take new students this year, but will continue with those students selected in previous years.

In June, 42 VI-A students received the M.Eng. degree having completed all their company assignments and Institute degree requirements. There were 32 students who were awarded their bachelor's degree and most of them will continue into the graduate phase of the program.

At the annual Department Awards Reception held in the West Wing of the Museum of Science in Boston, the following VI-A students were honored: Hur Koser and John C. Whaley received the Northern Telecom/BNR Project Award; Susan M. Dacy received a Morris Joseph Levin Award for a Best MasterWorks Oral Thesis Presentation; Leaf A. Jiang received the David Adler memorial Thesis Prize; and Anthony J. Accardi and Qiang Wu were two of the recipients of the Ernst A. Guillemin Thesis Award.

At the 1998 Awards Convocation Joseph B. Irineo received the Admiral Edward L. Cochrane Award which is presented to the male senior who has shown the highest qualities of humility, leadership and inspiration in intercollegiate athletics and Michael M. Bryzek was the recipient of the Priscilla King Gray Award for Public Service.

The Department of Athletics presented the Burton R. Anderson Award to Amy C. Geiffers as the intercollegiate manager of the year.

VI-A students continued their excellence in academic achievements. Forty-nine seniors were elected to MIT's Xi Chapter of Phi Beta Kappa and two of the honorees were VI-A students: Hur Koser and Maya R. Said. Of the 114 students from the School of Engineering who were elected to Tau Beta Pi, the National Engineering Honorary, 23 were VI-A's and Eta Kappa Nu, the Course VI Honorary, elected 83 members of who 30 were VI-As.

FACULTY

Five new faculty members jointed the department this year:
David Cliff, Associate Professor of Computer Science and Engineering, received his D.Phil. at the University of Sussex.

Daniel N. Jackson, Associate Professor of Computer Science and Engineering, received his Ph.D. at MIT.

Leonard McMillan, Assistant Professor of Computer Science and Engineering, received his Ph.D. at the University of North Carolina.

Martin C. Rinard, Assistant Professor of Computer Science and Engineering, received his Ph.D. at Stanford University.

Madhu Sudan, Associate Professor of Computer Science and Engineering, received his Ph.D. at the University of California, Berkeley.

Associate Professors Anant Agarwal, Munther A. Dahleh, Martha L. Gray, and Martin A. Schmidt were promoted to Professor. Assistant Professors Anantha P. Chandrakasan, Dennis M. Freeman, David R. Karger, Bernard C. Lesieutre, and Seth J. Teller were promoted to Associate Professor.

Faculty honors and awards:
Associate Professor Akintunde I. Akinwande was named ITT Career Development Associate Professor of Electrical Engineering.

Professor Jesus del Alamo received the Department Head's Special Recognition Award for his leadership of the Department's undergraduate and professional programs.

Associate professor Duane S. Boning was named Robert N. Noyce Career Development Associate Professor of Electrical Engineering. He also received the Ruth and Joel Spira Teaching Award.

Professor Michael L. Dertouzos was awarded the Commander of Merit Award by the President of the Hellenic Republic.

Associate Professor Srinivas Devadas was elected a fellow of the IEEE.

Associate Professor Dennis M. Freeman was named W.M. Keck Career Development Associate Professor in Biomedical Engineering.

Professor Jeffrey H. Lang was elected a Fellow of the IEEE.

Assistant Professor Amos Lapidoth was named KDD Career Development Assistant Professor of Electrical Engineering.

Associate Professor Steven B. Leeb received the Institute's Edgerton Award for research and teaching.

Professor Thomas L. Magnanti was named an Institute Professor, an honor reserved for no more than 12 faculty members who have "demonstrated exceptional distinction by a combination of leadership, accomplishment and service in the scholarly, educational and general intellectual life of the Institute or wider academic community."

Professor, Emeritus Jerome H. Saltzer was elected to the National Academy of Engineering.

Associate Professor Seth Teller was named X-Consortium Career Development Associate Professor of Computer Science and Engineering.

Professor George C. Verghese was elected a Fellow of the IEEE.

Professor Patrick H. Winston was named Ford Professor of Engineering.

Associate Professor Gregory W. Wornell received the Graduate Student Council Award for Excellence in Teaching.

The following faculty were on sabbatical for all or part of the year: Professor Dimitri A. Antoniadis, Associate Professor Munther A. Dahleh, Professor Paul E. Gray, Associate Professor Lynn A. Stein, Professor Peter Szolovits, Associate Professor Mitchell D. Trott, Professor John N. Tsitsiklis, and Professor Thomas F. Weiss.

The department hosted five visiting faculty:
Professor John S. Baras, from the University of Maryland, hosted by Professor Sanjoy K. Mitter.

Professor W. Gerard Hurley, from the University of Galway, hosted by Professor John G. Kassakian.

Assistant Professor Franz X. Kaertner, from the Swiss Federal Institute of Technology, hosted by Professor Erich P. Ippen.

Assistant Professor Kevin T. Kornegay, from Cornell University, hosted by Assistant Professor Anantha P. Chandrakasan.

Associate Professor Vivek Sarkar, from the IBM Academy of Technology and Stanford University, hosted by Professor Arvind.

Professor Charles W. Therrien, from the Naval Postgraduate School, hosted by Professor Alan V. Oppenheim.

The following retired from the faculty this year: Professor Walter E. Morrow and Professor Michael Athans.

Paul Penfield, Jr.

DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING

This past year has been an excellent one for the Department of Materials Science and Engineering. We were pleased to once again be ranked first in both undergraduate education and graduate education among the Departments of Materials Science and Engineering by *U.S. News and World Report.* We have maintained this ranking ever since this began nine years ago.

In spite of the more difficult research funding climate, the research volume of the department has been relatively constant during the past year, while the number of graduate students has increased somewhat. The undergraduate student population has increased to 119. In June, 1998 we awarded 37 bachelors degrees, 21 masters and 13 doctorates. Our program of offering fellowships to a large percentage of domestic applicants continues to provide us with an outstanding graduate student body; 57% of our entering graduate student class in September, 1997 were domestic.

During the past three years the department has assumed responsibility for the Archaeological Science Program at MIT. This program, which is home to two faculty, Professors Heather Lechtman and Dorothy Hosler, builds on the strong materials emphasis that was brought by Professor Cyril Stanley Smith '26 ML. This program has begun to flourish in the department with well over 150 students taking subjects in archaeology. We believe that this interface between archaeology and materials science is one of the strongest such programs in the world, and we hope that it will grow and prosper in its new home.

We are pleased to have added a new faculty member to our ranks this year: Professor William Craig Carter comes to us from his position as Research Scientist at the National Institute of Standards and Technology (NIST) in Gaithersburg, MD. After graduating with three degrees from the University of California at Berkeley, Professor Carter became an NRC Fellow and later a permanent staff member at NIST. His work involves both the theory and computation of microstructural evolution in a wide range of materials. He has already won two major awards from the American Ceramics Society. In the spring of 1997 Professor Carter was a visiting associate professor in the department, and assisted Professor Samuel M. Allen in teaching one of our introductory graduate subjects on kinetic processes. For his efforts Professor Carter received the 1997 Graduate Student Council Teaching Award for the School of Engineering. Professor Carter is an unusually gifted educator and researcher, and the department feels that he will make an outstanding addition to our faculty. He arrived at MIT in July, 1998 as the Thomas Lord Associate Professor. This is the second Thomas Lord Career Development Chair in the department. The first one is held by Professor Caroline A. Ross. The Thomas Lord Career Development Chairs are funded on an annual basis by the Lord Foundation of Massachusetts which was established through the will of Thomas Lord, the son of the founder of the Lord Corporation.

The department is pleased to report that Professor Anne Mayes, Professor Eugene A. Fitzgerald, and Professor Gerbrand Ceder each received tenure this past year. These are the first successful tenure cases in the departmental faculty rank over the past six years, and reverses a disappointing trend. With their promotions each has agreed to take on significant leadership positions within the department during the coming year. Professor Anne Mayes will serve as the Undergraduate Committee Chairperson, Professor Fitzgerald has expressed an interest in taking over the Admissions Committee over the next two years, and Professor Ceder will chair our new Initiative in Computational Materials Science.

We regret to report that Professor Andreas Mortensen resigned his tenure as of the end of this academic year in order to take a new position at the Swiss Federal Institute of Technology in Lausanne, Switzerland. In addition, Professor David Dunand, a promising young faculty member, resigned his position in order to take a position at Northwestern University in Chicago. Both of these departures were due to the employment of their spouses. While we wish them both many happy years with their new spouses, their departure is a significant loss to the department.

Last year we were grateful to have received two newly endowed professorships created in August, 1996 through a $4 million dollar gift from Dr. Vasilios S. Salapatas, an MIT alumnus and the managing director of Helliniki Halyvourgia, S.A., of Athens, Greece. The professorships are the Stavros V. Salapatas Professorship and the Matoula S. Salapatas Professorship, named in honor of Dr. Salapatas' deceased parents. These gifts are intended to strengthen the department and its teaching and research programs. Last year, Professor Lorna Gibson became the

first holder of the Matoula S. Salapatas Professorship in Materials Science and Engineering. This year, Professor Carl V. Thompson became the first holder of the Stavros V. Salapatas Professorship in Materials Science and Engineering. Professor Thompson received his undergraduate degree at MIT, and then went on to Harvard for the doctorate, studying under Professor David Turnbull, one of the great theoretical metallurgists of this century. Professor Thompson came to MIT as a young faculty member in 1983, and rose through the ranks to become a full professor. Recently, he served as the President of the Materials Research Society; hence, he is widely known as a materials scientist. His current research emphasis is on thin films as applied to electronic circuits, and his intellectual interest is in the grain growth of metallic thin films on these electronic circuits. In addition, he has considerable interest in the manufacturability and quality control aspects of materials processing.

In addition to these gifts from Dr. and Mrs. Salapatas, the department was pleased to receive another major donation this past year from them. This second gift has established the Danae and Vasilios Salapatas Professorship of Ferrous Metallurgy, and will fund the bulk of a career development chair in honor of Thomas B. King, a former head of the Department of Materials Science and Engineering. The generosity of Dr. Salapatas and his wife has added greatly to the financial strength and well-being of the department as well as providing significant honors for four of our faculty.

The administrative clustering, which was begun a year ago, has been strengthened immeasurably during the past year. Dr. Elizabeth Cooper now serves as the Administrative Officer for the Department of Materials Science and Engineering, the Department of Chemical Engineering, and the Center for Bioengineering. The Administrative Services Organization offices have been moved to the third floor of building 8, resulting in a much better working environment and greater ability to interact with the faculty in both the departments and the center. We have learned much over the past year about the strengths of clustering administrative services, and we have noted some difficulties which are being corrected. We plan to provide a report to the Senior Administration early in the fall concerning the best methods of developing future clusters.

In October, 1997, during our departmental Visiting Committee, we were pleased to dedicate a portrait of Richard P. Simmons, currently a life member of the MIT Corporation, a graduate of the department, and a dedicated alumnus of MIT. In April, 1997 about 70 former colleagues, students, and invited guests gathered for a portrait dedication in honor of the late Professor John F. Elliott. This was a wonderful event attended by both family and friends of Professor Elliott, a leader for more than 40 years in the field of chemical-process metallurgy and steelmaking.

Our faculty members continue to occupy a number of important leadership positions at MIT. Professor Vander Sande is Associate Dean of Engineering, Professor Kimerling serves as Director of the Materials Processing Center (MPC), Professor Rose continues as Director of the Concourse Program, Professor Roylance serves as Executive Officer, Professor Rubner serves as Director of the Program in Polymer Science and Technology (PPST), Professor Clark is the Director of the Center for Technology, Policy and Industrial Development, Professor Allen serves as Secretary of the MIT Faculty, Professor Latanision continues as Chairman of the MIT Council on Primary and Secondary Education, Professor Lechtman is Director of the Center for Materials Research in Archaeology and Ethnology (CMRAE), and Professor McGarry is the Director of the Summer Session.

Following our departmental Visiting Committee in October of 1997, the department become extremely active in developing a future strategic plan. In December, 1997 we held a full day retreat to define the areas of greatest need over the next several decades. During weekly faculty meetings over the spring semester we identified a number of strategic directions culminating in another full day retreat in May of 1998. At this meeting we agreed that it is necessary to develop a strong thrust in Biomaterials Engineering, to create a new Center for Computation Materials Science and Engineering, and to develop a Master's Engineering Program with emphasis on industrial practice. We will continue to further develop and refine these and other elements of our departmental strategy over the next six months, and beyond. This exercise has strengthened the department in many ways, especially in bringing the faculty together for thoughtful discussion about many topics. It significantly improved the morale of the department. The faculty appreciate the clear direction and the participative process through which it was achieved. Our challenge during the next few years will be successful implementation of these goals.

It is with regret that I announce the passing of Professor Carl F. Floe, a former metallurgy professor in the department who also served as MIT's Vice President for Research for 10 years.

UNDERGRADUATE EDUCATION

Our undergraduate enrollment remains at historically high levels. Essential to maintaining our undergraduate body are extensive recruiting efforts including a two day Open House, our annual John Wulff Lecture, direct mailings to the freshman class, Freshman Advisor Seminars, and IAP Activities. Our III–B Internship Program continues to attract the majority of the undergraduate students in our department. Through this program we have strengthened our interactions with 38 companies and government laboratories in the US, Europe, and Asia while providing summer experiences relevant to the educational development of our undergraduates. Our undergraduate body currently comprises 57% women, 12% underrepresented minorities, and 3% international students.

Professor Lorna Gibson continues to chair the Undergraduate Study Abroad Committee and coordinate the activities of the Materials Undergraduate Study Exchange Program (MUSE). In 1995 the department signed agreements to establish an undergraduate exchange program with KTH Stockholm, ETH Zurich, the Ecole Nationale Superieure des Mines de Paris, and Oxford University. During academic year 1997-1998 the department hosted four exchange students (two from KTH Stockholm, one from Oxford University, and one from ETH Zurich), while two of our students attended a semester at Oxford and two more students attended KTH Stockholm.

The Student Undergraduate Materials Society (SUMS) continued to be a source of strength for the undergraduate program. SUMS assisted in end-of-term subject evaluations, assisted in the organization of the UROP Open House, sponsored a Freshman Open House to help recruit new majors, organized seminars by departmental faculty members, planned socials, and assisted in tutoring of fellow students. In 1998 SUMS held the first Curriculum Colloquium in approximately five years in order to solicit feedback from undergraduates on the DMSE curriculum. Officers of the society during the spring and fall semesters of 1997 were: Kim Marie Levis (President), Ryan Cush (Vice President), June Cheng (Treasurer), and Chelsea Russell (Secretary). New officers elected in the spring of 1998 are: Ryan Cush (President), June Cheng (Vice President), Kathleen O'Brien (Treasurer), and Sandy Jen (Secretary).

GRADUATE EDUCATION

Approximately 23% of our graduate students are women and 2.3% are underrepresented minorities. The distribution of students among our six graduate degree programs and their affiliates is somewhat changed from last year. As of February, 1998 it was:

Degree Program	Percent of Total Graduate Students
Ceramics	12%
Electronic Materials	29%
Materials Engineering	21%
Materials Science	14%
Metallurgy	8%
Polymers	16%

Six of our students in Materials Engineering were enrolled in the Technology and Policy Program (TPP). Of these, two were in the Technology, Management and Policy (TMP) doctoral program, and seven were enrolled in the Leaders for Manufacturing Program (LFM). Sixteen of our Polymer students were enrolled in the Program for Polymer Science and Technology (PPST). We anticipate for the fall of 1998 a total graduate class of about 180. The program we adopted five years ago of offering one-term fellowships to a large percent of domestic applicants has been successful. We estimate we will register an incoming class of 42 for the coming fall, over 59% percent of which will be domestic.

Nearly all undesignated gifts to the department are currently being used to fund endowed fellowships (including the Nicholas J. Grant Fellowship, the John F. Elliott Fellowship, the Ronald A. Kurtz Fellowship, the Gilbert Y. Chin Fellowship, the R. L. Coble Fellowship, the Carl M. Loeb Fellowship, the David V. Ragone Fellowship, the H. H. Uhlig Graduate Fellowship, the Stuart Z. Uram Fellowship, the Class of '39 Fellowship, the Julian Szekely Fellowship, the Anthony D. Kurtz Fellowship, and the Department Endowed Fellowship).

Our endowed fellowships now provide sufficient annual income for one-term fellowships for approximately nine students. In addition to the above, we are the grateful recipients of a number of grants from corporations and foundations to aid our first year students. We have received two fellowships from the Lord Foundation of Massachusetts. These have been instrumental in assisting us to maintain the size and quality of our incoming domestic student class. We have fellowship support from a number of corporations including TECHINT and 3M. Of course, many students have other outside fellowship support as indicated elsewhere in this report. Of the 27 domestic students expected to enter in the fall of 1998, 13 will be entering on fellowships from the department and from a variety of sources including; MIT, NSF, DOD, NDSEG, and the Air Force.

The Graduate Materials Society Core Committee (GMC) continued its role in programming the Graduate Student Orientation/Luncheon for incoming students. Debbie Lightly and Philip Soo participated in two well-received informational Q&A format sessions with prospective students. Under the direction of social chairs Steven Murray and Chris Vineis, the GMC held monthly socials and an end–of–the–year barbecue. Vab Andleigh programmed MESS seminars featuring well-known lecturers such as Dr. Bob O'Handley and Professor Caroline Ross. The group continued to undertake the supervision of the arduous but important task of course evaluations, and this year introduced a more concise short answer course evaluation form. Officers of GMC Core Committee during academic year 1997-1998 were: Philip Soo (President), Debra Lightly (Vice President), Vab Andleigh (MESS Seminars), Matthew Rosenthal (Treasurer), Eric Wu and Todd Stefanik (Athletic Chairs), Steven Murray and Christopher Vineis (Social Chairs), Michael Groenert and Nicole Lazo (DCGS Representatives), and Matthew Farinelli and Olivera Kesler (GSC Representatives). Newly elected Officers of the GMC Core Committee for academic year 1998-1999 are: Christopher Henry (President), Wendy Katstra (Vice President), Tom Langdo (Treasurer), Tim Rittenhouse (GSC Representative), Richard Holman (MESS Seminars), Surekha Vajjhala and Mike Groenert (DCGS Representatives), Jim Yurko and Ben Hellweg (Social Chairs), Todd Stefanik and Eric Wu (Athletic Chairs).

The chairman of the the MIT Student Chapter of the Materials Research Society during the academic year 1997-1998 was Srikanth Samavedam. New officers for the 1998-1999 academic year will be elected in the fall. Professor Linn W. Hobbs will continue as the MRS Student Chapter faculty advisor for 1998-1999. The chapter arranged information sessions, seminars and special lectures dealing with issues of topical interest in materials science. The Association of Materials Students Societies (aMaSS) is a coalition of student chapters of three materials professional societies: Materials Research Society (MRS), ASM International/The Materials, Metals & Minerals Society (ASM/TMS), and the American Ceramics Society (ACerS). The association was formed in 1992 with the purpose of increasing the profile of MIT in the professional societies of materials research. Membership is offered to undergraduate and graduate students from all departments of MIT who are interested in materials. Members of the Executive Committee of aMaSS during academic year 1997-1998 were: Andrew Gouldstone, Michael Shin, Melody Kuroda and Andrew Takahashi. Elections for the 1998-1999 executive committee positions of aMaSS will be held in the fall. Professor Samuel M. Allen will continue as the faculty advisor for aMaSS during academic year 1998-1999.

FACULTY NOTES

Faculty members of this department now occupy 15 endowed chairs. The chairholders are: Sandra L. Burkett, John Chipman Assistant Professor; Yet-Ming Chiang, Kyocera Professor of Ceramics; Michael J. Cima, Sumitomo Electric Industries Professor of Engineering; Thomas W. Eagar, POSCO Professor of Materials Engineering; Merton C. Flemings, Toyota Professor of Materials Processing; Lorna Gibson, Matoula S. Salapatas Professor of Materials Science and Engineering; Linn W. Hobbs, John F. Elliott Professor of Materials; Lionel C. Kimerling, Thomas Lord Professor of Materials Science and Engineering; Anne M. Mayes, Class of '48 Associate Professor of Polymer Physics; Michael F. Rubner, TDK Professor of Materials Science and Engineering; Subra Suresh, Richard P. Simmons Professor of Metallurgy; Edwin L. Thomas, Morris Cohen Professor of Materials Science and Engineering; Carl V. Thompson, Stavros Salapatas Professor of Materials Science and Engineering; John B. Vander Sande, Cecil and Ida Green Distinguished Professor; and August F. Witt, Ford Professor of Engineering.

Term chairs, especially those held by junior faculty members, are of immense value to the holders in building careers. Faculty from this department currently occupy two such chairs; W. Craig Carter, Thomas Lord Associate Professor of Materials Science, and Caroline A. Ross, Thomas Lord Assistant Professor of Materials Science.

Professor Yet-Ming Chiang was inducted as a Fellow of the American Ceramic Society at its 100th Annual Meeting in May, 1998 in Cincinnati, Ohio. Professor Chiang, along with Professors Gerbrand Ceder, Anne Mayes, and Donald Sadoway, was featured in the April 29 issue of *Tech Talk* in an article about how their research has led to the development of a new material for rechargeable batteries. Their work was reported in the April 16 issue of *Nature Magazine*. Their findings take the DMSE professors one step closer to making cheap, light and powerful batteries which they hope will ultimately galvanize the electric car industry. "Our dream as a team is to make a battery that will enable the dawn of the electric vehicle age," Professor Sadoway told *Tech Talk*. Other DMSE researchers working on this project are postdoctoral associates Mehmet K. Aydinol and Biying Huang, and graduate student Youn-Il Jang. Professor Joel P. Clark became an AT&T Fellow in 1997. Professor Thomas W. Eagar presented the opening Plenary lectures at the Fifth International Conference on Welding Research and the Pacific Rim International Conference on Materials.

Professor Merton C. Flemings, Toyota Professor of Materials Processing and former DMSE department head, was presented with the eighth annual Acta Metallurgica J. Herbert Hollomon Award on September 16, 1997 in Indianapolis, Indiana. This award recognizes outstanding contributions to understanding the relations between materials technology and society, and/or contributions to materials technology that have had a major impact on society. Professor Flemings was cited for his contributions to the theory and practice of solidification processing, which are recognized as among the most significant in the world, and for his scholarly work and intellectual leadership in the field of Materials Science and Engineering. He was selected for this honor by an international selection committee, and was presented with the award during the ASM Annual Meeting. The award was established in memory of the late Dr. J. Herbert Hollomon, a graduate and former MIT faculty member, who was noted for his dedication in promoting positive societal consequences of science and technology. Dr. Hollomon was also the principal initiator of the international journal of the science of materials, *Acta Metallurgica.* Professor Flemings was also honored by The Materials Research Society (MRS) as the recipient of the 1997 David Turnbull Lectureship. He was cited for "his contributions to the foundations and technology of solidification processing and for educating a generation of materials engineers." The David Turnbull Lectureship recognizes the career of a scientist who has made outstanding contributions to understanding materials phenomena and properties through research, writing, and lecturing.

Dr. Tae Kwon Ha, a Visiting Scientist in Professor Samuel M. Allen's group, was selected to receive the 1998 Young Scientist Award of the Korean Institute for Metals (KIM). Dr. Ha visited MIT from the Center for Advanced Aerospace Materials at the University of Science and Technology as part of a collaborative program with MIT's Materials Processing Center (MPC). His research focuses on experimental studies of high-temperature deformation mechanisms in metals including superplasticity and deformation-induced phase transformations. Dr. Ha received the award in February, 1998 at the KIM annual meeting. In addition, Dr. Ha gave a presentation on behalf of Dr. Robert C. O'Handley, who was one of about a dozen US scientists invited to speak at the June, 1998 symposium at the Max Planck Institute in Halle, Germany, on the effects of stress and strain in thin films and surfaces.

Professor Linn W. Hobbs was the Plenary Lecturer at the Joint Fall Meeting of the American Ceramic Society, Glass and Optical Materials Division; Optical Society of American Conference on Bragg Gratings; 12th International Conference on Optical Fiber Sensors in Williamsburg, VA on October 25-28, 1997. Professor Dorothy Hosler was named the Hennebach Visiting Professor in the Humanities at the Colorado School of Mines, where she will spend the 1998-1999 academic year. The purpose of the Hennebach Chair is to infuse the Division of Liberal Arts at Colorado School of Mines with new perspectives, courses, and teaching methods and to help stimulate faculty interest and student involvement in the humanities. The chair was created with an NEH Challenge Grant that was met by Ralph E. Hennebach, a 1941 metallurgy graduate of Mines and the former chairman, CEO and director of the American Smelting and Refining Company (ASARCO). During Mr. Hennebach's tenure at ASARCO the company supported Professor Hosler's dissertation and her post-doctoral research at MIT on ancient Mexican metallurgy. Professor Hosler is currently on sabbatical in west Mexico, where she is investigating the earliest copper smelting and alloy production sites in Mesoamerica. During the past academic year she gave many distinguished lectures on and off campus, including those at: Colorado School of Mines, Dumbarton Oaks Distinguished Spring Lecture Series, Washington, DC; Conferencia Magistrial, Americanistas Conference Quito Ecuador; Conferencia Magistral, International Conference on Ancient Mining, San Luis Potosi, Mexico; the Lecture Series at SUNY

Albany, NY; the Distinguished Lecturer of Banco del Oro, Bogota Colombia; the MIT Knight Fellows, and the Harvard University Archaeology Department. She will return to MIT in the fall of 1999.

Professor Klavs Jensen, joint appointee in the Department of Materials Science and the Department of Chemical Engineering was elected Chair of the Materials Science and Engineering Division of the AIChE. Professor Lionel C. Kimerling received the 1997 Humboldt Senior Scientist Research Award, and The Minerals, Metals, Materials Society (TMS) 1999 John Bardeen Award. In addition, he was appointed President and Member-at-Large of the TMS Foundation Board of Trustees. The Board of Trustees of the American Ceramic Society approved a new Society Award in honor of Dr. W. David Kingery, a former professor in the department who is widely acknowledged as the most influential figure in the development of ceramics education, research, and technology in the 20th century. The W. David Kingery Prize will be awarded annually to recognize "distinguished lifelong achievements involving multidisciplinary and cross-cultural contributions to ceramic technology, science, education and art." The new award was presented at the Centennial Meeting of the Society in May, 1998, and the first recipient was W. David Kingery. The award was conceived to honor Kingery's outstanding contributions to the development of ceramics curricula, research and technology. Dr. Kingery, who received his Sc.D. degree in 1950 from MIT, served on the MIT faculty from 1951 to 1988. In the early 1950s he established at MIT the first graduate education and research program in what has become physical ceramics. In 1960 Dr. Kingery wrote the first edition of the field's seminal textbook *Introduction to Ceramics,* now in print for over 35 years and translated into several languages. His more than 200 scientific papers have had enormous impact on the course of ceramic science and technology through pioneering work in such areas as thermal properties, liquid phase sintering, oxygen ion conductors, defects and transport, and grain boundary phenomena. Dr. Kingery joined the faculty of the University of Arizona in 1988, where he is the Regents' Professor of Materials Science and Anthropology.

Professor Ronald M. Latanision gave the Keynote Lecture at the McFarland Award Golden Anniversary Symposium at The Pennsylvania State University. Professor James D. Livingston will present the Strant Memorial Lecture at the Rare-Earth Magnets Conference in Dresden in August, 1998. Professor Anne M. Mayes received the 1998 Materials Research Society's (MRS) Outstanding Young Investigator Award at the April 13, 1998 MRS Spring Meeting in San Francisco where she gave a talk titled, "Tailoring Polymer Surfaces for Controlled Cell Behavior." The award recognizes exceptional, interdisciplinary scientific work in materials research by a young scientist or engineer who also displays leadership in the materials area. Professor Mayes was cited for "incisive theoretical and experimental investigations of macromolecules at and near surfaces and interfaces leading to tailorable surface properties, especially novel biocompatible substrates." In addition, the department was pleased to honor Professor Mayes with the distinction of being the first awardee of the inaugural Joseph Lane Award for Excellence in Teaching in the Department of Materials Science and Engineering. This biennial prize was established thanks to a gift from Dr. Joseph R. Lane (ScD '50) who, prior to his retirement, was a senior staff metallurgist with the National Materials Advisory Board of the Commission on Engineering and Technical Systems.

Professor Michael F. Rubner and student Yot Boontongkong of the Department of Materials Science and Engineering, and Professor Mary Boyce of the Department of Mechanical Engineering and Sarah Clark of the Department of Chemical Engineering, shared in a $15,000 GenCorp Foundation research grant given in April, 1998. GenCorp's Signature Program provides technology partnership grants and student achievement awards to universities "renowned for their exceptional polymer science and engineering programs." Professor Subra Suresh was awarded the 1997 Distinguished Alumnus Award by the Alumni Association of the Indian Institute of Technology in Madras. This award honors alumni "who have distinguished themselves in their careers," and recipients are selected from among 10,000 alumni of the Indian Institute of Technology, many of whom occupy leading positions in academia and industry around the world. Professor Suresh received a Bachelor of Technology degree from the Institute in 1977. Professor Edwin L. Thomas participated in many distinguished outside activities during academic year 1997-1998. He was selected as the Centennial Lecturer for the American Physical Society and as the National Science Foundation (NSF) Distinguished Lecturer in Mathematical and Physical Sciences. In addition, he Chaired the Gordon Conference on Polymer Physics and he was the Symposium Organizer at the spring, 1997 Materials Research Society Symposium in San Francisco called "Metastability and Critical Phenomena in Polymer Science."

RESEARCH HIGHLIGHTS

During the past year Professor Allen has worked to apply the The Three-Dimensional Printing™ version of the rapid prototyping process to the manufacture of hardenable metal tools for injection molding of plastic parts, directly from computer-aided design (CAD) models. The approach involves three-dimensional printing of binder into metal powders and subsequent infiltration with a lower melting-temperature alloy. Recent developments include new heat treatable powder/infiltrant alloy systems with improved as-infiltrated machinability, development of a materials system with the potential for high-temperature applications such as metal die casting, and exploration of reactive binder materials systems for use with metal powders, as well as continuing development of an extensive thermochemical database for materials selection and process design for production of hard tooling by three-dimensional printing. Professor Allen is actively developing alloys based on the Fe-Ni-Co system that show promise for improved processability at reasonable cost.

A new class of alloys for actuator applications is under development at MIT in collaboration with Dr. Robert C. O'Handley. These alloys undergo large axial strains (in excess of 1%) through their interaction with a magnetic field. The mechanism of the shape change is being investigated experimentally and such materials' capacity for performing mechanical work is being characterized. The strain mechanism involves reorientation of different crystallographic variants in martensites, due to magnetostatic interaction. This new class of materials is becoming known as magnetic shape-memory alloys.

Professor Sandra L. Burkett has been busy this year overseeing the renovation of her new laboratory. She will investigate the interaction of proteins and small organic molecules with ceramic surfaces. The ability to control protein adsorption through engineering of ceramic surfaces should be relevant to the development of ceramics for vaccine and drug delivery. In addition, since surface-adsorbed proteins provide the critical intervening layer through which cells interact with an implanted biomaterial, results of these studies should have implications for the development of biocompatible ceramics and ceramic coatings for orthopedic use. In Professor Gerbrand Ceder's research on Lithium-Metal-Oxide cathodes he developed the first-ever "quantum engineered" new material. Using first-principles computational methods he predicted $Li(Co,Al)O_2$ materials to have a substantially higher lithium intercalation potential than $LiCoO_2$. This material has then been synthesized by Professor Yet-Ming Chiang and tested in battery configuration by Professor Donald R. Sadoway. Using similar techniques the researchers have also been able to shed light on the possible failure modes of intercalation cathodes in Li batteries. In more fundamental research, Professor Ceder presented the first detailed calculation of the effect of lattice vibrations on configurational disorder (in Ni_3Al), an effect which was previously neglected in ab-initio phase stability calculations.

During 1997, Professor Yet-Ming Chiang initiated a new research program under ONR sponsorship on the Growth and Characterization of High Strain Single Crystal Piezoelectrics. In his research on advanced lithium battery materials, new cathode materials based on aluminum-doping of lithium transition metal oxides have been developed and licensed for commercialization. His research on the chemistry and structure of interfaces identified conditions under which nanometer-thick intergranular and surface films are stable, and explained for the first time the mechanism of activated sintering in the solid state in ceramic systems.

Professor Michael J. Cima began two major new research programs, the first with sponsorship from American Superconductor Corporation to develop the MIT TFA process for coated conductors, and the second with sponsorship from TDK Corporation to develop 3DP for manufacture of ceramic RF filters. During the past year Professor Cima was the first to describe gel plating in several public meetings. This sparked widespread interest in gel plating as a method to replace large plating baths required for electrodeless plating. Professor Joel P. Clark developed a research program with the University of Stuttgart, and ETH Zurich, in Life Cycle Analysis (LCA) of automotive materials and products, working with most of the automotive assemblers in the US. and Europe. This LCA framework is being used to analyze the costs and highlights of: new light weight designs (e.g., aluminum, steel and polymer composite designs); electric vehicles vs. low emissions IC vehicles; and recycling technologies and policies. Professor Thomas W. Eagar, working with his graduate student Patricio Mendez, developed a new method of scaling dimensional parameters in large complex thermofluid mechanical systems. This technique has the capability of quantitatively defining the principle parameters of interest in a wide range of complex systems.

This year has seen advancement and key discoveries in two critical areas in Professor Eugene A. Fitzgerald's research, which also are the underpinnings of two PhD theses in his group. First, in order to integrate 1.3 micron

optical devices on GaAs, high-quality relaxed InGaAs layers must be produced on GaAs. Through experiments growing InGaAs in the MOCVD reactor, and analysis using the NSF MRSEC Center characterization equipment, he was able to determine that spinodal decomposition, induced by the dislocations which are introduced to relieve the lattice mismatch, was occurring in the InGaAs gradedlayer. The second advance in his research will lead to the ultimate achievement in this field: high quality, monolithically integrated GaAs on Si. A key step in his methodology is to create relaxed graded SiGe layers in between the Si and Ge (or GaAs, same lattice constant) to mitigate the lattice-mismatch and thermal expansion issues. The completely miscible SiGe alloy system allows him to deposit a graded structure that minimizes dislocation nucleation and encourages dislocation propagation, leading to low threading dislocation densities in relaxed SiGe alloys on Si. During the past academic year Professor Merton C. Flemings successfully completed a solidification experiment in space on nucleation and growth of stainless steels under micro-gravity conditions. He continued observations of flow and solidification behavior at rapid rates with a high speed (40,000 frames per second) video camera.

In Professor Lorna J. Gibson's project on mechanical behavior of aluminum foams she has been measuring a variety of mechanical phenomena, including uniaxial stress-strain behavior, multiaxial stress-strain behavior and creep. Work is in progress on microstructural characterization and modelling, and preliminary testing has begun of some structural components such as sandwich beams. Professor Gibson has continued her work on progressive damage in trabecular bone, demonstrating that the creep of fully dense cortical bone could be described by existing models for metal matrix composites and that the creep of trabecular bone could be described by combining that model with one for cellular solids. She is now working on higher temperature fatigue testing and on finite element modelling of both fatigue and creep in trabecular bone. Over the past year, Professor Gibson has developed a method of digitizing the images of strained cracks to quantify the amount of damage in the bone. She completed a project on interpenetrating composites and is currently writing several papers on this work. She measured the uniaxial properties of several types of such composites including a stainless steel/bronze alloy used in MIT's work on 3D printing of tooling components. The finite element models gave a good description of the mechanical behavior of the composites. In new work on tissue engineering begun in collaboration with Professor Yannas, studies on the mechanical interaction of the porous matrix with fibroblasts are being done to improve the understanding of the mechanism by which the matrix reduces scar formation. In work with Professor Griffith, measurements of the mechanical properties of porous matrices are being taken for use in cartilage and bone regeneration.

Professor Linn W. Hobbs has made substantial progress in optimizing the computational codes for local-rules based modeling of glass structure and radiation-induced reordering and amorphization in network structures, sponsored by the Department of Energy (DOE). This approach has been applied to silica (all crystalline polymophs and silica glass), SiC (both major crystalline polymorphs) and Si_3N_4 (both polymorphs), and represents a topologically-based alternative to molecular dynamics (MD) approaches. This work has attracted considerable attention and has been the subject of five invited presentations at major meetings in 1997. Professor Dorothy Hosler's research involves studies of rubber production in an Ancient Mesoamerica Collection of latex samples, and the observation of native methods of coagulation, and sampling for elemental analysis of ancient Mexican rubber balls at the Peabody Museum at Harvard University. In addition, she is involved in three collaborative research programs. The first is in collaboration with the Instituto de Geologia y Instituto de Geofisica and involves collection of ore samples to expand lead isotope work. The second is with the government of Colombia to investigate prehispanic copper processing and production in that country, and the third is with the Instituto Mexicense de Arqueologia to carry out surveys of ancient mining sites in the Balsas river region in Mexico.

Professor Kimerling developed new processes for high yield and performance in silicon processing. Transition metal gettering from silicon wafers is a key to integrated circuit process yield. Professor Kimerling incorporated models for the process which he developed into a process simulator that allows design of the wafer consistent with process flow. Last year he developed models for point defect reactions based on experimental data from his radiation effects studies. This year he created a simulator from these models and applied it to Reactive Ion Etching. The simulator accurately predicts the dependence of defect introduction on wafer specifications. It is the first defect/diffusion simulator to be based entirely on experimental data. The development of supercritical water as a vehicle for chemical waste destruction continues to attract attention. The selection of the materials of construction for large scale systems is the central focus of the work done by Professor Ronald M. Latanision. In particular, he has identified thermodynamic conditions in potential-pH-temperature space which allow materials such as nickel-based and titanium-based alloys to be protected while not compromising the waste destruction efficiency.

Professor Heather N. Lechtman continues a long-term research program on the development of bronze alloys in the Andean culture area during prehistory. This year was devoted to determining the phase diagram and some physical properties of a ternary Cu-As-Ni bronze alloy that was in common use in the southern Andes (Bolivia) during the Middle Horizon (ca. A.D. 600-1,000). This kind of bronze was discovered by Professor Lechtman during her 1995 field research in Bolivia. It was used in the architectural I-cramps that clamp together sandstone blocks in the monumental buildings at Tiwanaku, capital of the great South Andean Middle Horizon state. Professor James D. Livingston submitted a manuscript to Wiley Publishers for a textbook to be used in subject, 3.10, "Chemical Physics of Materials."

In Professor Anne M. Mayes' work several schemes for developing nanotechnologies hinge upon the ability to create patterns of discrete chemically homogeneous domains on the scale of nanometers. Given this paradigm for device production, the possible utility of block copolymers, which spontaneously order into nanoscale domains of uniform size and spacing, has been amply noted. In practice, however, the use of block copolymers for device production has seemingly been limited by the fact that the patterns one might produce are restricted to the domain morphologies these systems display in nature. Professor Mayes has developed a novel simple scheme for more general nanoscale chemical patterning of block copolymer films that exploits the dependence of block copolymer morphology on film thickness. By controlling local film thickness, she demonstrated that topographical information, provided it has an appropriate amplitude, can be transformed to chemical patterns on the sub-micron scale utilizing block copolymer thin films. The observed phenomena is consistent with self-consistent mean field predictions of film morphology for symmetric diblock copolymer films of sub-lamellar thickness. Professor Frederick J. McGarry developed and patented several ways to toughen rigid silicone resins, and in other research is working toward an understanding of the causes of brittleness in silicon metal.

MIT's worldwide reputation as a center of expertise in magnetic sensors and magnetoelasticity has spawned newly funded programs (Finland, DARPA and Lord Corporation) in novel actuator materials, and three in magnetic thin film devices (Applied Magnetics) for Dr. Robert C. O'Handley's group. The actuator work has quickly attracted attention from ONR, ARO, GM and EG&G. This year he demonstrated field induced strain in these materials under loads up to 120 Mpa. Further, he demonstrated for the first time that they can be operated above their austenite finish temperature. His pioneering work of imaging and understanding of domain structure in ultrathin Cu/Ni/Cu/Si (001) films continued to receive wide acclaim. This year he was the first to show that variations in magnetoelastic coupling with film thickness are not a surface effect but rather a second-order effect due to the misfit strain in thin epitaxial films.

Former department head, and now retired, Professor W. Owen has collaborated with Professor Mica Grujicic (Clemson University) to develop the theory of interstitial strengthening of austenite, which they published a few years ago, in order to explain quantitatively the remarkable solution strengthening, work hardening, and strain aging phenomena in Fe-12Mn-1.3C (Hadfield steel). The model, using pair exchange energies deduced from the ThermoCalc database, has been extended to compare carbon and nitrogen strengthening of highly alloyed Fe-Ni-Cr and Fe-Mn-Cr quaternary alloys. The results are in good agreement with the limited available experimental data. One of their objectives is to combine the model with phase equilibrium data to design high-nitrogen steels and other advanced austenitic alloys. Some progress in that direction has already been achieved.

The determination of the magnetization distribution throughout the thickness of a thin film is of importance both from a fundamental point of view and in industrial applications including magnetic recording. In Dr. David I. Paul's previous work he centered on single surface semi-infinite media. In his current work he studies the magnetization orientation in a thin film with two surfaces, thus containing the film thickness as a parameter. Graphs are given of nucleation fields as a function of the surface anisotropy for various film thickness for various orientations of the applied field. Remanent state magnetization distributions throughout the film thickness are given. It is shown that when the film thickness is small compared with the exchange length, the magnetization remains approximately constant throughout the film thickness, its value depending on the magnitude of the surface anisotropy. As the film thickness increases, the region of rotation becomes more localized to the film surface, reducing for thick films to about the size of the exchange length.

In work on Humanitarian Demining Research begun in 1998, Professor Robert M. Rose designed a system for differentiating dielectric materials in high explosives, casings and detonator materials by complex susceptibility signatures. In other research on Microtechnology, he worked on molecular dynamic modelling of the behavior of liquid water in high electric fields. Working with Professor H. I. Smith of the Department of Electrical Engineering and Computer Science, Professor Caroline A. Ross has manufactured templates for electrodeposition for arrays of magnetic particles with a 200 nm period. She has also deposited chromium and cobalt alloy films on silicon and hard disk substrates while determining conditions necessary to obtain the proper texture in the chromium film. These advances have the potential to continue the growth in magnetic recording storage data density for a number of years to come. Professor David K. Roylance's research has centered on process-structure-property investigations of polymers and composite materials, dealing especially with mechanical properties. Among these topics have been the durability of filled elastomers subjected to large cyclic loads, the role of chain extension versus crosslinking in high-temperature polymer matrix resins, the role of processing variables on the morphology and properties of toughened polyamide resins, the modeling of flow and heat transfer during infiltration processing of composites, and the response of ultraoriented fiber to high-speed impact.

Over the past year, Professor Michael F. Rubner has successfully fabricated new red-light emitting electroluminescent devices that exhibit external quantum efficiencies as high as 3% and luminance levels as high as 500 cd/m^2 (five time the brightness of a computer screen). In addition, he has continued development of techniques suitable for modifying the wettability of surfaces including contact lenses. Professor K. Russell further developed his theory for the unusual nucleation processes which occur in such non-equilibrium materials as thin films undergoing ion mixing and light water reactor pressure vessels undergoing irradiation. Promising agreement has been found between the theory and existing experimental data. A joint program with Northrop-Grumman under the Office of Naval Research sponsorship is in progress. Earlier theoretical and experimental work on controlled porosity in cast metals by the Naval Research Laboratory, the Dnepropetrovsk Metallurgical Institute in Ukraine, will be reduced to practice. The Civilian Research and Development Foundation is supporting a joint program with Professor Russell and the University of Kiev, Ukraine, on self-organizing systems. Professor Donald R. Sadoway's work in collaboration with Professors Ceder, Chiang, and Mayes has resulted in several major discoveries related to solid-state rechargeable lithium polymer batteries. Electrochemical testing has demonstrated that the group has identified (Ceder) and synthesized (Chiang) new cathode active materials that are far cheaper than those used in today's commercial product.

In Professor C. Scott's research the lattice-Boltzmann method has been used to simulate breakup and coalescence of phase domains in three-dimensional flows. Flow phenomena which have been investigated include capillary wave instability, droplet deformation in simple shear, droplet breakup in simple shear, end-pinching of an elongated domain, and coalescence of a doublet. Quantitative comparisons have been made with experimental and theoretical results in the literature. The agreement with experiments in simple shear flow is excellent. The lattice-Boltzmann method accurately predicts the shape and orientation of a droplet subject to simple shear flow. This method also correctly reproduces the dependence of the critical capillary number for droplet breakage on the viscosity ratio. His lattice-Boltzmann simulations also correctly predict the behavior of an elongated domain in terms of whether it end-pinches or retracts. The experimentally observed dependence of system behavior on viscosity ratio and aspect ratio has been successfully reproduced. In investigations of doublet coalescence he has demonstrated limitations of the lattice-Boltzmann method due to finite mesh size and he has suggested improvements to the simulation scheme. Simulation of domain size and shape at high concentrations of the dispersed phase has revealed new insights into the behavior of these systems which he is continuing to investigate. Professor Scott's understanding of the phase inversion mechanism during compounding of immiscible polymer blends has advanced rapidly. His work has clearly elucidated how the relative transition temperatures and relative viscosities of the two components along with the temperature history determine whether or not phase inversion will occur during processing. Morphological changes near the phase inversion point have been identified and quantified.

Professor Subra Suresh has identified a new gradient profile for coatings and surfaces which suppresses tribological damage. In addition, he has developed a new method for the characterization of the dielectric and piezoelectric constants for sensors and actuators. This year Professor Edwin L. Thomas published a long review/future potential article in *Science*. This article describes the recent advances and research opportunities in liquid crystals, block copolymers and hydrogen-bonded complexes. Key to the development of new devices will be the manipulation of complementary and antagonistic interactions to create order in materials over many length scales.

Professor Carl V. Thompson developed a grain-structure-sensitive (and therefore process-history-dependent) simulator for prediction of integrated circuit interconnect reliability, MIT/EmSim. A version of this simulator has been made available for use over the web, and is in use by scientists and engineers by a number of IC manufacturers (including Motorola, DEC, AMD, and IBM) as well as researchers of other universities. He modified his grain growth simulation for simulation of grain structure evolution in interconnects with complex shapes, and developed this tool (GGSim) for use with IC layout tools as well as with MIT/EmSim, for prediction of the reliability of design-specific and layout-specific interconnect configurations. He also developed a new hierarchical reliability assessment methodology for assessing the reliability of the networked interconnect of specific integrated circuits. A tool based on the use of algorithm, ERNI, is under development in collaboration with Professor D. E. Troxel of the Electrical Engineering and Computer Science Department. In addition, he designed and fabricated microelectromechanical sensors for in situ monitoring of the stress in thin films which develops during deposition and post-deposition processing. This will provide an important new tool for experimental and theoretical studies of the co-evolution of stress and microstructure in polycrystalline thin films. Finally, he demonstrated the use of ion-induced chemical vapor deposition for the deposition of polycrystalline thin films with unique nanocellular structures which have potential interest for applications in magnetic or microelectromechanical devices.

Dr. Gerardo Trapaga conducted two successful experimental campaigns during the NASA space shuttle missions STS-83 (one week duration due to problems with the orbiter) and STS-94 (full reflight mission in July, 1997). A very significant amount of experimental data was collected on viscosity and surface tension measurements of metallic and glass-forming materials. The preliminary analysis of the data demonstrated the containerless technique to perform these kinds of measurements. The experiments allowed measurements of these properties to very high degrees of undercooling, and it is expected that viscosity measurements will also provide insight on the corresponding free flow regimes in the electromagnetic levitation system. It is hoped that this will determine the critical Reynolds number for levitated droplets. Other research during the year focused on the development of mathematical models and process analysis in different areas of interest in the materials field (PVD, plasma spraying, electric arcs, electromagnetic levitation and electromagnetic stirring and separation). In addition, he made significant progress in a project on industrial ecology in steelmaking.

Professor Tuller's work achieved breakthroughs in the micromachining of the wide band gap semiconductor SiC. This will have important implications for the processing of high temperature-high power electronics and MEMS for aggressive environments. In work on ZnO grain boundaries, Professor Tuller conducted oxygen and cobalt diffusion measurements in single crystal and polycrystalline ZnO as a function of temperature, Po_2 and crystal orientation. Grain boundary diffusivities were typically 4-5 orders of magnitude higher than the bulk diffusivities. A defect/transport model is in development capable of predicting cation and anion diffusivities over wide experimental conditions. His collaborative research with Professor Chiang examined oxygen nonstoichiometry in nanocrystalline ceria, x in CeO_{2-x}, directly by solid state coulometric titration revealing values of x on the order of 10^{-3} - 10^{-4} at 400-450°C and Po_2= 0.21-10^{-5} atm compared to a 10^{-9} for coarsened material. Apparent discrepancies with their earlier electrical measurements were resolved by considering the formation of neutral oxygen vacancies.

Professor John B. Vander Sande continues his research work processing superconducting oxides under high magnetic fields (up to 10T) at elevated temperatures to produce highly textured, high performance wires. On the materials science front he developed an understanding of the fundamental influence of this thermomagnetic process on both the nucleation and growth of superconducting grains and, thereby, on texture. On the practical front, he is aggressively pursuing the formation of thick film (10-100 m) on substrate wires for superconducting applications. These wires must exhibit superior superconducting properties as well as excellent mechanical properties.

In Professor Bernhardt J. Wuensch's research establishment of a connection between a structure determined at ambient temperature and a property measured at elevated temperature can lead to spurious conclusions if the structure at elevated temperature is not preserved upon cooling. In studies of pyrochlore oxides, $A_2B_2O_7$, in fuel cells, Professor Wuensch showed that the increase in anion disorder induced by substitution of a larger ZR^{4+} ion for Ti^{4+} in $Y_2(Zr_yTi_{1-y})_2O_7$ could account for an increase in oxygen conductivity by three orders of magnitude to levels attractive for application in fuel cells. Mixing between occupation of the cation sites proceeded at a very different rate with increasing y than did disordering of the anion arrangement. Three order parameters rather than one proved necessary to specify the state of disorder. He subsequently determined the structures of $Y_2Sn_2O_7$ and Y_2

$(Zr_{0.6}Ti_{0.4})_2O_7$ as a function of temperature (20 to 1500°C) and oxygen partial pressure. Yttrium stannate is a fully-ordered pyrochlore whereas the zirconium-titanium solid solution has approximately 50% disorder in the anion array but only slight mixing of the occupancies of the cation sites. The objective of these recent analyses was to determine whether the state of disorder in situ at temperature—especially that of the highly-mobile oxygen ions—is preserved as the sample is quenched and also to observe the progress of anion and cation disorder as a function of temperature. Scattering data obtained in the Intense Pulsed Neutron Source at Argonne National Laboratory showed that the structure of $Y_2Sn_2O_7$ remained fully ordered at temperatures up to 1500°C. An unexpected result, however, was that the oxygen ion array became progressively more distorted at elevated temperatures. This result could be successfully interpreted in terms of different rates of thermal expansion of the Y^{3+}-O^{2-} bonds. The partially-disordered yttrium titanium zirconate displayed the onset of additional thermally-induced disorder at 1200°C. The structure and fast-ion conducting properties of this solid electrolyte should thus be expected to be a function of thermal history and/or processing conditions.

DEPARTMENTAL AWARDS

The initiates during the 1997-1998 academic year into the MA Beta Chapter of Tau Beta Pi Engineering Honor Society were: Anita J. Chung, Carla E. Heitzman, Jessica S. Lai, Andrew W. Sparks, Andrew R. Takahashi, Christine H. Tsau, and Evangeline M. E. Yeo.

Maisha Grey, a DMSE junior, was named *The Tech's* Athlete of the Week for the week of March 17, 1998. Maisha was recently selected as a New England Women's 8 Conference all-star, and helped lead the Engineers to a 17-7 record, the best in MIT women's basketball team history. DMSE senior Melody Kuroda was named the 1998 recipient of The Minerals, Metals & Materials Society's (TMS) Presidential Scholarship, the society's most prestigious student award. The award is presented annually to an undergraduate student majoring in metallurgical engineering, materials science and engineering, or minerals processing/extraction who has demonstrated outstanding academic and leadership performance. Melody was presented with the award at the 1998 TMS Annual Meeting and Exhibition in San Antonio, Texas in February, 1998. Melody has earned numerous honors and awards throughout her undergraduate years in the department. These include: the 1997 Barry M. Goldwater National Scholar; 1997 Caterpillar Scholar Award; the 1996 Myrtle and Earl Walker Scholarship-SME; 1996 George A. Roberts Scholarship-ASM International; 1996 Pell Scholarship-COHEAO; and the 1996 TMS/SMD Scholarship. Melody is a member of Tau Beta Pi National Engineering Honor Society; Alpha Sigma Mu National Honor Society, and the Cum Laude Society.

Matthew Lozow, a DMSE junior, was one of 26 MIT sophomores and juniors selected as Burchard Scholars in the School of Humanities and Social Science for 1998. The awards, named after the School's first dean, John Ely Burchard, are given to students who demonstrate unusual abilities and academic excellence in the areas embraced by the School. The Burchard Scholars and a rotating group of faculty will be invited to a series of dinners at which an MIT faculty member or visiting scholar will present work in progress, followed by a discussion. This will allow students and faculty members to mix and will give students, especially, an opportunity to engage in the kind of intellectual exchange that characterizes scholarship in the humanities, arts and social sciences. The emphasis throughout the program is interdisciplinary.

In May, 1998 six seniors were accepted as associate members in the Society of Sigma Xi, The Scientific Research Society of North America: Sharon Chang, Kim Marie Levis, Hsin-Chiao Luan, Jennifer Ann Pinson, Justin Sanchez, and Patrick Trapa. Matt Farinelli, a graduate student in Dr. O'Handley's group, was awarded full financial support to attend a week long workshop in August, 1998, on "Spintronics" the new class of electronic devices based on the spin of ferromagnetic thin films.

In June, 1998 senior Patrick LeClair won the award for Best DMSE Senior Thesis. His thesis titled, "Titanium Nitride Thin Films by the Electron Shower Process," was written under the supervision of Professor Caroline A. Ross. Nicole D. Gerrish received the award for Best III-B Internship Report for her internship at Draper Laboratories. Her report was titled, "Metal-Si Interfaces in MEMS Devices: Mechanisms of Formation and Electronic Characteristics." Meredith A. Rising received Honorable Mention for her III-B Internship Report for her internship at Los Alamos National Laboratory. Her report was titled, "Microbial Corrosion of Aluminum Composites." The award for Outstanding Student: DMSE Class of 1998 was given to Benjamin P. Nunes, who was honored for both his outstanding academic record and the strong leadership role he holds within the department

student body. Certificates of Honor for a Perfect 5.0 Cum were given to Nicole D. Gerrish, Wendy L. Mao, Benjamin P. Nunes and Sara L. Ransom. The department was pleased to present awards for Outstanding Service to William Danny Perez and Ryan J. Kershner. Danny Perez received the award for Outstanding Service to the MIT Community for his leadership in the Society for Hispanic Professional Engineers. Ryan Kershner received the award for Outstanding Service to the Department for his participation in and support of many of DMSE's academic and social activities during academic year 1997-1998.

Of the 37 students who graduated in June, 1998 with the SB degree, nine are staying on for graduate school here. Of those nine students, four received NSF Graduate Fellowships: Jeri'Ann King, Melody Kuroda, Benjamin Nunes and Patrick Trapa, and two enrolled in the III-B Internship Master's program: Kim-Marie Levis and Nicole Gerrish.

In May, 1998 four graduate students were accepted as associate members of the Society of Sigma Xi, The Scientific Research Society of North America: Bruno Cheron, Minha Hwang, Matthew Rosenthal, and Christopher Vineis. Two graduate students were accepted as full members of the Society of Sigma Xi: Patricio Mendez and Song Zhao.

Benita J. Dair, a graduate student in Professor Thomas' group, was awarded the 1998 MRS Student Award. Graduate student, Michael J. Fasolka received the "Technical Creativity" award at the Amoco/PPST Poster Competition on November 5, 1997. In addition, The Materials Research Society (MRS) honored Michael with a 1997 MRS Graduate Student Award. Luis Ortiz, a graduate student in Professor Sadoway's group, received the William L. Stewart Award at MIT's 1998 Awards Convocation. The award is presented to students who have made outstanding contributions to co-curricular activities and events during the preceding year. The award is funded under a grant from the W. L. Stewart Jr. Memorial Foundation in memory of Mr. Stewart, a member of the MIT Corporation from 1952 until his death in 1963. Luis was honored for being a leading force behind the Student Advisory Committee to the Task Force on Student Life and Learning.

In December, 1997, Patrick Pallot, who performed his Master's degree research under the direction of Professor Subra Suresh, was awarded the best research award by the Ecole Polytechnique in France. Patrick was one of several students from the Ecole Polytechnique who carried out their final year research projects at European and American universities during 1997. Patrick's research at MIT led to a report entitled, "Two-Dimensional Contacts Between Graded Elastic Materials." A panel of professors at Ecole Polytechnique elected Patrick for this prestigious award based on the quality of his work. Patrick was honored at a special ceremony at the Ecole Polytechnique. Philip Soo, a graduate student working with Professor Anne Mayes' group received the 1997 Electrochemistry Society I.E.E.E. Division H. H. Dow Memorial Student Award.

DMSE graduate student, Jian Luo along with postdoctoral associate Haifeng Wang, who are both in Professor Yet-Ming Chiang's research group, won first prize in the Graduate Student Poster Contest at the meeting of the New England Section of the American Ceramic Society in June, 1998. The John Wulff Award for Excellence in Teaching during academic year 1997-1998 was awarded to David E. Wooley.

Fellowship awards for one or more semesters were held during academic year 1997-1998 by 55 students: Institute fellowship were held by two students: Valarie I. Benezra, Henry Bromfield Rogers Fellowship (Office of the Dean of Graduate Education); Samuel A. Newell, MIT Environmental Fellow. Department Fellowships were held by 11 students: Thomas Bessom, Allegheny-Ludlum MPMI Fellowship; Sara H. Buta, Lord Foundation Fellowship; Min-ha Hwang, Loeb Foundation Fellowship; Miguel A. Marioni, Roberto Rocca Fellowship; Jonas D. Mendelsohn, Starr Foundation Fellowship; Jeffrey D. Nystrom, Ronald A. Kurtz Graduate Fellowship in MS&E; Rodrigo J. Quintero, Lord Foundation Fellowship; Michael J. Read, Lord Foundation Fellowship; Douglas J. Twisselmann, Loeb Foundation Fellowship; Augustine M. Urbas, Starr Foundation Fellowship; James A. Yurko, Nicholas J. Grant Graduate Fellowship. DOD NDSEG Fellowships were held by 12 students: Benjamin Hellweg, Neil T. Jenkins, Lisa M. McGill, Thomas J. Nugent, Wynn S. Sanders, Kevin M. Chen, Matthew J. Farinelli, Michael E. Groenert, Jason R. Heine, Andrew Y. Kim, Samuel A. Newell, and Stephen C. Britten. NSF Fellowships were held by 13 students: Jiang-Ti Kong, Sara L. Ransom, Amy C. Richards, Eric J. Wu, Paul R. Birch, Christine S. Hau, Thomas A. Langdo, Debra J. Lightly, Michael J. Fasolka, Darrell J. Irvine, Erin B. Lavik, Sanjeev Makan, and Martin L. Panchula. A variety of other Fellowships were held by 17 students: Emiliano Cecchetti, 1997 Italian Trade Commission Scholarship; Vanessa Z.-H. Chan, IBM/Almaden Cooperative Fellowship; Michael F. Durstock, Air Force Fellowship; Kevin M. Eberman, Argonne National Laboratory Graduate Participant Fellowship; Toby M.

Freyman, NIH Training Grant; Laura M. Giovane, AT&T Fellowship; Peter Y. Hsieh, Draper Fellowship; Olivera E. Kesler, ONR Fellowship; Esther M. Ku, DOE Technical Leadership Development Program Fellowship; Alice M. Man, EPA Fellowship; James E. Neely III, DOE Fellowship; Anne-Valerie G. Ruzette, Belgian American Foundation Fellowship; Sajan Saini, Quebec, Canada, Government Fellowship; Amy L. Smith, DOE Fellowship; Gianni Taraschi, Quebec, Canada, Government Fellowship; Surekha Vajjhala, Beinecke Brothers Memorial Scholarship; Anton F. Van der Ven, DOE Fellowship.

CLOSING REMARKS

The past year has been an important one for the department in that the faculty have developed a strong sense of community and have begun to establish a coherent long-range strategic plan. Morale has improved significantly as compared with the immediate prior years. Our challenges for the future are implementation of our three new strategic thrust areas and the hiring of new, young faculty. We are continuing to make progress in curriculum development at both the undergraduate and graduate levels, and we are beginning to see a modest expansion of our departmental research effort. The past year has been marked by a new sense of unity and increased participation by all members of the department. After several difficult and somewhat troubling years we have emerged with a new sense of purpose and greater strength and commitment than ever before.

More information about the Department of Materials Science and Engineering can be found on the World Wide Web at the following URL:http://tantalum.mit.edu/

Thomas W. Eagar

DEPARTMENT OF MECHANICAL ENGINEERING

The Academic Year 1997-98 has been a particularly successful one for the Department of Mechanical Engineering. Course II's new undergraduate curriculum has made a positive impact on the quality of our undergraduate education, and faculty members have devoted a significant effort to make the new curriculum successful. New textbooks are being written to emphasize the new pedagogy that stresses the integration of disciplinary knowledge.

The Department continues to thrive in research, both in basic engineering science and in technology innovation. The Department began a new research effort in the field of bio-instrumentation. This focus arose through the collaborative efforts of our faculty in the bioengineering area, some of whom have joined the Department recently. Similar efforts are being planned in the field of energy to strengthen the research infrastructure, consolidate existing activities, promote synergistic activities, and increase external visibility. The Center for Innovation in Product Development funded by NSF has begun to make a significant and positive impact on the Department's research and education. These activities are complementing other strong research efforts in the d'Arbeloff Laboratory for Information Systems and Technology, the Laboratory for Manufacturing and Productivity, the Manufacturing Institute, and Engineering Science. The research in these areas is well funded by industrial firms and government agencies.

The MIT-Pappalardo Series of Mechanical Engineering Books will be published by Oxford University Press, which is created with the endowment fund given by Mr. and Mrs. A. Neil Pappalardo. The books expected to be published in this series should have a major impact on Mechanical Engineering education at MIT and elsewhere in perpetuity.

The student enrollment in the Department has been nearly constant over the past decade with approximately 400 sophomores, juniors and seniors and 400 graduate students.

The high cost of implementing the new curriculum, particularly the increased requirement of hands-on and laboratory experiences, has placed a large strain on our budget. The Department also has a critical shortage of space which is impacting the quality of our educational and research programs. These are not new problems, but they continue to have a serious negative impact.

The Department of Mechanical Engineering continues to enjoy the highest reputation among all mechanical engineering departments in the United States. To maintain this tradition, we continuously re-examine all aspects of our educational and research activities.

Our departmental goals of the last five years have been as follows:

Education: To create future leaders in engineering, industry, research, academia, and society at large.

Our specific goals are: (1) to provide a broad-based engineering education, (2) to develop an ability to execute engineering tasks by providing students with an integrated view of engineering, (3) to encourage active learning, (4) to provide hands-on experience, and (5) to enhance the students' ability to deal with engineering tasks using both analytical and design skills.

Our graduate program is designed to provide professional and scholarly education for those interested in academic, industrial and research careers. We continue to emphasize original research as an integral part of graduate education.

Research: The Department is seeking to make an impact on society, industry, academia, and the knowledge base by being the best at the two opposing ends of the research spectrum, i.e., fundamental knowledge generation and technological innovation.

Service: The Department is keenly aware of the fact that for MIT to succeed, we must work with other universities to improve the quality of education; and with industry, to help them become competitive and productive. Ultimately, we seek to improve the quality of life for humankind.

We revised the undergraduate curricula for Course II and for Course II-A to help us achieve these goals in all three areas. Course II-A is intended for those who seek education at the interface between traditional mechanical engineering and other disciplines such as biology, business, public policy, large systems, and information.

The Department formed large research groups in order to increase flexibility and intellectual opportunities. In addition to those in design, manufacturing, information and bioengineering, we are actively working towards forming a large research group in thermal energy. These research groups draw their intellectual base from the basic disciplines that are present within the Department as well from those outside.

The research programs of the Department are strong. The MIT-Industry Partnership for Engineering Excellence was formed to strengthen our research support base and to conduct long term research efforts in areas of industrial importance. Efforts are also being made to conduct large systems research programs to teach students all aspects of systems engineering by involving them in this type of research. The Department's research volume has been increasing rapidly in recent years. The total research volume in FY98 is estimated to be $23,329,932, and is 10% greater than FY97, 28% greater than FY96 and 54% higher than FY95.

This increase is, in part, due to several large research projects related to development of complex engineering systems. This is a result of our attempt over the past several years to teach more systems related topics through involvement of graduate students in execution of large R&D projects. These large projects are typically interdisciplinary and multi-disciplinary. Students working on these projects learn about the systems aspect of engineering, in addition to disciplinary research issues. These systems projects will complement our traditional strengths in investigating well focused disciplinary research projects.

The Department's research support base is broad. Our research is supported by government agencies, many different industrial firms, and foundations. Some contracts and grants are administered through the Department and by the interdepartmental laboratories or centers. The funds come in as overhead bearing research contracts and grants or as gifts which has a limited overhead burden. Federal government support is 35%, industrial support is 54%, and foundation support is 11%.

An ongoing effort is being made to solicit gifts from our alumni, friends and corporations to continue to strengthen the financial base of the Department. We need more senior chairs for faculty, better space for research and education, more fellowships for graduate students, and a funding base to initiate new research endeavors in areas that have not yet been explored.

UNDERGRADUATE CURRICULUM

Course II: Implementation of New Undergraduate Curriculum

Our new undergraduate curriculum has made a major impact for the betterment of the learning process for our students. An example is the new required subject 2.670 (Mechanical Engineering Tools). This two-week, 80 hour subject offered during IAP has changed the outlook of our undergraduate students. They learn the essence of engineering in this subject through acquiring computer and machining skills. This course also promotes a close fellowship among 150 sophomores at a scale never achieved before.

The Undergraduate Curriculum Committee has done an outstanding job of implementing the new curriculum under the leadership of Professor David Gossard.

One of the major intellectual challenges of the new curriculum is that we have begun to work on the integration of subjects in the four required sequences: Sequence 1: Mechanics and Materials; Sequence 2: Systems, Dynamics, and Control; Sequence 3: Thermodynamics, Heat transfer, and Fluids; Sequence 4: Design and Manufacturing.

These efforts are being coordinated by "Designated Professors" who are in charge of these subjects. They, with the help of other colleagues, are determining course content, developing teaching materials, and establishing faculty consensus. These professors are at the center stage of implementing the new curriculum.

One of the central concepts of the new curriculum requires a completely new set of teaching materials because we want to provide students with an integrated view of engineering by teaching, for example, thermodynamics, heat

transfer, and fluid mechanics in an integrated manner. This process began concurrently with the new curriculum. One of the most exciting developments of this year has been the establishment of the MIT-Pappalardo Series of Texts in Mechanical Engineering which will be published by Oxford University Press. This effort has been made possible by the generous endowment made by Jane and Neil Pappalardo. The proceeds from this fund will enable faculty to spend time during the summer, and even the academic year, on producing educational material.

Course II-A

The Department has implemented its revised curriculum for Course II-A. The goal of Course II-A is to provide a more flexible curriculum for those interested in seeking a broader education than the more structured Course II. The six options currently provided under Course II-A are:

1. Biomedical Engineering and Pre-Medicine
2. Technology-Policy and Pre-Law
3. Management and Entrepreneurship
4. Large-Scale Systems Design
5. Information and Computation
6. Open Track.

Our goal is to increase the enrollment of students in Course II-A substantially. Professor Seth Lloyd, the professor in charge of Course II-A, has initiated a number of activities to introduce the freshmen class to Course II-A.

Graduate Curriculum

A committee under the leadership of Professor Ain Sonin has begun to examine our graduate curriculum. During the coming academic year they will make recommendations to the Department concerning both fine tuning the current program as well as major innovations as may be needed.

RESEARCH

Innovation by the faculty and students

The Department has a strong research program, ranging from basic research to technology innovation. Many seminal papers and patents have resulted from these research projects. The topics range from mechanics applied to biological systems, nonlinear dynamics of bubbles, computational mechanics, design of quantum mechanical computers, biomechanics, design of products, design theory and methodology, to manufacturing processes and systems, microcellular plastics, new sealing technology, rapid prototyping, ATM, precision stages, high speed machines and tools, instrumentation, nanoelectromechanical devices, to combustion processes in IC engines.

Large systems research projects

Most academic research is comprised of small scale projects involving one professor working with a limited number of students. It is difficult to do research on large system design and manufacturing issues in this context. A part of the problem is developing a working relationship with industrial firms willing to fund such a large project. The Department has begun to work on large systems projects in collaboration with and with the support of industrial firms. Students and faculty are designing and manufacturing a large system for semiconductor industry under the leadership of Professor Jung-Hoon Chun, Dr. Andre Sharon and Dr. Nannaji Saka through the Manufacturing Institute. Professor Ian Hunter is leading an effort for a large project with the sponsorship of a bioengineering firm. System research is also being conducted in the d'Arbeloff Laboratory for health care automation under the sponsorship of a consortium of industrial firms led by Professors Harry Asada and Ian Hunter. Other large projects are also being negotiated with industrial firms.

New Laboratory for Bio-Instrumentation Systems

The Department created a new Laboratory for Bio-Instrumentation Systems. The faculty group in bioengineering and related fields have chosen instrumentation for bioengineering and biomedical sciences -- measurements, devices, control, and information required to deal with biological and medical sciences -- as one of the Department's focused areas of excellence for two reasons. First, advances in instrumentation will be a pre-requisite in making further progress in biology and medicine. Second, the Department is the home for the basic disciplines needed for bioengineering instrumentation including materials, manufacturing, information, optics, mechanics, controls, thermal science, mechanics and design. Thus, the Department's effort in this area will provide the "third leg" of the

biology-medicine-engineering triad, which will dominate socio-economic activities of the 21st century, and at the same time, strengthen the basic disciplines of Mechanical Engineering.

MIT has a long and impressive record of successful instrumentation research. Many of the instrumentation laboratories in the past at MIT primarily developed instrumentation for military applications (e.g. Radiation Lab., Draper Lab., Lincoln Lab.). Our Laboratory for Bio-Instrumentation Systems has as its major objective to produce instrumentation for use in the bio-medical areas (e.g., medicine and healthcare, bio-technology, molecular biology, physiology, biophysics, toxicology, pharmacology, cell biology). These areas are growing very quickly with a voracious appetite for instrumentation. It is our objective to make the new MIT Laboratory for Bio-Instrumentation Systems the world center for advanced bio-medical instrument research and development.

Last year, the Department has also initiated the MIT-Industry Partnership for Engineering Excellence with Silicon Valley Group, Inc. as its first partner. The goal of the program is to establish a long-term relationship with industrial firms so that MIT can conduct fundamental research in the partner firms' areas of interest. Both MIT and partner companies gain in achieving their mutual and individual goals. Since then, we have added an additional research project sponsored by SVG. We now have similar relationships with Cadus and Caterpillar with million plus funding for an individual program.

CHALLENGES

There are many short- and long-term challenges facing the Department. The foremost on the short-term list is the lack of space for the Manufacturing Institute, the Center for Innovation in Product Development and the Laboratory for Bio-Instrumentation Systems. We need to have this issue resolved in the near future at the School and on the Institute level. Another space related issue is the renovation of the laboratories in Buildings 3 and 35.

MAJOR ACCOMPLISHMENTS AND SPECIAL EVENTS

The two major accomplishments of the Department in AY 1997-98 are the establishment of the MIT-Pappalardo Series of Texts in Mechanical Engineering to be published by Oxford University Press, and the formation of the Laboratory for Bio-Instrumentation Systems. The text book series, which has been made possible by the generous gift of Mr. & Mrs. A. Neil Pappalardo, will have an impact on Mechanical Engineering education everywhere, while the Laboratory will enable modern developments in Biology to have their intended impact on the practice of Medicine.

SPECIAL RECOGNITION

The faculty members continue to receive major recognition. Over the Academic Year 1997-98, the following faculty members were recognized for their various contributions: Professor Ali Argon - ASME Nadai Medal; Professor Mary Boyce received the Keenan award and the Bose Award; Professor Doug Hart received the Bose Award; Professor L. Mahadevan was named the Karl Van Tassel Career Development Professor; Professor Rohan Abeyaratne was elected Fellow, ASME.

Professors Wai Cheng, Alexander Slocum and Kamal Youcef-Toumi were promoted to the rank of Full Professor.; Professors Frank Feng, Doug Hart, Seth Lloyd and Kevin Otto were promoted to the rank of Associate Professor without tenure.

The Department continues to attract some of the most promising young faculty members. The following faculty member joined the Department in Academic Year 1997-98: Samir Nayfeh, Assistant Professor, Interest in design.

More information about the Department of Mechanical Engineering can be found on the World Wide Web at the following URL: http://me.mit.edu/

Nam P. Suh

DEPARTMENT OF NUCLEAR ENGINEERING

The department was again rated the top department in its field by *US News and World Report.* The consistency of this ranking over many years has reflected the quality of scholarship by students and faculty in the department.

In December 1997, the Nuclear Engineering Visiting Committee met with the department. In general they were pleased with the smoothness of the transition to a new department head. They were, by and large, in agreement with the faculty on the problems and possible solutions facing the department and urged us to carry our long-range planning activities one step further by developing a detailed strategic plan.

Professors Jeffrey Freidberg and Richard Lester, acting as coordinators, developed a strategic plan to guide the department over the next 5–10 year period. The plan has achieved consensus among the faculty, and we are now seeking a wide range of external input. Implementation has already started and should be in full swing by the fall semester.

In relation to the strategic plan, the department has initiated a major recruiting drive to increase both graduate and undergraduate enrollment. Professor Neil Todreas, aided by Professor David Cory, is leading the effort on graduate recruiting. Professor Kim Molvig is leading the undergraduate effort.

UNDERGRADUATE PROGRAM

A record 30 students were enrolled in the undergraduate program during the past year. This included eleven sophomores, nine juniors, six seniors, and four fifth-year students. Three students completed requirements for the bachelor's degree in nuclear engineering.

GRADUATE PROGRAM

The graduate program totaled 116 students during the fall term. Of this number, 28 were enrolled for their first term. Forty-two percent are specializing in radiation science and technology; 38 percent are working in fission and energy studies, and 20 percent in fusion. The department awarded 30 master's, 2 engineer's, and 14 doctoral degrees during the academic year.

Lab subject 22.104 was introduced fall 1997. This was the last course of the four-subject Core Curriculum, a requirement for all doctoral candidates. The newly restructured doctoral qualifying examination will be introduced fall 1998. Candidates will complete the written portion in September and the oral portion during the following spring term.

Professor Cory presented a new seminar on magnetic resonance, 22.915. Faculty revised the content of eight existing subjects.

Nuclear Proliferation: Technology and Control (22.903) was developed and offered for six weeks during the spring term by Dr. Kory Sylvester. Dr. Sylvester received his doctorate from NED and currently holds the position of postdoctoral associate.

FACULTY HONORS, AWARDS, AND ACTIVITIES

The Ruth and Joel Spira Award for Distinguished Teaching was presented to Professor Kent Hansen. This award acknowledges the tradition of high quality engineering education at MIT.

The American Nuclear Society (ANS) MIT Student Chapter Outstanding Teaching Award was presented to Professor Jacquelyn Yanch.

Professor Todreas continued as chairman of the INPO Advisory Council. He served on the Department of Energy working group to develop its Nuclear Energy Research Initiative Program.

Professor Michael Golay was appointed to the INPO Advisory Council.

Professor Ronald Latanision was named a Fellow of the American Academy of Arts and Sciences. He was honored as a Centennial Fellow by the College of Earth and Mineral Sciences at the Pennsylvania State University. He was a Visiting Professor at the University of Naples, Italy.

Professor Mujid Kazimi chaired an MIT panel to review the project on Accelerator Based Transmutation of Nuclear Waste (ATW) at the Los Alamos National Laboratory. He resumed chairmanship of the Hanford Tank Waste Panel for DOE-Richland, which he had chaired in the period 1990–1995. He was a member of the review panel of the Fission Energy and System Safety Program of Livermore National Laboratory. In April he and Professor Golay organized a two-day workshop at MIT on research priorities for nuclear energy in a greenhouse constrained world.

Professor Sidney Yip chaired a committee which organized a three-day Institute-wide international workshop on Multiscale Materials Prediction: Fundamentals and Industrial Applications. The September 1997 workshop was supported by the MIT Center for Materials Science and Engineering with collaboration from the Industrial Liaison Program and the Materials Processing Center. Faculty from the departments of Physics, Materials Science and Engineering, Chemical Engineering, and Mechanical Engineering participated.

Professor Sow-Hsin Chen was an invited speaker at the Toyota Symposium on Nano-structure Materials which was held in Nagoya, Japan, in November 1997. In December, he was invited to speak at the Boston meeting of the Materials Sciences Society. He also spoke in March at the American Physical Society Meeting which was held in Los Angeles.

RESEARCH

FISSION

Professors Neil Todreas and Michael Driscoll are researching advanced reactor designs involving novel containment cooling concepts for Korea Electric Power Research Institute and advanced boiling water reactor designs for Tokyo Electric Power Company. Professors Driscoll, Golay, Meyer, and Todreas have continued to study means of improving the economic performance of the US nuclear operating fleet by investigating the technical and economic constraints to extended reactor cycle operating lengths.

Professor John Meyer and Zaichun Feng of the MIT Department of Mechanical Engineering initiated a project that is aimed at studying approaches to reduce the severity of fluid induced vibrations. Initial efforts are concentrated on understanding sources of intense noise being generated in main steam lines of an operating nuclear power plant.

Professors Kazimi and Driscoll have initiated an investigation of advanced nuclear fuel cycles to allow higher efficiencies in uranium ore utilization, spent fuel production, and proliferation resistance. The application of dry recycling of LWR spent fuel in CANDU reactors was investigated. This will allow the extraction in the CANDU reactor of about 15 MW-days/ton from the LWR spent fuel, i.e. enhance the energy utilization of the LWR fuel by about 30 percent. If the United States could supply such fuel to Canada, both the United States and Canada could reap considerable economic and environmental benefits from cooperation on such a fuel cycle.

Professor Golay's research topics include the following: completion of an on-line power plant monitoring and expert system for improved power plant operational availability; improved strategy for nuclear power development to alleviate global warming; and a project to show benefits and to refine risk-informed performance-based safety regulation. He and Professor Todreas are working on methods for plant management to improve power plant operational availability.

Professors Ronald Ballinger and Jeffrey Freidberg and a graduate student are developing a procedure for determining pipe thickness from a series of external impedance measurements. Such a procedure would be of great safety value and economic importance to the nuclear power industry, where steam pipe thinning due to corrosion is a critical problem. The new procedure saves time (i.e. money) by allowing continuous monitoring of pipe thickness without the need for shutdown as is the current practice.

The entire fission research group has developed a strategy and initiated implementation of a Center for Management of Nuclear System Performance and Risk.

RADIATION SCIENCE AND TECHNOLOGY

Professor Yip's research in the theory and simulation of materials across different length and time scales continues to focus on fundamental challenges in long standing problems, such as crystal plasticity and fracture, thermal conductivity in defective solids, and migration of radioactive nuclides, which have significant current technological implications. His particular thrust is in atomistic simulation studies of complex materials systems. Several sponsored projects involving students and a sizable number of collaborators at the Institute and elsewhere are at the center of a growing area of research, becoming known as multiscale materials modeling. A noteworthy success, reported in the journal *Nature*, is the linking of large-scale molecular dynamics simulations with mesoscale dislocation dynamics. A number of international workshops and calls for proposals by national funding agencies are currently focusing on the emerging role of materials modeling coupled with high-performance computing, indicating an increasingly broad-based recognition of its relevance to various institutional programs in universities, national laboratories, and corporate research.

Professor Chen developed a new method for measuring interfacial curvatures in porous media using small angle neutron scattering techniques which were based on a theory of clipped random wave. A theoretical method for computing low shear viscosity of dense colloidal solutions based on analysis of small angle neutron scattering data was developed. The method should find wide applications in polymer industry. His research group identified a kinetic glass transition temperature in super-cooled water based on a computer molecular dynamic simulation.

The development of supercritical water as a vehicle for chemical waste destruction continues to attract attention. The selection of the materials of construction for large scale systems is the central focus of the Uhlig Corrosion Laboratory, under the direction of Professor Latanision. In particular, he has identified thermodynamic conditions in potential-pH-temperature space which allow materials such as nickel-based and titanium-based alloys to be protected while not compromising the waste destruction efficiency.

Professor Kenneth Russell continued to develop a theory for nucleation in solids under irradiation. Progress was made on including a source term for cluster injection in addition to cluster destruction through irradiation cascades. He entered into a collaboration with Professor V. Sugakov of the University of Kiev on the kinetics of self organizing systems.

Professor Otto Harling, along with medical collaborators at the Beth Israel Deaconess Medical Center (BIDMC), Drs. Paul Busse and Robert Zamenhof, Professor Peter Griffith of Mechanical Engineering, several staff of the Nuclear Reactor Laboratory, and six MIT graduate students, has continued research in the area of neutron capture therapy for cancer. Clinical trials for a particularly refractory form of brain cancer (glioblastoma multeforme) and for metatstatic melanoma on the extremities and in the brain were continued. The goal of these Phase I trials is to determine the maximum tolerable dose so that Phase II trials efficacy can be initiated. Tumor control has been observed for two peripheral melanoma subjects and for one subject with a melanoma brain metastasis even though the doses delivered were well below the maximum tolerable level.

In a separate but related project, $2.5 M in construction funding has been granted to the Nuclear Reactor Laboratory for a new medical irradiation facility to be used for neutron capture therapy at the MIT Reactor. The facility is based on a design developed at the NRL and uses a fission converter to produce a high intensity and high purity epithermal neutron beam suited for neutron capture therapy. When the new facility is completed in two years, the MIT/BIDMC group will have the best beam for neutron capture therapy and will be well positioned to conduct advanced clinical trials and eventual routine therapy.

Professor Freidberg and Drs. Stefano Migliuolo, Ali Shajii, and Jay Jayakumar developed a novel method for mapping the magnetic fields in the large detectors located in high energy particle accelerators. The method makes extensive use of Green's theorem and the theory of integral equations to greatly reduce the cost and time of traditional volume mapping techniques to a much simpler surface mapping procedure. The procedure is now being implemented on the PHENIX detector of the RHIC facility at Brookhaven.

FUSION

Under the direction of Professor Ian Hutchinson, the Alcator C-Mod tokamak continued its studies in high-performance, compact magnetic plasma confinement. Very large core plasma rotations have been measured in

plasmas with no external momentum input. The rotation is a key factor in understanding the reduction of transport by flow shear stabilization. Important new structure of the edge confinement barrier was measured using new high-resolution diagnostics, and the turbulence responsible for the degradation of this barrier has been documented. Edge plasma research demonstrated sustained divertor detachment during high confinement mode operation with minimal impact on the core plasma. In this work, the otherwise very large plasma heat flow to the divertor plates is reduced by large factors by volumetric radiation and recombination processes, through the addition of trace impurity gases. Plasmas that are identical in dimensionless plasma parameters to those on the much larger JET tokamak have been obtained. The results confirm the applicability of the dimensionless scaling approach over the largest range of sizes yet studied.

Professor Freidberg and his graduate student completed an analysis of energy transport in a reversed field pinch (RFP) fusion configuration. By assuming that the magnetic field and pressure profiles relax to a state which is marginally stable to the Suydam criterion (because of the related MHD turbulence), they derived an expression for the energy confinement time. This expression is in exact agreement with the empirically determined scaling law obtained from various RFP data.

Professor Freidberg, Dr. Joseph Minervini, and a graduate student are developing a continuum model of a multistrand superconducting CICC magnet in order to explain the ramp rate limitation observed in certain coils. This is a significant modeling effort attempting to account for transverse geometric effects in cables with as many as 1000 strands with time varying transport current and transverse fields.

Professors Kazimi and Meyer continued their investigation of the limits on heat removal from plasma facing components by highly subcooled water. Tests were carried out that showed when water velocity is 15 m/s or above, the heat flux removed in channels of a few mm diameter can be on the order of 25 MW/sq. m.

ENVIRONMENT AND WASTE TECHNOLOGY AND POLICY

In order to expand nuclear waste management research within the department, Professor Kenneth Czerwinski initiated a program to investigate health hazards associated with nuclear waste. In collaboration with the Center for Environmental Health Sciences, this program is multidisciplinary and includes Institute toxicologists and environmental engineers. It will have three main aspects: investigation of a site contaminated with nuclear waste; biological effects of radiation; and examination of health records of areas near nuclear installations. Results will be used to quantify and model the effect of radioactive waste on human health. As with other Center programs, results will be communicated to the public.

Professor Czerwinski obtained first selective separation of lanthanides with ion specific resins. The selective uptake of Eu from aqueous solutions containing La was investigated and the ionoselectivities of the resins were compared. The separation factors obtained (S = 6.2, 6.9, 9.9 + 5%) by phenolic ion-exchange resins from aqueous solutions indicate that ion-specific resins can be developed for the specific separation of actinide ions from nuclear waste.

Professors Golay and Hansen continued work on the representation of the interactions between management policies and nuclear plant performance. They completed the development of a simulator model of plant operations.

STUDENT AWARDS AND ACTIVITIES

Extracurricular NED student functions center around the MIT American Nuclear Society Student Branch. There have been many social and athletic events during the year, reflecting the interests of its members. The Monday Afternoon Seminar Series, NED Orientation for incoming students, holiday party, and international dinner are a few of the successful events from the past year.

The MIT Chapter of the Alpha Nu Sigma Society, a national honor society for students in applied nuclear science and nuclear engineering, recognized 15 graduate students and 2 undergraduates for their outstanding academic achievement. The MIT Health Physics Society Student Branch's activities are focused on environmental radiation transport, radiobiology, and radiation detection and measurement.

Several students were recognized at the annual international dinner/awards ceremony. The Roy Axford award for outstanding academic achievement by a senior in nuclear engineering was given to Eric Empey. The Irving Kaplan award, which recognizes academic achievement by a junior in nuclear engineering, was presented to Marc Berte.

The Manson Benedict Fellowship for 1998-99 will be shared by Damien Hicks and Roberto Accorsi in recognition of their excellence in academic performance and professional promise. The Theos Thompson Memorial Fellowship was held by Daniel Caputo and Laura Murphy during fall 1997.

The William and Ann McCormick Fellowship was given to Jacopo Buongiorno. The Sherman Knapp Scholarship, funded by Northeast Utilities, was presented to Michael Reynard. National Academy for Nuclear Training Fellowships for 1997-98 were held by Anthony Chatelain, Michael Folkert, and Michelle Ledesma.

The Outstanding Student Service Award, which recognizes exceptional services to the students, the department, and the entire MIT community, was presented to Christopher Handwerk. The Outstanding TA Award was presented to Mr. Buongiorno in recognition of his exceptional services to education as a teaching assistant.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/ned/www/

Jeffrey P. Freidberg

DEPARTMENT OF OCEAN ENGINEERING

The goal of Ocean Engineering is to develop the knowledge and technology to foster and enable the wise and effective use, development, and preservation of the ocean, its natural resources and environment. Our mission is to educate students to meet this challenge and to provide them with the foundation for life-long learning and growth to become leaders in this exciting field.

MAJOR ACCOMPLISHMENTS

Academic Year 1997-98 continued to be an exciting year for the Department of Ocean Engineering. Continuing with our efforts to strengthen our undergraduate program, we made extensive use of our new Ocean Engineering Teaching Laboratory during the summer of 1997. With marine robotics being the common theme of our student projects, I am pleased to report that three new marine robots have been developed. *Autolycus* is a new submarine robot designed as a teaching tool and as a platform for student research in autonomous underwater vehicles. During the Summer Workshop, a team of three UROP students completed the development of an autonomous boat designed to follow and log the position of a large fish, such as a shark, tagged with an acoustical transmitter. This work was the culmination of a multi-year student research project which originally began at MIT Sea Grant. Last summer the students developed the boat to the point where it can follow a boat towing an acoustic fish tag. Finally, during the fall semester of 1997, a UROP student proved that you don't have to be high-tech to build a marine robot. She built a small remotely-operated vehicle out of PVC pipe and small, inexpensive motors. This vehicle, called the *Sea Perch*, was the focus of an undergraduate seminar class (13S36) taught this past spring in which ten students were enrolled. In addition, we began initiating the prefreshman activity, "Discover Ocean Engineering," planned for August of 1998. Dr. Thomas Consi is a key player in these activities.

With the development of the new Teaching Laboratory complete, our focus is now on the creation of a student testing tank under the direction of Professor John Leonard. This is an essential part of our strategy to improve our facilities for undergraduate education and, indirectly, our enrollment. This new testing tank will provide hands-on experimental facilities for both undergraduate and graduate students with regard to education and research. This new tank will serve as an adjunct to our new and highly successful OE Teaching Laboratory directly across the hall, and will be used in conjunction with OE class projects and UROP projects. Although the tank will be useful for marine robotics research performed by Professors Leonard and Triantafyllou, the major focus is on easy undergraduate access to the tank where students can perform in-water tests of the instruments that they are building. In addition, the tank will allow professors to perform simple demonstrations of marine instruments (such as sonar sensors in operation), for their classes.

Professors Patrikalakis and Schmidt are part of a project involving twelve partners from academia, government laboratories and industry in the development of the scientific and technical conceptual basis of a generally applicable inter-disciplinary littoral ocean and observing system, the Littoral Ocean Observing and Predictive System (LOOPS). The partners bring to the program diverse and relevant expertise and experience in interdisciplinary ocean science: systems and ocean engineering; data assimilation and ocean prediction methodologies; and synthesis and collaboration, as well as a suite of existing robust and tested measurement and model components for integration into the overall system.

UNDERGRADUATE EDUCATION

The Department's undergraduate curriculum remains focused on five areas:

- Hydrodynamics and Oceanography
- Structures and Materials
- Dynamics and Wave Propagation
- Mathematics and Computation
- Design/Application/Experience

During our departmental retreat in December 1997, the Department concluded that its undergraduate curriculum continues to provide a solid foundation in all the basics that make up the discipline of Ocean Engineering. Our most immediate need is to increase the number of our undergraduates. We determined that our first task was that prospective students be made aware of existing opportunities in the five major segments of the ocean industry: shipbuilding and design; shipping; offshore oil exploration and production; instrumentation; and acoustics. In

addition, we needed to identify new industries that could employ our graduates. We also needed to establish better dialogue with Industry to find out their needs and anticipate their future demands as well as making sure Industry knows about our students. Finally, we need to evaluate how responsive our curricula are to the needs of prospective employers. Although some degree of specialization is desirable at the graduate level, we have to be careful of the degree of specialization we introduce in our curricula at the undergraduate level.

It appears our strategy to increase our undergraduate enrollment has begun to pay off as we have increased our enrollment for Fall 1998 by 11 new students, for a total of 21 undergraduates. This was accomplished by a tremendous effort on the part of our faculty and staff, by personal contacts, through the efforts of the Freshman Seminars, preparation of a new undergraduate brochure and an exciting Open House in April, 1998. Four of our faculty presented Freshman Seminars in the fall of 1997. We will continue to review our undergraduate program on an annual basis to ensure that it is up-to-date and to fine-tune it as necessary. Our curriculum, which has been in place since 1993, appears to be working well. Except for minor adjustments and the introduction of an experimental hydrodynamics subject, we do not expect any changes in the foreseeable future.

Our new Ocean Engineering Teaching Laboratory for undergraduates has successfully completed its first year. We have invested in equipment (approximately $45,000) and we have raised funds from one of our alumni (Hin Chew Chung) to provide additional support and maintenance. The staff member responsible for the laboratory is Dr. Thomas Consi.

We will continue to increase the UROP activities in the Department. This past year we had 54 UROPs; 14 for Summer 1997, 15 for Fall 1997, 3 during IAP, and 22 for Spring 1998. Out of a total of 54 students, 13 were from Course 13 and the Department funded seven of these students from its General funds. Except for six students who took UROPs for credit, the remainder of the students were covered by research accounts and/or funds from the UROP Office. We will continue to run summer workshops in the OE Teaching Laboratory in order to expose the Institute undergraduates to Ocean Engineering. Dr. Consi will continue to run this program under my supervision, and I have earmarked substantial funds from our budget to supplement other funds to support this effort. The UROP program is an integral part of the Teaching Laboratory.

In another effort to increase undergraduate enrollment in our Department, we are launching the pilot for the MIT *Discover Ocean Engineering* program being offered for the first time in the summer of 1998. It is our intent to have approximately 30 incoming students attend this summer experience which will introduce them to the Department of Ocean Engineering as well as various aspects of MIT. The planned agenda includes hands-on experience building a small remotely operated vehicle (ROV), testing the ROV, and a chance to perform some actual research experiments with an ROV in Boston Harbor (see our Web page http://oe.mit.edu).

GRADUATE EDUCATION

Professor Paul Sclavounos chaired a committee which arrived at the current graduate level curriculum in hydrodynamics. The product was the emergence of the new sequence of subjects which follow 13.021 as the entry level hydrodynamics subject for our graduates. The sequence also includes 13.022 which teaches students free surface wave effects, 13.023 which exposes students to viscous and boundary layer effects, 13.024 which introduces students to numerical marine hydrodynamics, and 13.04 which discusses lifting and propeller flows to be taught in alternate years. In addition, two subjects were introduced into our curriculum to strengthen our 13A Program. The first, 13.391J, involves marine fabrication technologies (a joint subject with the Department of Materials Science and Engineering) and the second, 13.811, involves structural dynamics and acoustics.

Professor Nicholas M. Patrikalakis, with the assistance of Dr. Takashi Maekawa, have considerably revised and updated the notes for subject 13.472. These notes will become the basis of a new textbook in the area of geometric modeling which is currently under development. This is being supported, in part, by funding from the Dean's Office as well as the Department and the Kawasaki Chair. This textbook will have an impact on the educational activities of eight MIT professors whose research is related to CAD and computer graphics and numerous other academics around the world.

The current status of our graduate curriculum development builds upon the previous curriculum, which placed MIT's Department of Ocean Engineering in the forefront of marine education. We continuously monitor our

curriculum, and our faculty is committed to evaluating change and taking action where necessary. In addition to our new subjects which I mentioned earlier, a much more flexible graduate curriculum was developed and will be totally integrated into our program by September, 1998. We continue our effort to strengthen our relationship with Woods Hole Oceanographic Institution. As a result of this effort, our Master of Engineering degree is now part of the joint MIT-Woods Hole Program, combining the best the two institutions have to offer.

RESEARCH ACTIVITIES

The department's faculty and staff continued their pursuit of a variety of outstanding research programs, many of which are currently receiving worldwide attention, both inside and outside the field of ocean engineering.

Professor Arthur Baggeroer participated in the development of an exhibit, with the assistance of the New England Aquarium and a grant from NSF, entitled "The Sounds of the Sea" which informs the public of the importance of acoustical phenomena in the ocean. In addition, Professor Baggeroer worked on the Arctic Climate Observations using Underwater Sound project which will provide data on the large thermohaline change now occurring in the Arctic Ocean.

Professor Justin Kerwin is working on the development of a next-generation design and analysis method for marine propulsors. ONR has made a multi-year commitment in spite of reductions in hydrodynamics research.

Professor Judith Kildow has completed her book *Coastal Zone: Principles and Strategies for Management* which is expected to be published in early 1999. The book demonstrates how natural variations and human activities and perspectives create coastal problems.

Professor John Leonard is working on concurrent mapping and localization which is funded by the Naval Undersea Warfare Center (NUWC) as part of a collaboration between the US Navy and the French Navy. A longer term goal is to develop techniques for concurrent mapping and localization using natural terrain features.

Professor Nicholas Makris has continued both his experimental and theoretical work in remotely sensing the marine environment with underwater sound. This includes determination of oceanographic properties of the water column, geophysical characteristics of the sea floor, and the localization, imaging and classification of submerged objects. He is also working on an ONR sponsored program of statistical acoustics and environmental inversion after stochastic propagation and scattering in shallow water.

Professor Henry Marcus is working on a new project "Improving the Movement of Marine Containers: The Role of Smart Identification Tags." This project is supported by New Industry Research Organization (NIRO), a non-profit group based in Kobe, Japan.

Professors Koichi Masubuchi and Nicholas Patrikalakis are also involved in a NIRO project entitled *Advancement of Manufacturing Technologies Through Application of Laser Measurement Techniques and Fabrication.* In addition, Professor Masubuchi continues with his ARPA funded project on *Laser Forming for Flexible Fabrication.*

Professor Jerome Milgram has just completed a four and a half year study of the dynamic behavior of natural sea surfactants as well as thirteen years of work in the area of dynamics and extreme tensions in open ocean towing. The programs developed have been implemented on computers in the office of the Supervisor of Diving and Salvage at NAVSEA and will form a basis for the next edition of the U.S. Navy Towing manual. In addition, Professor Milgram is cultivating a new area in computational reconstruction of optical fields from holograms. This research focuses on holograms used to record quantitative scientific and technical data.

Professors Milgram, Leonard, and Schmidt are currently working on ultrasonic experimental modeling of acoustic scattering and are in the process of creating an Ultrasonic Modeling Facility to assist in the study of ocean acoustics propagation issues with funding assistance from the Dean's Office.

In the area of Computational Geometry and CAD/CAM, Professor Nicholas Patrikalakis is involved in a major new NSF and ONR funded project entitled, *Solid Freeform Fabrication (SFF).* The objective of this project is the development of a solid modeling method for SFF, providing support for functionally gradient materials, which is not

possible in today's CAD systems. In the area of Coastal Zone Management, Professor Patrikalakis continued working on the *Formulation of a Model for Ship Transit Risk.* The goal of this project is to develop a statistical model for evaluating the relative risk of ship transit through the nation's ports and waterways. This model will allow federal agencies (NOAA, USCG, and USACE) to perform their tasks more efficiently and rationally, and will enable the agencies to evaluate new technologies as they become available.

Professor Nicholas Patrikalakis has received a grant entitled *Poseidon: A Coastal Zone Management System Via the World Wide Web.* The Poseidon system's goals are to make scientific inquiry easier, quicker, and more collaborative in nature by creating an oceanographic metadata (data about data) standard and a software system that uses that standard to create a frictionless simulation environment. With the advent of new sensors, storage technologies, and especially the Internet, the potential exists for a new era of ocean science investigation. The resulting system will ease the burden of finding and retrieving the right oceanographic information and will automate many of the burdensome tasks in initiating and executing an oceanographic simulation.

Professor Paul Sclavounos continues with his research in the development of advanced computational methods for the prediction of loads and motions of ships and offshore structures.

Professor Michael Triantafyllou's research remains focused in the area of vorticity control and his autonomous robot fish. His research had been reported by the national media and he was a finalist in the 1998 *Discover Magazine* Award for technological innovation.

Professor Kim Vandiver remains active in the offshore industry and as Director of the Edgerton Center. For the offshore industry he continues with his research of flow induced vibration of risers and cables and is examining various techniques to suppress these vibrations.

Professor Tomasz Wierzbicki continues with his consortium on Tanker Safety Phase II and has begun a new Consortium on Ultralight Structures which involves strength, ductility, and fracture of welds with defects.

Professor Dick Yue's research encompasses areas such as hydrodynamics of fish-like vehicles, autonomous robotic vehicles, technology and maneuvering for flexible vehicles, and extreme wave-loads of offshore structures.

EDUCATIONAL INITIATIVES

Professor Nicholas Patrikalakis undertook a major effort in preparing an alumni survey (to assist our undergraduate program, obtain reliable statistics, and collect ABET related data). In addition, with the assistance of Professor John Leonard, they revised the OE web page and created a comprehensive jobs links for OE graduates in general, and built a "Career Profiles" web page for our graduates. Hopefully these activities will assist our undergraduate program to a major extent, as well as being useful for our graduate program.

Professor Henry Marcus is participating in two activities that will benefit our department, the first being a new International Logistics subject. As part of MIT's new MENG program in Logistics, Professor Marcus and Don Rosenfield, Leaders for Manufacturing Program, are developing a new subject in International Logistics which will be of interest and value to OE students. The second activity, the Extended Engineering Systems Council (EESC), is one in which Professor Marcus will participate with the School of Engineering to address issues of broader education. These new subjects will benefit our Ocean Systems Program and our Naval Engineers curriculum.

Professor Nicholas Makris is focusing his teaching efforts on developing a new undergraduate course 13.810, *Acoustic Sensing*, to satisfy Departmental and Institutional needs for an elective in the area of acoustics. He is also revising the undergraduate subject 13.015, *Mathematical Methods in Ocean Engineering*, by the introduction of statistical techniques.

Professor Dennis Mahoney has started efforts to redefine and reorient the 13A curriculum given the Navy's decision to reduce the program's duration from 36 to 27 months. This will involve distilling the current Navy Educational Skill Requirements (ESR) into core competencies, and then mapping those competencies to existing or potentially new subjects.

Professor John Leonard has devoted a great deal of time and energy to the department's undergraduate program in his teaching and co-teaching of undergraduate subjects (13.017, 13.018, 13.010), supervising UROP students in the OE Teaching Laboratory, and teaching a Freshman Advising Seminar for nine students, with great success.

Professor Michael Triantafyllou has recently secured approval for a space change in the basement of Building 48 to utilize some open space as a hydrology wet lab and to provide a secure area for staging field experiments.

PERSONNEL

Captain Alan J. Brown retired from the Navy but continued as a Senior Lecturer in the Department teaching 13.21, 13.122 and 13.60. He has accepted a position at Virginia Tech and part of his former teaching activities in Ocean Engineering will be taken over by Dr. David Burke, Senior Lecturer in Ocean Engineering, and former Senior Vice President and Vice President for Engineering of Draper Laboratory.

Dr. William Carey served a second year as a Senior Lecturer in the Department teaching graduate subjects in shallow water acoustics and sonar technology. He continues to work with ARPA and MIT to develop a comprehensive report on shallow water sonar technology which addresses the key performance and system technology issues concerning active/passive system performance in key littoral regions.

Professors Carmichael, Dyer, Newman and Ogilvie although retired, continued with student supervision, teaching and research.

Professor Chryssostomos Chryssostomidis played a key role in obtaining a grant from Hin Chew Chung to set up an endowed account for support of the Teaching Laboratory in the Department and was also instrumental in establishing the Edward C. Brainard II Fund to support undergraduate student financial aid. He co-chaired a Coastal America mini-conference in June, 1998 with Dr. Jerry Schubel, President of the New England Aquarium, in conjunction with the White House Conference on the Oceans in Monterey, California, which involved leaders from the local area regarding maritime issues. He is also the chair of the Local Organizing Committee for the International Conference on Computer Applications in Shipbuilding, a major international conference to be held at MIT in June, 1999.

Professor Ernst G. Frankel continued with his lecture series in the Center for Advanced Engineering Studies.

Professors Kerwin and Masubuchi, although retired, continued with 49% appointments and remain active in teaching, student supervision, and research.

Professor Judith T. Kildow was an invited delegate to the White House Conference on the Oceans in Monterey, California in June, 1998. She will be assembling a panel of economic and policy experts who will advise and help produce a major economic study on the oceans during the next several years.

Professor John J. Leonard received a National Science Foundation Career Award entitled *Dynamic Sonar Perception and Navigation* effective July 1, 1998 for a total of $200,000 over a period of four years. He also continues as the Henry L. and Grace Doherty Professor in Ocean Utilization through 1999.

Captain Dennis Mahoney, USN, replaced Captain Alan Brown as Professor and Head of the Naval Construction and Engineering Program on August 29, 1997.

Professor Nicholas C. Makris joined the Department on July 1, 1997, bringing the total faculty strength to 14. He was inducted as a Fellow of the Acoustical Society of America in December, 1997.

Professor Henry S. Marcus continues to hold the NAVSEA Chair (through ONR). He has also begun preparations for a two-day course in risk management to be held August 31 to September 1, 1998.

Professor Koichi Masubuchi received the Best Paper Award for his paper entitled "Development of Arc Welding Method for Building and Repairing Structures in Space" from the Japan Society of Mechanical Engineering.

Professor Jerome H. Milgram was elected a Fellow of the Society of Naval Architects and Marine Engineers.

Professor Patrikalakis was the workshop chairman for the NSF Invitational Workshop on Distributed Information, Computation, and Process Management for Scientific and Engineering Environments held in May, 1998. The objective of this workshop was to bring together scientists involved with the development and utilization of simulations of complex systems, and computer scientists working on distributed intelligent repositories and process management.

Professor Henrik Schmidt was on sabbatical at SACLANT in Italy for the Academic Year 1997-98 employing the MIT autonomous underwater vehicles in the study of 3-D acoustical scattering in shallow littoral environments as part of the Generic Oceanographic Array Technology (GOATS 98) Project.

Professor Michael S. Triantafyllou assumed the position as Head of the 13W Program.

Professor J. Kim Vandiver completed his first year as CGSP representative which became effective July 1, 1997. Professor Vandiver also continues to serve as Director of the Edgerton Center which provides opportunities for students, especially freshmen, to engage in projects in engineering and science. In addition, he was a member of the Search Committee for the Dean of Admissions.

LCDR Mark S. Welsh, USN, continued as Associate Professor of Naval Construction and Engineering.

STUDENT AWARDS

William R. Kreamer received the Society of Naval Architects and Marine Engineers (SNAME) Undergraduate award for FY98.

Gerard McHugh was awarded the National Graduate Student Paper Honor Prize at the Annual Meeting of SNAME in Ottowa, October, 1997.

Roger Anderson received the American Bureau of Shipping (ABS) Scholarship Award for FY99.

Douglas Read received the George N. Butzow Systems Corporation Graduate Fellowship Award from MTS Systems Corporation for FY99.

The following graduate students were awarded the Martin A. Abkowitz International Fellowship: Wonjoon Cho who attended the CGI 98 Conference, and Lian Shen and Kelli Hendrickson who will attend the 1999 ONR workshop in Pasadena, California on "Free-Surface and Wall-Boundaries Turbulence and Turbulent Flows."

In addition, Professor Judith Kildow was provided funds from this fellowship to attend the White House Conference on the Oceans in Monterey, California in June, 1998.

The winner of the 1998 Wallace Prize, Nicholas Hahn, will be provided a full academic year of tuition and stipend. Nick was selected from a list of extremely qualified candidates.

The Fifteenth Wallace Lecture was presented in April, 1998 by Marcia McNutt of the Monterey Bay Aquarium Research Institute. The title of her lecture was "Ocean Observatories: Present Effort and Future Prospects."

The Third Annual T. Francis Ogilvie Lecture, held in October of 1997, was given by Dr. Wade R. McGillis on "Interfacial Hydrodynamic Measurements in the Ocean." Dr. McGillis is currently an Assistant Scientist at the Woods Hole Oceanographic Institution. His research interests include the effect of turbulent boundary layers on the exchange of heat, mass, and the momentum at interfaces.

The Mit Naval Construction and Engineering Ship Design and Shipbuilding Technology Symposium is part of a series of symposia and workshops established in 1986 to bring together Navy, Industry and Academia to discuss important educational and research issues that affect naval construction and engineering and to help expose our Naval officer-students in Course XIII-A to the communities with which they will have to interact after graduation.

This year's event was held on May 19 and 20, 1998. Invited guests included members of the naval ship design community, U.S. Laboratories and the Office of Naval Research, as well as several major shipbuilders for the U.S. Navy. The featured speakers were Dr. Paris Genalis, Deputy Director Naval Warfare, Office of the Secretary of Defense; Dr. Reuven Leopold, President, SYNTEK; and Dr. Robert Winkler, Assistant to the Deputy Assistant Secretary (Ship Programs), Department of the Navy, Office of the Assistant Secretary (Research, Development, and Acquisition.)

Our 18th annual reunion was held at the Westin Ottawa on October 16, 1997. Professor Henry S. Marcus represented Ocean Engineering and brought the alumni up to date with regard to the Department and its activities.

FUTURE PLANS

During this past year we have been gathering information on alumni who received their degree from the Department. This ever-increasing list of graduate career profiles can be found on our web page(http://oe.mit.edu) and will also be produced in a brochure for the upcoming academic year. These profiles are being used to show potential students the possible career opportunities that are available to them.

In addition, in a continuing effort to increase awareness of our undergraduate program, the Department has offered to run the pilot program for the first undergraduate pre-freshman program offered by a department. This three-day program held just before Orientation Week in August is intended to bring freshman to MIT prior to the regular orientation period. The program is geared to help familiarize incoming students with life at MIT and to introduce them to Ocean Engineering by having them perform a simple, yet fun, experiment. The Department will follow up with several Freshman Advisor Seminars in the fall, UROPs during IAP, as well as Spring and Summer Terms 99. The program is limited to 30 students from the Class of 2002, showing them first-hand how ocean engineers create the technology that allows us to explore, utilize, and conserve the oceans in ways never before imagined. One goal of this program is to give these students a first glimpse of what engineering is all about and to let them sample some of the opportunities that the field of ocean engineering has to offer. A second, and perhaps more important goal is to get to know the students, build the basis for close relationships between them and the faculty, staff, and current students, and give them a preview of life on campus.

With the departure of Dr. Alan Brown, it has been decided to shift a portion of 13.21, *Ship Power and Propulsion*, into 13.410, *Introduction to Naval Architecture*, and to increase the units by six. In addition, the balance of 13.21 will be taught as a new 6-unit subject during IAP by Professor Douglas Carmichael.

Ship Structural Analysis and Design, 13.122, which was also taught by Dr. Brown, will be taught by Senior Lecturer David Burke. *Ship Production*, 13.60, will be moved to the summer, while 13.112, *Safety of Marine Systems*, will be on a one-year hiatus.

One of the new areas we are investigating is to introduce a new graduate subject, 13.40, *Principles of Naval and Marine Engineering*. This is one of three core subjects required for all NA & ME graduate students and may become two 12-unit subjects in a two semester sequence (Fall & Spring) offered every year beginning in Fall '98. Such a subject will replace 13.410.

More information about this Department can be found on the World Wide Web at the following URL: http://oe.mit.edu/

Chryssostomos Chryssostomidis

ARTIFICIAL INTELLIGENCE LABORATORY

The Artificial Intelligence Laboratory has undertaken a reorganization into spatially adjacent groups of intellectual commonality. We are using these larger groupings to pursue new research agendas and to become more involved in corporate sponsored research. Much of the year was spent in conversations with NTT which resulted in a five year research collaboration agreement that covers both the AI Lab and the Laboratory for Computer Science. We will pursue further industrial collaborations over the coming year.

Down in the basement, Professor Gill Pratt and his students are building new generations of walking robots, with applications in urban antiterrorism situations. At the same time, their fundamental work on understanding walking has led to a commercial collaboration with a manufacturer of leg prostheses. Soon, amputees throughout the United States will be walking around on artificial legs with intelligent knees, developed at the AI Lab. Next: ankles.

On the 4th floor, Professors Gerald Sussman and Hal Abelson are trying to make stuff, i.e. matter, smart. The fundamental idea is that as computing gets cheaper, we will be able to embed disposable computers in all manufactured material, even paint. Imagine walking up to a large wall with a can of paint riddled with tiny display elements and simply painting a huge high resolution display with a standard paintbrush. The goal of the "amorphous computing project" is to develop languages and algorithms so that the display elements can self organize to allow just this.

We are just completing renovations of the 7th floor to make a large new vision and learning environment. Professor Olivier Faugeras works on fundamental geometry of computer vision. Professor Berthold Horn is studying the propagation of light through biological material so that he can build visible light "x-ray" systems for medical imaging. Professor Eric Grimson is leading an active group in medical vision systems. Over the last few years, he has collaborated with Brigham & Women's Hospital and the image guided surgery systems they have developed are being used for brain surgery on real patients on a daily basis. These computer vision systems provide the surgeons with real time updates on where their instruments are inside the heads of patients, and relate that information to automatically extracted anatomical features from MRI scans. Professor Grimson works on a number of other vision systems also, and he and his students have developed new real time surveillance systems which allow cameras to monitor human and traffic activities to learn what is normal in a given situation and to automatically notice when something strange is happening. In collaboration with Professor Paul Viola, a new variable viewpoint reality system is being built. The ultimate idea is that a sports stadium, or the surface of Mars, might be decorated with 200 video cameras and you sitting at home get to choose the actual viewpoint you want to look at during the game, or exploration, and the system synthesizes an accurate view for you at your chosen virtual viewpoint. Some NFL refs could have used this system recently! Professor Viola is also working on image database retrieval and an engineer's workbench where an engineer sketches, scribbles, and talks while they design and the power of commercial CAD and analysis systems are brought to bear on their work. Professor Viola has also been active in machine learning and has recently been joined by Professor Tommi Jaakkola, who brings great expertise in statistical learning techniques. Over the next couple of months, other faculty members are joining the 7th floor, including Professor Whitman Richards of Media Arts & Sciences, whose work has been in fundamental areas of human cognition; Professor Ted Adelson from Brain & Cognitive Sciences, who works in early vision; and Professor Steve Massaquoi who works on understanding the human cerebellum. Professor Tomas Lozano-Perez has recently taken up duties as Associate Department Head of Electrical Engineering and Computer Science, but manages to spend time on the 7th floor where he works in computational biology, applying robotics techniques to understanding the structure of proteins. Professor Tomaso Poggio is running an outpost of the AI Lab over in E25 where the research is centered around computer vision, graphics and machine learning.

On the 8th floor, Professor Patrick Winston is pursuing the fundamental nature of human memory and its coupling to the human sensory motor system and the language facility. Professor Bob Berwick is researching the relationship between evolutionary constraints and human language abilities. Dr. Boris Katz is extending his work on practical natural language systems, the START system, which enables us to use English to query both database and more generally, the web. Professor Randall Davis, besides his strong interest in legal aspects of software intellectual property, is also working in collaboration with Dr. Howard Shrobe on a number of projects. These include systems that help the design process in the mechanical and software domains, and systems which provide information access interfaces to large organizations ó they have built a number of systems which are used on a daily basis by the White

House and other government agencies for the dissemination of their information. Professor Lynn Stein is working on revamping the whole approach to teaching computer science using a process rather than algorithm based model. And, she is also collaborating with Professor Lozano-Perez, Dr. Shrobe and myself on human computer interaction. On the 8th floor, we have built both an intelligent room and an intelligent office where we invert the normal relationship between people and computers and drag computers out into the physical real world where they must interact with humans doing their normal sorts of activities, providing them with computational support. This is in contrast to the standard model where people are drawn into the virtual world of the computer. Professor Tom Knight is also located on the 8th floor, but all his activity happens up on the 9th floor. Besides developing low power reversible computers in silicon, Professor Knight has embarked on a radical new approach to computation, biology, and the manipulation of matter. We have replaced our silicon clean room with a wet bio lab where Professor Knight is inserting DNA into living E. Coli cells, highjacking their natural mechanisms so that they will compute while maintaining and reproducing themselves. The ultimate idea is to couple this with the amorphous computing work of the 4th floor and have self organizing living cells become molecular engineers that carry out manufacturing processes.

Dr. Ken Salisbury also straddles the 8th and 9th floors, and his work includes planetary rovers from NASA's Jet Propulsion Laboratory and haptic interfaces. Haptic interfaces provide a person with a sense of touch and ability to feel forces, masses, texture, friction, and temperature. This new mode of human computer interface is allowing all sorts of new applications. Most recently, Dr. Salisbury and his students have developed remote laporascopic surgical systems where the surgeon controls tiny robotic manipulators inside a person. The surgeon gets feedback from cameras attached to optical fibers inserted in the patient, and more importantly, retains a sense of touch via the haptic interface. Also on the 9th floor, I and my research group are studying the fundamentals of human intelligence by building robots with human form that interact with people in human like ways, learn in human like ways and develop just as humans do.

If you are interested in seeing more information on our research, please look at our web site, http://www.ai.mit.edu, and in particular, http://www.ai.mit.edu/lab/abstracts/1998

Rodney Brooks

BIOTECHNOLOGY PROCESS ENGINEERING CENTER

The Biotechnology Process Engineering Center (BPEC) is a multidisciplinary body with faculty members from Departments of Biology, Chemistry and Chemical Engineering as well as from the MIT Whitehead Institute. The BPEC was established in 1985 and is funded by the National Science Foundation (NSF) under the Engineering Research Center Initiative. The missions of the Center are to carry out multidisciplinary research and education with a strong relationship with industry in all of its activities. The goals of the Center are to perform cutting-edge, generic research in biotechnology with a strong component of interdisciplinary collaboration.

INFRASTRUCTURE

The organization structure and management of the Biotechnology Process Engineering Center (BPEC) is going through a major change. The present Director, Professor Daniel I.C. Wang, has planned to step-down as of September 1, 1998. The new Director will be Professor Douglas A. Lauffenburger. Professor Lauffenburger served as the Executive Director of the Center during fiscall 1997 in preparation for the new change.

The center Director reports directly to the Dean of Engineering (Professor Robert A. Brown). The Director is also a member of the Engineering council attending the pertinent weekly meetings, which are directly related to the Center's activities.

There are two Industrial Advisory Boards to assist the planning and assessment on the Center's activities. These two Boards are Industrial Advisory Board in Protein Production (11 members) and Industrial Advisory Board in Gene Therapy (10 members). Two new Associate Directors have been selected to oversee the research and education programs. The Associate Director for Research is Professor Harvey F. Lodish (Department of Biology and Whitehead Institute) and the Associate Director of Education is Professor Linda G. Griffith, and is assisted by the Educational Coordinator, Ms. Lorraine E. Cable. The Education Coordinator processes all of the UROP and REU affairs in the Center.

Ms. Audrey Jones Childs is the Assistant Director for Administration and Operations. The Assistant Director handles the center's human resource, purchasing, prepares and monitors all budgets and proposals, and prepares statistical reports. In addition, the Assistant Director is the direct liaison with the School of Engineering. Both the Director and Assistant Director are liaisons with the National Science Foundation ERC Division. One full time and one part-time administrative staff workers in addition to the Education Coordinator assist Ms. Childs.

Three additional faculty members were added to the Center during fiscal 1997, Professors George Q. Daley, Linda G. Griffith, and Rudolph Jaenish. These additions are directly related to the Center's present activities as well as the future initiatives in nucleic acid biotechnology.

RESEARCH STRUCTURE

A cross-disciplinary team consisting of biologists, chemists, and chemical engineers executes the research in two thrust areas: 1. Therapeutic Gene Biotechnology, 2. Therapeutic Protein Production: Quantity and Quality, 3. Therapeutic Protein Aggregation, Stability, Formulation and Delivery.

A team of 14 faculty members participated in the center's activities from July 1, 1997 through June 30, 1998. They are from the Departments of Chemical Engineering (School of Engineering), Biology and Chemistry (School of Science), The Whitehead Institute, and the University of Maryland, Department of Chemistry. Undergraduate and graduate students, postdoctoral fellows, visiting scientists, and industrial associates are also integral participants in the center's activities.

Statistically reporting, 254 personnel took part in the center's research activities during fiscal 1997. This figure comprises of the following: 80 MIT Undergraduate Research Opportunities Program students (UROP), two MIT Undergraduates working on course-related thesis projects; 12 non MIT undergraduates from 10 different Universities who participated in the center's NSF Research Education for Undergraduates Program (REU); 77 graduate students from four departments; 48 postdoctoral associates/fellows; 22 visiting scientists, engineers, industry researchers, four other administrative personnel and 14 faculty.

The NSF provides the major financial support for BPEC personnel. The National Institutes of Health (NIH-NIGMS) provides additional support for graduate educational activities for the MIT students. The NSF (34%), industry (24%), and other sources (42%) support the Center's research and administration.

AFFIRMATIVE ACTION

The BPEC is committed to increasing the number of women and minorities in its programs. Our success is dependent on the type of applicants. To strengthen the number of applicants for the National Institutes of Health Interdepartmental Training Grant, we reformed our minority recruitment committee this past year to analyze and address the current recruitment procedures. Ms. Araba Lamousé-Smith has been appointed chairperson of this committee. The following two specific examples highlight BPEC's recruitment activities. First, Ms. Araba Lamousé-Smith again recruited undergraduates at the National Society of Black Engineering National Conference. Second, Ms. Lorraine Cable solicited additional minority universities, colleges and programs for the REU solicitation. Our recruiting effort was quite successful, having under-represented populations in the BPEC in the following numbers; American Indian—1, Pacific Islander—1, African American—2, Hispanic—4.

FACILITIES

Some major changes occurred during fiscal1998 with respect to the BPEC's headquarters and associated laboratories of the Center. As of March 12, 1998, the BPEC moved from Building 20A into its new space in Building 16. The Center's Headquarters are now located in Building 16, Room 429. The Center's laboratories occupy the entire fourth floor of Building 16 with approximately 12,000 square feet of totally renovated and modernized laboratories.

The major "bio-related" research in the department of Chemical Engineering are now all located contiguously with Building 66 (Department of Chemical Engineering). Five of the Chemical Engineering faculty members in the BPEC (C.L. Cooney, D.A. Lauffenburger, L.G. Griffith, G.N. Stephanopoulos and D.I.C. Wang) now occupy contiguous laboratory and office spaces on the 3rd and 4th floors of the adjoining buildings 16 and 56. This consolidation and occupation of this totally renovated laboratory space represent over 60,000 square feet for "bio-related" research. This centralization and consolidation will greatly increase the interactions among the various ERC researchers in the future as well as with other students in the Department.

Through this consolidation and proximity of the laboratories in Building 16 and 56, the equipment and facilities for researchers in the BPEC will also be vastly increased. Presently, the core equipment in the BPEC include major items such as MALDI/TOF Mass Spectrometer, Biocad and Integral Liquid Chromatography, other HPLCs, Scintillation Counter, Coulter Counter plus many other equipment valued in excess of $4,0 million. However, the equipment in other BPEC facility member's laboratories is now easily accessed. These include Confocal Microscope with Video-Imaging, Ultra Centrifuges, Coulter Counters, Fluorescence Imager, Bioreactors (2 liters to 52 liters) totally instrumented and computer interfaced to name only a few items.

EDUCATIONAL ACTIVITIES

The goal of BPEC's educational programs is to train undergraduates, graduates, post-doctoral and industrial personnel. BPEC's vision in the educational programs is to incorporate biotechnology principles into our existing courses. This is being accomplished through course modifications and interdisciplinary teaching in the areas of chemistry, biology, and chemical engineering. The planning of our educational programs affects all sectors of the student body. To provide an industrial perspective to our students, course contents have been planned to incorporate real problems in biotechnology manufacturing. Invited lecturers from the biotechnology industry expose students to current day research problems.

To meet the goals and objectives of our educational visions, the course curricula for undergraduates, graduates and industrial personnel have continually undergone changes and had new initiatives implemented. For example, to integrate biotechnology concepts as well as our research thrusts, several undergraduate courses have been instituted. "Chemical Kinetics and Reactor Design": Biochemical reactions have been included in this undergraduate core course; "Biotechnology and Bioengineering" (Joint Chemical Engineering/Chemistry): Integrating principles in biology, chemistry and chemical engineering of therapeutic protein production. Directly related to the Center's research thrusts; "Molecular and Engineering Aspects of Biotechnology" (Joint Biology/Chemical Engineering): Integrating molecular biology and biochemical engineering principles in the production of therapeutic proteins from

mammalian cells. Directly related to the Center's research thrusts. "Chemical Engineering Project Laboratory" (Chemical Engineering): Projects designed for undergraduates to examine protein quantity and quality from mammalian cells. Directly related to the Center's thrusts. "Integrated Chemical Engineering" (Chemical Engineering): Two modules with a systems view on biotechnology manufacturing as part of the undergraduate core curriculum. Directly related to the Center's thrusts; "Interdisciplinary Research in Biomedical Engineering": A new course integrating biology with engineering;

At the graduate level in education, a large number of courses have been modified to incorporate the research thrusts from the Center. In addition, new courses have been implemented as a direct result of the presence of the Center. Graduate courses presented by the Center's faculty during fiscal 1998 are: "The Folding Problem" (Joint Biology, Chemical Engineering and Chemistry): Mechanism and pathways of protein aggregation and folding relating to the biotechnology industry. Directly related to the Center's thrusts; "Principles and Methodologies of Metabolic Engineering" (joint Biology and Chemical Engineering): Application of chemical engineering principles and genetic techniques to the analysis and modification of metabolic pathways of bacteria and mammalian cells. Directly related to the Center's thrusts; "Biochemical Engineering" (Chemical Engineering): Integration of chemical engineering, biochemistry and microbiology in biochemical processes. Directly related to the Center's thrusts; "Separation Processes for Biochemical Products" (Chemical Engineering): Fundamental principles of separation operations for the recovery of biological products. Directly related to the Center's thrusts; "Tissue Engineering" (Chemical Engineering): A new course dealing with cell growth on artificial matrices. Principles in course include metabolism, regulation transport phenomena. This course is directly related to the new research thrust in Gene Therapy; "Cell Bioengineering" (Chemical Engineering): A new course in the analysis of mammalian cell function from quantitative and engineering perspectives; directly related to Center's research thrusts.

There are several graduate courses that provide both cross-disciplinary principles as well as systems view which were in the fiscal 1998 curriculum. The highlights of these courses are "Macromolecular Structure and Function Seminar": As the direct result of the research in Thrust Area II (Protein Aggregation and Folding), this seminar represents an institutional forum to discuss research of mutual interests. Participants have been from a wide variety of disciplines including Biology, Brain and Cognitive Science, Chemistry and Chemical Engineering; "Seminar on Pharmaceutical and Biotechnology Industry Management": A joint seminar (Biology, Chemical Engineering and Sloan School) dealing with management, finance, regulatory, R&D and manufacturing in the biotechnology industry.

To ensure the educational needs of industry are met, the Center has provided one-week special summer courses in fiscal 1998 which include "Fermentation Technology", "Downstream Processing", "Advances in Controlled Release Technology and Delivery of Pharmaceuticals and Other Agents", "Management for Physicians, Scientists, and Engineering in the Pharmaceutical and Biotechnology Industry", "Methods, Logic and Opportunities in Metabolic Engineering": This is a new summer continuing education course to be offered in August 1997. This course is a direct result of the research thrust of the ERC.

These industrial courses typically have 50 to 75 attendees, which represent the training of 250 to 300 industrial participants annually.

The impact of the Center's educational achievements has been quite significant at MIT. Through the efforts of the BPEC, an Interdepartmental Biotechnology Training Program was established. This training grant has faculty participants from five (5) MIT departments: Biology, Chemistry, Electrical Engineering and Computer Science, Chemical Engineering and Math, with a total of 25 faculty mentors. This training grant is funded by NIH (NIGMS) with a total of 20 pre-doctoral trainees.

The demonstration of cross-disciplinary training by the BPEC has encouraged other MIT programs to emulate our success. Our model was used to formulate an interdisciplinary Human Genome Science Training Grant with faculty participants from Biology, Chemistry, Chemical Engineering, Electrical Engineering and Lincoln Laboratory. This grant was funded through the NIH; six pre-doctoral and 3 post-doctoral traineeships were awarded. Here again, the focus of this research-training grant is on cross-disciplinary interactions among the different departments at the Institute.

A last example of the institutional impact of the BPEC is the following new initiative by the Department of Chemical Engineering. In order to provide the School of Engineering's faculty with an awareness of the role of molecular biology in future engineering research, a special one-week intensive course on molecular biology was held in June 1996. A total of 25 engineering faculty members participated in this course along with two biology lecturers from the BPEC. This molecular biology course was extremely well received in 1996 by the engineering faculty and was repeated in 1997 with participation by 25 engineering faculty members. The significance of this is the direct result of the BPEC and its various activities in biotechnology, which, in the future, will have an impact on all departments in the School of Engineering.

The most important product from the BPEC in all its years at MIT has been the outstanding body of students it has produced who have joined industry, university and government. At a time when major industries have faced employment reduction and cutbacks, we have not found this to be true with respect to BPEC graduates. Following are several examples that illustrate the impact of our educational and training achievements. The BPEC's Undergraduate Research Opportunity Program (UROP) has provided a superb foundation for our undergraduates. Upon graduation, these students are singled out for industrial summer internships as well as exciting careers in industry. An example of our educational impact is the breadth and depth of the training the Center has provided to our graduates. Small start-up biotech companies (e.g., Advanced Tissue Sciences, Khepri, Tanox Biosystems, etc.) have sought out our graduates due to the diversity of their training experiences.

As a second example of the training of students with a systems view in manufacturing is the recently founded company Covance, Inc. This is a contract manufacturing and development services company for therapeutic proteins with a GMP facility in Research Triangle Park, NC. The Vice President and Chief Scientific Officer of Covance is a graduate of out program and two senior bioprocess engineers were graduates and participants in the BPEC.

On the other hand, large pharmaceutical companies (e.g., Merck & Co.) have hired a large number of our graduates. The reasons Merck gave us for seeking out our graduates were:
Excellent breadth and depth of training.
Ability to work as a team and in different areas.
Reduced on-job training time from the typical 18 months to fewer than 6 months.

During the fiscal 1998 the Center graduated 16 PhD, 2 MS and 2 BS students. From this total, 60% joined the industrial ranks and 40% went to academia either as faculty members or to graduate school to continue their education.

We believe we have fulfilled the visions and goals of our educational programs and will continue to excel in the future.

RESEARCH HIGHLIGHTS AND FUTURE PLANS

The Center continued to focus on its two main research thrusts during fiscal 1998. Thrust 1: Therapeutic Protein Production: Quantity and Quality was lead by Professor Gregory N. Stephanopoulos and a team of five other faculty members (Harvey F. Lodish, Philip A. Sharp, Charles L. Cooney, and Daniel I. C. Wang). Thrust 2: Therapeutic Protein Aggregation Stability, Formulation and Delivery was lead by Professor Jonathan A. King and Alex M. Klibanov and a team of four other faculty members (Charles L. Cooney, Cheng S. Lee – University of Maryland, Robert S. Langer, Daniel I. C. Wang). Research results from these thrusts are seen through the number of collaborative projects and industrial members mentioned in the Technology Transfer section below.

The Center is moving its primary direction from therapeutic protein biotechnology to therapeutic *gene* biotechnology, in order to attack bottleneck problems in this highly promising new area using the multi-disciplinary approach proven in its previous incarnation. Investigator turnover of more than 50% along with a change in Director characterize this substantial change in technical direction while retaining the same emphasis on solving fundamental problems of generic importance for aiding the growth of a nascent industry.

It is widely recognized that the crucial bottleneck holding back gene therapy from reliable implementation lies predominantly in the area of *delivery*, much more than in discovery and production, at the present time. In

particular, effective delivery of a therapeutic transgene is typically limited by one or more of the following issues, depending on the approach and application: (1) longevity, or repeatability, of transgene expression; (2) selectivity of transgene expression; (3) efficiency of transgene expression; (4) regulation of transgene expression. Our new BPEC program is dedicated to creating new fundamental knowledge, enabling technology, and a systems perspective addressing these issues in focused manner, synergistically combining bio/chemical engineering with molecular cell biology.

Recognizing that different applications will require differing delivery vehicles, we are currently focusing our research efforts on two chief approach categories motivated by the issues listed above—representing *ex vivo* and *in vivo* approaches, respectively. One approach category is the use of pluripotent stem cells transfected via chromosomal-integrating retroviral vectors, as an *ex vivo* gene delivery vehicle that can potentially offer expression longevity. Critical problems for this approach are expanding these cells to significant numbers in culture, and obtaining high transfection efficiencies for reimplantation. The second approach category is the use of nonviral targeted polyplexes as an *in vivo* gene delivery vehicle that can potentially offer expression selectivity and repeatable retransfection. A critical problem for this approach is transfecting cells with adequate efficiency. In both of these two approaches—*ex vivo* stem cell delivery and *in vivo* targeted polyplex delivery—a capability for regulating transgene expression at the tissue level using small molecule drugs. We are therefore pursuing research directed toward this capability in relation to both delivery approaches. As ultimate aims we are focusing on hematopoietic stem cell gene therapy via retroviral vehicles as an *ex vivo* target application and on liver gene therapy via molecular conjugate vehicles as an *in vivo* target application. Accordingly, a centerpiece of our efforts is the development of tissue-engineered "vascularized" hematopoietic and liver cell microarrays to serve as a unique model testbed integrating all research projects.

INDUSTRIAL COLLABORATIONS AND TECHNOLOGY TRANSFER

Industrial collaboration and technology transfer are accomplished through a number of different routes. In the BPEC, one of the major avenues leading to collaborations and technology transfer is through our Industrial Consortium. The "Cell Culture Process Optimization Consortium" was established in 1996. The Director of this Consortium is Professor Gregory N. Stephanopoulos. Since December 1997, this industrial consortium has integrated the research for both Thrust Areas I and II. (Thrust I: Therapeutic Protein Production and Thrust II: Protein Aggregation, Stabilization and Delivery.) There are presently 14 companies in this consortium. Each member contributes $25,000 annually. The benefits for the consortium members include: Participation in the planning of the Center's research; serving on doctoral thesis committees; semi-annual reports on the research progress; licensing rights to the research; access to the BPEC's facilities and personnel; direct technology transfer and testbeds at BPEC or company sites; and recruitment of BPEC students.

The interface between the consortium members and the BPEC is through the Industrial Coordinator, Dr. James C. Leung. Through the Coordinator, the semi-annual reports are gathered and transmitted to the industrial members. Dr. Leung is also responsible for organizing the consortium meetings. During fiscal 1998, five (5) consortium meetings have been held at the BPEC: February 1997, July 1997, November 1997, December 1997 and April 1998.

Collaboration and technology transfer initiations with consortium members are achieved mainly from the consortium meetings. At those meetings, the research results are presented and potential collaborations and technology transfers are then addressed. The follow-up for these activities by the Industrial Coordinator is then exercised.

There are also other ways to affect industrial collaborations and technology transfer outside of the Industrial Consortium. These involve visits by companies to the BPEC, research contracts with companies, and seminars or consulting by the BPEC faculty with companies. We have found these latter methods are equally effective for industrial involvements.

Industrial collaborations play many important roles in achieving the success of the BPEC's goals as presented in our strategic plan. First, when industrial participants are active and collaborative partners in research and development, the collaborations are guaranteed to be relevant to industrial activities. Second, without industrial collaborations, much of our research would be difficult if not impossible to implement. For example, easy access to reagents, recombinant cell lines, analytical methodologies, etc., reduces dramatically the time required to reach the goals of

both the Center and industry. Third, expertise that resides in the companies and complements our technical compatibility plays a synergistic role in reaching our goals. Fourth, these collaborations provide realism to our students' and faculty's research. Fifth, although industry is in many instances more focused on its own immediate needs, it can still recognize the importance of fundamental and generic research by a Center which would aid their future programs. Sixth, industry provides an excellent testbed for deliverables in assessing both knowledge-based and technology-based research and development. Seventh, when mutual satisfaction is achieved in successful collaboration, industrial representatives can act as an excellent spokespeople on the Center's behalf. Lastly, the financial support, equipment and materials donations from industrial sources represent significant leverage for the Center's financial base. A total of thirty-two companies are members of the Center.

A total of 41 companies collaborated with the BPEC in its research Thrust Areas during fiscal 1998, with some of these companies collaborating on more than one project with the Center.

Twenty-six different items ranging from enabling technologies to new reagents have been transferred in 1997-1998. One important item to be mentioned is the association with Concordance Biosystems, Inc. This is a spin-off company using patents and research findings in our Thrust Area III.

More information about this center can be found on the World Wide Web at the following URL: http://web.mit.edu/bpec/

Daniel I. C. Wang

CENTER FOR INNOVATION IN PRODUCT DEVELOPMENT

The Center for Innovation in Product Development, an interdisciplinary program between the School of Engineering and the School of Management, defines itself as an engine of innovation for the product development system in the United States. The Center envisions an America in which industry achieves and sustains the highest levels of customer satisfaction and product value while enjoying long-term vitality and profitability. Each American company will become more competitive by creating and using the right information at the right time, making informed decisions about product development, and improving its ability to learn and adapt to changes in product development processes. To those in the Center, the product development system encompasses the end-to-end business process to conceive, plan, define, develop, demonstrate, deliver, and support families of products and services.

For its overarching goal, the Center (comprised of representatives from academia, industry, and government) will advance the theory and practice of product development to such a degree that American industry will double the effectiveness of its annual investment in product development over the next decade. To that end, the Center is developing programs in the areas of research, education, and outreach.

The Center's major accomplishments include:

- Deployed Design Structure Matrix (DSM) models to suggest better organization of work teams at Ford Motor Company and at Hewlett-Packard
- Successfully piloted the project management tool "Critical Chain" at ITT Defense and Electronics
- Successfully piloted DOME (Distributed Object-based Modeling and Evaluation) at Polaroid
- Created and launched four new courses in product development
- Created and launched the Product Development Track in the Systems Design and Management Program
- Created and held the first annual Software Tools Symposium at MIT
- Co- sponsored the first annual Manufacturing and Engineering Conference at MIT

RESEARCH ACTIVITIES

The Center has organized its research program into four thrust areas: (1) Defining Successful Products, led by Kevin Otto, Robert Noyce Career Development Assistant Professor; (2) Information-Based Development, led by Associate Professor of Management Science Stephen Eppinger; (3) Enterprise Strategy, led by Management Associate Professor of Management Rebecca Henderson; and (4) Accelerating Capabilities Improvement, led by Visiting Scholar David Bell of the Xerox Corporation. Over the past year, the Center has refined its research process for students and faculty. Research begins by developing testable hypotheses. Students and faculty then gather information on site at Center partner companies (which act as research sites), bring it back to campus, and use it to develop ideas, software, and other representations to test, evaluate and demonstrate the hypotheses.

The Center initiated research programs with all six of its corporate partners. Three examples are particularly worth noting. At Polaroid, the modeling framework DOME (Distributed Object-based Modeling and Evaluation) was successfully applied to the conceptual design phase of a new product development project. DOME is an integrated product development tool that uses different "lenses," allowing a user to apply different criteria to evaluate a design problem. For example, a designer can use a lens to evaluate the performance of the design in terms of cost and safety. By creating appropriate representations of the design model, people from different domains, such as designers and managers, will be able to easily perceive the information and interconnections of complex models in the best way possible. DOME will next be piloted at Ford Motor Company.

At ITT Industries, Goldratt's "Critical Chain" method was successfully piloted with three divisions in ITT's Defense and Electronics. This method considers resource limitation when determining the critical pathway in a chain of dependent tasks. Unlike typical project management, which sets task due dates assuming a time buffer for each task, critical chain management sets task duration (halving the predicted task time) and aggregates the individual task time buffers into one at the end of the project to absorb delays. The goal of critical chain is to help projects finish on time, within budget, and without cutting scope.

At Ford Motor Company and at Hewlett Packard, the use of Design Structure Matrix (DSM) models recommended new ways to organize work teams around the flow of highly related information. DSM provides a framework and a

compact notation to show the interrelationships and information flow between tasks. Controlling the communication between the tasks in a feedback loop is vital to the timely and accurate execution of the process.

Center researcher Michael Cusumano, Sloan Distinguished Professor of Management, has just finished a book, *Thinking Beyond Lean: How Multi-Project Management is Transforming Toyota and Other Companies*. The book, now in press at the Free Press, examines product development strategies that center on sharing platforms and other key components across multiple projects.

EDUCATIONAL INITIATIVES

One of the Center education program's goals is to establish instruction in the process of competitive product development as a standard component of both engineering and management education, first throughout MIT, then throughout the country. All mechanical engineering undergraduates at MIT now take a senior level course in the product development process, in which they encounter many of the same issues that teams in industry face. In the past year, Center faculty have created and launched four new courses in product development:

- 2.009U Product Engineering Process, developed and taught by professors D. Wallace, W. Flowers, W. Seering
- 2.742G Integrated Product and Process Design, developed and taught by Professor A. C. Thornton
- 2.875G Mechanical Assembly and Its Role in Product Development, developed and taught by Professor D. E. Whitney
- 16.881G Robust System Design, developed and taught by Professor D. D. Frey and Dr. D. P. Clausing

The Center also worked closely with the Systems Design and Management (SDM) Program and industrial representatives to develop a Product Development Track within SDM that blends engineering and management concepts, integrates the best formal education, ongoing research, and industrial practice, and educates the engineering professional who will take a leadership role in bringing new products to market. To spread the SDM-Product Development Track beyond MIT's campus, the Center has joined with the SDM Program, the University of Detroit Mercy in Detroit, and the Rochester Institute of Technology in New York to form PD21, the Education Consortium for Product Development Leadership in the 21st Century. This consortium is developing the Product Development Leadership (PDL) Program, which will confer a master's degree in product development which will be a dual degree in engineering and management. The consortium model and program curriculum will be consistent in concepts, methods, and terms and will be capable of being tailored for delivery in major American industrial centers, incorporating specific cases, projects, and examples. The Consortium will kick off its activities in July, 98, with a workshop to develop a common language and understanding between and among the three universities; to enhance integration of the program across traditional academic boundaries; and to encourage a spirit of camaraderie amongst the working group members.

In addition, the Center worked with colleagues at partners' internal training programs, such as the Ford Design Institute and the Xerox Engineering Excellence Program, to understand what topics and material should be included in a new curriculum.

OUTREACH ACTIVITIES

The second annual Key Characteristics Symposium, organized and facilitated by Professor Anna Thornton, drew 80 people from 28 organizations to the NASA Kennedy Space Center on January 21-23, 1998. The purpose of this seminar series is to bring experts from a variety of companies together to share experiences, successes, and problems with Key Characteristic methodologies. Complex products can contain millions of dimensions and characteristics (voltages, forces, etc.), each of which impact the performance of the product. In addition, each of these features as manufactured will deviate from its nominal value because of inherent variability in manufacturing, assembly, and environment. However, only a small few of the millions of features, the Key Characteristics of the product, will significantly affect the final quality, performance, and cost of the product. The third annual symposium next January will most likely take place in Tempe, Arizona.

The first annual Software Tools Symposium, held at MIT on May 1, 1998, provided a forum for the sharing of both existing software tools and concepts for potential tools that arise from Center research. More than 40 people from MIT, industry, and software developing companies came together to discuss how to adapt innovative ideas and tools from academic research into marketable products that American industry can use.

The Center and the Industrial Liaison Program, along with several other MIT programs and centers, sponsored the first annual Manufacturing and Engineering Conference at MIT on May 12-13, 1998. This year's conference, entitled "Designing & Managing Corporate Technology Supply Chains: Creating Competitive Value Chains in an Age of Temporary Advantage," provided a special strategic briefing for senior manufacturing, engineering, technical, operations, and corporate executives. Few decisions senior executives make will affect their company's survival like the design of their company's value chain, including their choice of key technology supplier alliances and relationships. As part of MIT's Series on Technology and the Corporation, this examines important new strategies in supply chain design, business strategy and product development by focusing on the experiences of industries with much faster product and technology development cycles and by extrapolating the lessons for industries with slower cycles. Next year, the Center will also co-sponsor the Second Annual Manufacturing and Engineering Conference, scheduled for April 20-21, 1999, and entitled, "Innovations in Product Development."

A seminar series was launched this past year to provide a forum for researchers from other universities and Center researchers to share their respective findings. On May 4, 1998, Professor Dr. Jan Buijs and Dr. Kees Dorst from the Delft University of Technology talked about their efforts in "Teaching product design: a curriculum and a methodology." The School of Industrial Design Engineering at the Delft University of Technology is one of the biggest in the world, now training 1800 students in integrated product design. From the very first day of their studies to the last, students do design exercises that integrate the knowledge, skills, and methods taught in lecture courses. Final design projects are done in close cooperation with Dutch industry. On June 9, 1998, Per Elgård from The Department of Control and Engineering Design at the Technical University of Denmark discussed his research in "Designing Product Families." Today's customers expect products to be tailored to their exact needs. Using product platforms, firms can customize products, each product being a variant of a product family. Mr. Elgård discussed the design principles that can be used to create architectures supporting variety, from conventional modularization to inheritance and parameterization.

Under the auspices of the Center's outreach program and supported by a Research Experience for Undergraduates grant from the National Science Foundation, six undergraduates from universities across the nation joined Center scientists and engineers in June, 1998, to experience first-hand how basic research is carried out. The ten-week summer program, which began in early June, targets talented, underrepresented minority and women sophomores and juniors.

Each summer, Center faculty, students, and staff also assist the Minority Introduction to Engineering and Science Program (MITES). The MITES program is a six-week residential summer course designed to introduce promising underrepresented minority high school juniors to careers in engineering and science. In summer, 1997, Center personnel assisted more than 40 MITES students in two courses: one on entrepreneurship, the other on design.

The Center welcomed Conger Gabel as the Executive Director for 1998. Mr. Gabel is on leave from the Xerox Corporation. Linda Breisch also joined the Center as the Communications Coordinator. Kamala Grasso, the Center's Director of Industrial Collaboration, left MIT for a position with the Bose Corporation. Jo-Anne Lema, the Center's Director of Finance and Administration, left MIT for a position with St. Paul's School in Concord, NH. Suzanne Weiner, the Education Coordinator, left MIT for a position with North Carolina State University.

More information about this center can be found on the World Wide Web at the following URL: http://mit.edu/cipd/

Warren Seering

CENTER FOR TECHNOLOGY, POLICY, AND INDUSTRIAL DEVELOPMENT

The Center for Technology, Policy, and Industrial Development was founded in 1985 to foster teaching and research on policy issues related to science and technology. The Center was established in response to the realization that as technology proliferates it effects profound and pervasive changes in our economic system and its component industries, changes that intensify the fundamental complexity of our lives. This growing complexity challenges us to develop policies that will do at least two things: allow us to enjoy technology's benefits, and, protect us against its possible harmful side effects.

The Center's goal is to understand the effect of technological changes on the development of society and to help formulate policies for an era of intensified international economic competition. It works to accomplish this through an active and rigorous academic program and by overseeing research activities that incorporate many disciplines.

One major focus of these research activities consists of industry study programs that investigate particular industries like the automotive and aerospace industries. Below is an overview of these study programs, highlights of the Center's other research activities, and descriptions of the Center's academic programs. Director of the CTPID in 1997-98 is Prof. Joel Clark; Associate Directors are Prof. Charles Fine and Prof. Michael Piore.

INTERNATIONAL MOTOR VEHICLE PROGRAM

The International Motor Vehicle Program (IMVP), established in 1979, is a multidisciplinary research enterprise that conducts comprehensive studies of the automobile industry. Its current research efforts focus on three key factors that will govern the evolution of the automobile industry into the next century: the fluctuation of power relations within the global supply chain, the future of the "lean" paradigm of industrial organization, and the need for an industry that is socially as well as economically viable. Changes in customer preferences, vehicle and information technology, industrial globalization, and the policies of both public and private institutions raise a wide range of issues whose resolution will determine the future course of the industry. The IMVP research program is exploring these changes through a broad-based portfolio of research, conducted worldwide, that is tracking these changes and developing a deeper understanding of both the principles underlying them and their implications for the future of this industry and the society of which it is part.

1997-98 has been a transition year for IMVP. The Co-Directors, with the strong support of the IMVP Sponsors, agreed to concentrate and coordinate the Program's research agenda around a more narrow set of research projects, with key financial and management responsibility residing with a handful of Principal Investigators. This research will be concentrated in four areas: Management of the Extended Enterprise, Technology, Social Agenda, and Globalization. The transition to this new agenda will continue into the current year.

Among its other major activities, in September 1997 IMVP hosted a Policy Forum in Korea. In May of 1998 IMVP was co-sponsor of a Technology Supply Chains conference held at MIT. IMVP also continues its collaboration with a number of affiliate programs, including the International Car Distribution Programme based in Great Britain.

Co-Directors for IMVP are Profs. Joel Clark and Charles Fine. Research Director is Dr. Frank Field III.

LEAN AEROSPACE INITIATIVE

The Lean Aerospace Initiative (LAI) , begun in September 1993, is a consortium of 16 aerospace companies, 14 U.S. Government agencies, labor representatives, and MIT. It has as its goal: "To significantly reduce the cost and cycle time for military aerospace products throughout the entire value chain while continuing to improve product performance." LAI research is being conducted by 20 faculty members from the Schools of Engineering and Management, 21 graduate students from several MIT courses and Graduate programs, and six research staff members of the Center for Technology, Policy, and Industrial Development

In 1997-98 LAI expanded to include the space sector (satellites and launch systems) in addition to the previous airframe, engine, and avionics/missiles sectors of the original Lean Aircraft Initiative. Also, the Lean Enterprise Model (LEM), an organized compilation of LAI research findings and other related information, was reworked and

released as a web-based product. Further information on LAI can be found at http://web.mit.edu/lean/. Director of LAI is Prof. Earll M. Murman.

LEAN SUSTAINMENT INITIATIVE

The Lean Sustainment Initiative (LSI) began in May 1997 and will be in a planned Transition Phase through September 30, 1999. The ultimate goal of LSI research is to reduce the cost of logistics support in the United States Air Force and increase the flexibility and responsiveness of the entire public-private logistics support system.

In its Startup Phase LSI developed a basic understanding of the Air Force sustainment system and made preliminary assessments with respect to "lean" principles and practices in key areas of the system. Lean Sustainment's next phase will move toward a more fully robust research project that will focus on: obtaining feedback on Startup Phase results and adding greater fidelity to the research areas investigated; benchmarking world-class sustainment practices across the public-private sectors; and facilitating a collaborative process that will enable the sustainment public-private team eventually to design an effective lean sustainment model for the early 21st century from the research results developed by LSI's current efforts. Director of LSI is Prof. Wesley Harris.

FAST AND FLEXIBLE COMMUNICATION PROJECTS

The Fast and Flexible Communication Projects have been part of a government initiative to improve U.S. manufacturing capability and analyze product development in the automotive and aerospace industries, focusing in particular on the relationship between complex assemblies and multiple sources for parts and tooling. Originally designed as a 28-month project in 1994, the research was extended to 1998 and divided into two sections: the Fast and Flexible Communication of Engineering Data in the Aerospace Industry, and the Fast and Flexible Communication Design and Manufacturing Systems for Automotive Components and Sheet Metal Parts. In May 1998 the projects completed their final Reports.

The Projects' research focused on developing more "agile" or "fast and flexible" communications and processes. One component of the research included hypothesis-testing of agile manufacturing principles that were developed by the Agile Manufacturing Forum at Lehigh University. The Projects have deployed faculty, staff, and graduate students from MIT and Lehigh University at multiple manufacturing sites of participating companies: the General Motors Saginaw Steering Division and Luxury Car Division, the Northrop-Grumman Vought Center, the Boeing Commercial Aircraft Group, several Ford Motor Company facilities, and a primary sheet metal supplier, the Budd Company. Co-Directors for the Projects have been Prof. Charles Fine and Dr. Daniel Whitney.

COOPERATIVE MOBILITY PROJECT

The Cooperative Mobility Project's (CMP) objective is to improve our understanding of world motorization as a phenomenon, help implement policies to alleviate the problems increased motorization may bring, and facilitate the opportunities increased motorization may yield. CMP provides a new vision of a sustainable multimodal transportation system. Its task is to analyze what our mobility needs and choices are through the process of collecting data worldwide and comparing how certain policy and technology approaches have worked in facilitating mobility.

The Mobility Project has established the International Mobility Observatory, a worldwide effort to identify, evaluate, and document outstanding examples of innovative mobility systems and strategies. A series of case studies has been prepared that examines how urban areas around the world have implemented mobility strategies. Research is also being conducted on mobility and the environment, focusing on global warming and air pollution. Director of CMA is Associate Dean Daniel Roos.

RESEARCH PROGRAM ON COMMUNICATIONS POLICY

The Research Program on Communications Policy (RPCP) has the following objectives: To study technical and economic developments and government and other policies that challenge maintaining an open interface between scalable digital systems and broadband networks; to facilitate dialogue on these issues across industries, across government agencies, and across academic disciplines; and, to disseminate the results of these activities.

Major RPCP projects developed over the past year and continuing into 1998-99 include:

- The Internet Telephony Consortium (ITC), an international research organization that works on technical, economic, strategic, and policy issues that arise from the convergence of telecommunications and the Internet. The ITC has developed into an independent operation; it is comprised of member companies and academic researchers who work collaboratively to understand and shape future technologies, industry and market structures, and regulatory policies worldwide. The ITC seeks to be a neutral forum in which members—who represent the various interests associated with the Internet, Internet telephony, and the telecommunications industries—may discuss these matters and benefit from cross-industry communication. The ITC's long-term goal is to make possible the growth of new forms of mediated, integrated, multimedia communication that span the Internet and the telecommunications infrastructures.

- The Cambridge Roundtable, a student-led brownbag seminar series, brings together faculty, research staff, and graduate students from across the Institute, as well as other academics and industry representatives, to present findings informally and to obtain feedback and critiques of ongoing research. The Cambridge Roundtable is sponsored by RPCP.

MATERIALS SYSTEMS LABORATORY

The Materials Systems Laboratory (MSL) is internationally recognized for its innovative work on the competitive position of materials and the strategic implications of material choice, over the past five years emphasizing automobile materials and processing. Its work builds upon a unique combination of materials processing knowledge, engineering design practice, manufacturing process analysis, and environmental information to construct analytical tools for decision support and competitive analysis.

MSL has been particularly successful in developing an understanding of the cost of using new materials and materials processes—such as tailor-welded blanks in sheet metal stamping or hydroformed metal structures—in a wide range of applications and contexts. Three continuing research projects for MSL have been: (1) establishing the impact of automobile technology and performance initiatives on the development of vehicle materials and processes (particularly lightweighting and low production-volume initiatives); (2) evaluating and assessing alternative vehicle recycling and recovery technologies and strategies; and (3) developing tools to facilitate the use of life cycle analysis in materials selection decisions. Director for MSL is Dr. Frank Field III.

TECHNOLOGY, BUSINESS AND ENVIRONMENT PROGRAM

The Technology, Business, and Environment Program was founded to help companies meet the challenge of achieving environmental excellence *together with* business success. The Program's mission is to work to improve environmental quality through research that develops profitable strategies for industry and effective policies for governing society.

Two major projects for TBE are: a research initiative that studies the ways companies are adopting non-regulatory codes of environmental management; and a set of studies that looks at the adoption of tools and guidelines for introducing environmental themes into a company's products and processes. Director for TBE is Dr. John Ehrenfeld.

TECHNOLOGY AND LAW PROGRAM

The Technology and Law Program offers a cluster of graduate-level subjects associated with the Technology and Policy Program at MIT as well as research opportunities at the interface of law and technology. Research activities included the design and evaluation of policies intended to encourage technological change that would prevent chemical accidents and pollution through the application of regulation, liability, and economic incentives; promote environmental justice by involving communities in governmental and corporate decisions that affect their health, safety, and environmental concerns; and that investigated sustainability, trade, and the environment. The Program's director is Nicholas A. Ashford.

TECHNOLOGY AND POLICY PROGRAM

The Technology and Policy Program educates men and women for leadership on the important technological issues confronting society. TPP prepares its graduates to excel in their technical fields and to develop and implement effective strategies for dealing with the risks and opportunities associated with those technologies.

TPP's primary efforts concentrate on the Master of Science Program, which prepares students for practical work in government and industry. An integral part of the TPP curriculum is a Summer Internship Program. This year it placed over 30 interns in major policy centers in the United States and abroad. With about 150 students on campus and approximately 650 graduates, TPP is the largest program of its kind in the world. Students require between one and two years to complete the degree, which includes writing an interdisciplinary thesis that focuses on a Technology Policy issue.

TPP also has an active doctoral program in Technology, Management, and Policy. This Program has about 20 dissertation students at any one time. Over the past three years it has placed graduates in major universities in the United States, Europe, and Latin America, as well as with the US government. and industry.

Additionally, TPP conducts an active international outreach program. This year a new association was initiated with the Instituto Superior Tecnico of Portugal, at which TPP associate Dr. John Ehrenfeld has arranged to spend a sabbatical. Prof. Nicholas A. Ashford has similarly arranged a sabbatical at another affiliated institution, theTechnical University of Delft (Netherlands). These institutions join many other universities and educational agencies with which the program actively maintains relations, particularly in France, the Netherlands, the United Kingdom, and Japan.

Also noteworthy this year were the achievements of TPP graduate Lissa Martinez, who was elected to the MIT Corporation alongside another Program graduate, Elizabeth Stock, who serves as a Representative of Recent Graduates. Chairman for TPP is Prof. Richard de Neufville.

MIT COMMUNICATIONS FORUM

The Communications Forum is an interdisciplinary seminar series that reviews the full range of communications-related issues. Topics explored in 1997-98 included developments in communication technology, the economics of telecommunications markets, and regulations in the communication industry. Sessions are held approximately every two weeks.

This year the Forum also conducted the "Media in Transition" project, a major initiative funded by the Markle Foundation that will continue into 1999. The project held lecture series, international conferences, panel discussions, and Internet activities concerned with emerging communications technologies. An experimental web site also was mounted in connection with the project: http://media-in-transition.mit.edu

In 1997-98, completing its development and association with CTPID, the MIT Communications Forum moved its affiliation to the Department of Humanities. Director for the Forum is Prof. David Thorburn.

The Center for Technology, Policy, and Industrial Development has an extensive Internet site at "http://web.mit.edu/ctpid/www", where one can attain research papers and more information about its program groups and personnel.

Joel Clark

CENTER FOR TRANSPORTATION STUDIES

The Center for Transportation Studies was established in 1973 to develop and coordinate the wide range of transportation-related activity at MIT. It provides a focal point for transportation education, facilitates transportation research, conducts an outreach program to the transportation industry, and encourages a sense of common purpose among the many departments, centers and laboratories involved in transportation and logistics at MIT.

The Center's Web address is <web.mit.edu/cts>. In addition to a wealth of information about the Center and its programs, the site includes descriptions of current research projects in transportation, and a listing of MIT theses in transportation since 1980. Transportation faculty and research staff are also listed with their areas of interest, along with connections to other interesting resources on the Web.

EDUCATION

Much of this year was spent in preparation for the new Master of Engineering in Logistics program (MLOG), which will admit its first students in September: a new director for the program was hired (see "Personnel Changes"), new curriculum was developed (including five entirely new subjects and two others which were substantially modified), $120,000-worth of new fellowship funding was secured and 1470-square-feet of new student space is now being renovated. In September, 12 students will enter the new program.

The MST committee worked on a proposal to modify the Master of Science in Transportation Program. A proposal was submitted to the Dean and it will hopefully be funded by the new Engineering Systems Division. The new curriculum is based on five modular half-semester courses.

Again this year, because of the high quality of applications, qualifying for graduate admission for transportation studies is increasingly difficult. This year, 81 applications were received for graduate studies in transportation — including the MST, the MLOG and the PhD programs — and 45 students were enrolled. Funding was found for 82% of the students.

RESEARCH

During the past academic year, 138 projects were listed in the Center's current research listing, 28 of which had been started since last year's listing was published. Sponsored research volume remains level again this year.

MAJOR NEW PROJECTS

Personal mobility is a private problem of public importance. Private automobile use is frequently cited as a public cost - - building and maintaining infrastructure, environmental degradation and congestion. However, individual isolation is less often recognized as a societal cost. Yet, the relative isolation of seniors has been linked to increased health care costs for the aged, reduced productivity of adult children who are employed caregivers as well as the cause of lost human capital that might have contributed to extended family, the work place, charities and other volunteer services.

National survey data indicate a decrease in the number of trips taken by people as they age. Those seniors 75+ exhibit the fewest number of trips. Although it has been argued that retirement from full-time employment is an explanation, journey-to-work travel only accounts for approximately 25 percent of trips - - a remaining 75 percent of trips are for other activities such as shopping, health care, religious and civic activities. This project examines the role of transportation alternatives, and its interaction with selected social, economic and physical factors, on the activity patterns of seniors.

Bidding and Awarding Motor Carrier Traffic. A look into the bidding and award practices of the US Defense Logistics Agency. Comparison of shipper-carrier relationships in the public and private sectors. Sponsored by the US Defense Logistics Agency.

MAJOR MEETINGS

Nearly 100 professionals from North and South America, Europe, the Middle East, Malaysia, Australia and New Zealand convened at MIT in August for a four-day International Workshop on Computer-Aided Scheduling in Public Transportation. About half of those assembled were public transit operators bringing practical experience of

what has worked and what has failed in the field with current scheduling software; the rest of the group, about evenly split, were academic researchers and software developers introducing the next wave. The workshop was structured around the presentation of 36 papers by the researchers and developers, focusing on proposed solutions for various industry problems, followed by discussion of the operators' reactions.

As part of its commitment to the development of the logistics profession, in September the Center hosted a roundtable discussion on "Logistics for the 21st Century". The discussion was the centerpiece of a project conducted by the Center — in cooperation with *Logistics Management and Distribution Report* (formerly *Logistics Management Magazine*) and Mercer Management Consulting — to find out what leading logisticians think the state of the art might be in the year 2007, in order to help today's logistics managers prepare for the future. Results of the effort were published in the January issue of *Logistics Management and Distribution Report* and, later, in *Supply Chain Management Review*. Participants in the roundtable represented six important sectors of the economy — automotive, consumer, high-tech, industrial, health care and retail.

In September, more than 100 people convened at the MIT Faculty Club for a retrospective look at the first ten years of research conducted by the New England University Transportation Center (UTC), headquartered at MIT. Participants represented the federal government, state and local governments of the New England region, university researchers and consultants. Focused on the strategic management of multimodal transportation systems, the conference featured simultaneous sessions presenting research results in four areas — transportation policy and strategic management; ITS and transportation technology; public transportation; and transportation systems modeling.

About 40 people convened at the MIT Faculty Club in December for a day-long meeting on transportation services for the elderly. Sponsored by the Volpe National Transportation Systems Center (US DOT), and the Federal Transit Administration — in conjunction with WFD, Inc. (formerly Work/Family Directions of Boston), a consulting firm that specializes in balancing work and family demands on employees in the workplace — the meeting drew a combination of federal, state and local officials who deal with issues concerning transportation and the elderly, and private sector providers of hardware for intelligent transportation systems. The meeting was part of the National Science and Technology Council Working Group on Transportation, a committee formed in response to the Clinton Administration's targeting of the needs of the elderly as a priority in transportation research and development.

About 60 people convened at the MIT Faculty Club in December for a two-day meeting exploring the art of infrastructure development and questions of where it might go from here. Presented by the Center in conjunction with MIT's new Infrastructure Development Group, the meeting was attended by both public and private officials involved in the design, construction and finance of public infrastructure such as highways, bridges, water treatment plants and even stadia.

Over 80 people convened at the MIT Faculty Club in January for a day-long talk among shippers, carriers and third party logistics providers to explore the state-of-the-art in bidding and transportation procurement. Attendees were evenly split between representatives of carriers, shippers and third party providers, and people from the US Department of Defense. The conference was part of a research project currently being conducted by the Center in collaboration with the American Trucking Association and The SABRE Group, to analyze and evaluate the Guaranteed Traffic Program at the US Defense Logistics Agency. In addition to analyzing the DLA's current practices, that study aims to benchmark transportation procurement practices throughout the commercial sector and generate recommendations to improve DLA's practices.

About 90 people convened at the MIT Faculty Club in March for a two-day affiliates seminar focused on excellence in customer service. The meeting was organized in response to a growing interest among the members on how to leverage customer service as a competitive advantage and included presentations by Yellow Freight, Fidelity, British Airways, America Online and the Ritz-Carlton Hotel Company. Those presentations were augmented with talks by faculty from the Sloan School of Management — Gabriel Bitran on the elements of service operations quality, John Van Maanen on the sociology of customer service at the Disney Worlds, and Maurice Segall on customer service as a strategic issue.

Over 60 people convened at the MIT Faculty Club in June for a two-day affiliates seminar focused on The Impact of Logistics on Corporate Performance. Along with an overview of related research, the seminar featured presentations from several corporations at the forefront of professional practice, describing their current state-of-the-art in assessing the contributions of their logistics and supply chain management functions to corporate goals. The topic was identified as a major issue on the minds of senior logistics managers at the roundtable discussion held last fall, sponsored by the Center in conjunction with Logistics Management and Distribution Report and Mercer Management. MIT will be tracking this topic over the next year to watch for important developments to report in a follow-up seminar.

SMALLER FUNCTIONS

As usual, the Center sponsored a reception at the annual Transportation Research Board meeting in Washington in January. This year's event was attended by about 150 alumni and friends. Every semester the Center sponsors a luncheon seminar series featuring transportation experts from the public and private sectors, and from academia, discussing current issues in the transportation field. Open to the public at large, the seminars draw an audience made up not only of students and faculty from the Institute, but also of representatives from the Volpe National Transportation Systems Center in nearby Kendall Square, from other universities, and from business and research organizations in the area. This year the series included Kelley Coyner, Administrator (Acting), U.S. Department of Transportation; William Zollars, President Yellow Freight Systems; Rick Adante, Vice President Materials Management, Goodyear Tire & Rubber Company; Hank Dittmar, Director, Surface Transportation Policy Program; William Millar, President of the American Public Transit Association; Gordon Linton, Administrator of the Federal Transit Administration; Mort Downey, Deputy Secretary of Transportation; and Lawrence Dahms, Executive Director of the Metropolitan Transportation Commission for the San Francisco Bay Area. Another series of luncheon seminars featured MIT faculty and research staff presenting their current work for discussion and feedback. Participants in the series this year were Markos Papageoriou, Visiting Professor, MIT; Fred Salvucci and Jose Gomez-Ibanez, Senior Lecturer, MIT and Professor, Harvard, respectively; Joseph Coughlin, Director, UTC Program, MIT; Allan Sloan, Visiting Fellow, McCormack Institute; Bob Dial, Operations Research Analyst, Volpe; Doug Lee, USDOT, Volpe; Suzanne Rasmussen, City of Cambridge; Frank Hassler, Director, Office of Strategic Programs and Resource Planning, Volpe; Kenneth Gwilliam, Principal Transport Economist, The World Bank; Peter Metz, Deputy Director, CTS; and Alan Bing, Senior Consultant, Arthur D. Little, Inc.

CORPORATE AFFILIATES PROGRAM

The Corporate Affiliates Program maintained a membership of 35 this year. The new members are Wisconsin Central, Nestlé USA, Polaroid and SEMA. Continuing members are British Airways, Canadian National Railways, Canadian Pacific Railway, Caterpillar, Conrail, Crowley Maritime, CSX Transportation, Cummins Engine, DuPont, Emery Worldwide, Federal Express, General Electric, Gillette, Goodyear Tire & Rubber, Honda, International Business Machines, Mars, NYK, Osram Sylvania, P&O Nedlloyd, Procter & Gamble, Ryder System, The SABRE Group, Sea-Land Service, Sony, Unilever, Union Pacific, United Parcel Service, United States Postal Service, Volkswagen and Yellow Freight.

Every year, as part of the Center's Corporate Affiliates Program, one of the members hosts the rest of the group at a two-day meeting and tour of one of its facilities. This year the meeting was held at the US Postal Service in Washington DC. In addition to their logistics people, some of the affiliates sent people involved in their own mail operations — MIT brought along its director of mail services too — and there was also a healthy representation from the Center's Public Affiliates Program.

INTEGRATED SUPPLY CHAIN MANAGEMENT PROGRAM

Since its inception in Fy 95, the MIT/Industry Integrated Supply Chain Management Program has grown to nine members -- Caliber Logistics, Cummins Engine, Monsanto, Procter & Gamble, Quelle AG, Siemens, Solutia, Volkswagen AG, and Xerox. In addition to the sixteen research projects that had been initiated in the first three years of the program, the 1998 Program research agenda included a collaborative effort with the Center for Coordination Sciences. There were also fifteen quarterly collaboration meetings held at sponsor locations, and the third annual executive seminar has been conducted, attracting over 35 senior managers from sponsor companies for a two-day session.

PROFESSIONAL EDUCATION

Every summer for the past thirteen years, the Center has offered an intensive week-long seminar on Logistics Analysis for Carriers and Shippers. Attended by representatives of carriers, shippers and third-party logistics providers, the course is structured around a series of lectures and case studies and involves intensive interaction among the participants. This year the course was attended by 55 participants.

PERSONNEL CHANGES

Last July, Dr. Joseph Coughlin joined the staff of the Center as the new director of the New England University Transportation Center (UTC). Before coming to MIT he worked as director of transportation and logistics research at EG&G, where he served on assignment to the Volpe National Transportation Systems Center, helping develop national transportation plans and policy options; as part of that effort he served as the primary policy resource on university research.

Late in June, Dr. James Masters joined the staff as Director of the Master of Engineering in Logistics Program. Prior to this, he spent ten years teaching and conducting research in the development and application of quantitative techniques to the solution of logistics problems at Ohio State University.

Professor Cynthia Barnhart was awarded tenure in the Department of Civil and Environmental Engineering; Barnhart's research work aims to bridge the gap between optimization theory and transportation practice by improving the design and operation of scheduled carrier systems

RECOGNITION

Center Director Yossi Sheffi was presented with the Distinguished Service Award of the Council of Logistics Management at their annual meeting in Chicago in October. The award, presented annually to an individual who has made a significant contribution to the art and science of logistics management, is the highest honor that can be bestowed upon an individual for achievements in logistics, according to the Council.

Also at the CLM meeting in October, MIT alumnus Christopher Caplice (PhD'96) was presented with CLM's 1997 Doctoral Dissertation Award for his paper's "originality, technical competence and contribution to the logistics knowledge base." His thesis, An Optimization Based Bidding Process, developed a new framework for shipper/carrier contracting in the motor carrier industry. Caplice's thesis advisor at MIT was Yossi Sheffi.

Carl Martland, Senior Research Associate in the Department of Civil and Environmental Engineering, was honored as the sixteenth recipient of the Transportation Research Forum's Distinguished Transportation Researcher Award. The plaque for this lifetime achievement award was inscribed "In recognition of pioneering the planning and costing techniques that are now commonly used by many US railroads; his research has in a small way aided the revitalization of America's railroads, improving their efficiency, productivity, and service quality."

Constantinos Antoniou, a 1997 graduate of the Master of Science in Transportation program, was presented with the Milton Pikarsky Award in January by the Council of University Transportation Centers (CUTC). Presented at CUTC's annual meeting, the award was given in recognition of his thesis, "Demand Simulation for Dynamic Traffic Assignment", which addresses the problem of estimating the effects of new developments in traffic management, such as ATIS and ATMS, on travel demand. Antoniou's thesis advisor was Moshe Ben-Akiva.

JR East Professor Joseph Sussman received the Effective Teaching Award of the Department of Civil and Environmental Engineering for 1996-97, based on student course evaluations. Sussman is director of the AAR Affiliated Laboratory at MIT.

The Tren Urbano Project, a joint MIT/University of Puerto Rico (UPR) program created to work on an urban rail transit system in San Juan, has been so successful that the Federal Transit Authority (FTA) designated it as a model project for its national technology transfer program. The agency sponsored a symposium on the topic in Baltimore in November.

More information about the Center can be found on the World Wide Web at http://web.mit.edu/cts

Yossi Sheffi

CONCOURSE

Concourse is a highly structured and integrated program for freshmen covering the standard core curriculum in mathematics, physics, chemistry, and humanities. The structure of Concourse follows that of the standard curriculum with scheduled lectures, recitations, problem sets and quizzes. Small class size (limited to 64 students) and extensive personal interaction with senior faculty and tutors provide students with the intimate atmosphere of a small school while retaining all of the excitement and resources of a large institution like MIT.

59 freshmen enrolled in Concourse for fall term, essentially full registration. Spring term's enrollment was 44, a 37% increase from the spring of 1997. Registration for IAP 1998 was full at 15 students who participated in Concourse's twelve-unit course on problem solving.

The new offering SP344 "Problems in Electricity and Magnetism" continues to succeed and has given rise to the First Annual MIT Perpetual Motion Machine Contest, in which undergraduates are encouraged (by a $500 cash prize for the best submission) to subvert the known laws of physics and chemistry. Spring term registration in Concourse increased substantially due to the availability of 18.03 Differential Equations, which was made possible by supplemental funding from the Office of the Dean of Engineering. Reception to the new offering SP330 "The Meeting of Art and Science Through Method" continues to be very positive and we are videotaping the classes as this will be the last time that this subject will be offered, anywhere.

Members of the Concourse faculty for 1997–98 were: David Amundsen, Department of Mathematics; Roberta Brawer, STS Program; Dr. Yuri Chernyak, Harvard-MIT Division of Health Sciences and Technology; Professor Jerome Y. Lettvin, Professor Emeritus, School of Engineering; Dr. Joseph Parse, Lecturer, Department of Materials Science and Engineering; Dr. Kevin Rhoads, Lecturer, School of Engineering; Professor Robert M. Rose, Department of Materials Science and Engineering; Professor Judah L. Schwartz, Professor Emeritus, School of Engineering; Radica Sipcic, Department of Mathematics; and Dr. Jeremy Wolfe, Visiting Associate Professor, Department of Brain and Cognitive Sciences. Sixteen MIT undergraduates in the fall and twelve undergraduates in the spring were employed as teaching assistants for recitations, grading, and running evening tutorials in chemistry, calculus, physics and differential equations.

The Concourse Program was overseen by Robert M. Rose as Director and by Ms. Cheryl Butters of the School of Engineering as Program Coordinator.

Robert M. Rose

INDUSTRIAL PERFORMANCE CENTER

The MIT Industrial Performance Center is dedicated to the study of industries in the United States and in other advanced economies. The Center brings together the intellectual resources of the Institute in a search for fresh insights into the nature and origins of successful industrial performance. Through our research we seek to help leaders in business, labor, government, and the universities better understand global industrial development and to work with them to develop practical new approaches for strengthening public policies, business strategies, technical practices, and educational programs. With the participation of about 30 faculty members and more than 50 students from the School of Engineering, Management, Humanities and Social Sciences and Architecture and Planning, the Center today serves as a listening post on industry, monitoring and interpreting industrial trends, techniques, and patterns of organization.

HIGHLIGHTS

The IPC received a grant from the German American Academic Council to conduct a research project on *International Changes in Industrial Innovation : Consequences for the Research System.* This is a collaborative research project with the Fraunhofer Institute for Innovation and Systems Research of Karlsruhe, Germany. The team consists of Professors Richard Lester, Richard Locke and Ed Roberts, and two Ph.D. students from Political Science: Trudy Wilcox and Jeremy Shapiro.

The goal of this project is to make a comparative study of the processes that companies in Germany and the United States are using to acquire new technical knowledge and to apply it to the development of new products, services and production processes. The motivating hypothesis for our research is that these processes have been changing over time in significant ways (perhaps as a result of the growing importance of externally-funded knowledge acquisition relative to the more traditional internal processes). Our task, therefore, is to describe these changes, understand their causes, and analyze their implications both for the sectors under study and more generally for the broader political economies of Germany and the United States.

This year, we have been engaged in doing the field research for two case studies on key innovations in the telecommunications and financial services sectors. We have also begun to design a survey of large corporations engaged in significant R & D activities (i.e., spending above US$150 million per year) which will be sent to companies in the US, Europe and Japan by the end of the summer.

In another new project, the MITRE Corporation and the IPC have embarked on a collaborative research project to examine knowledge sharing and organizational integration at MITRE. The project's goal is to understand organizational structures that creatively integrate knowledge and skills. Because of significant changes in the defense community, particularly decreased funding, ongoing acquisition reform, and increased use of commercial technology, MITRE is adapting new strategies for providing its systems integration services. As more organizations move towards flatter, less centralized organizational structures, the task of integrating individuals and technologies within and across organizations becomes increasingly vital. This research builds on the IPC's extensive studies of design and product development and interpretive approaches to general management problems. Professors Richard Lester and Michael Piore are leading this research.

The IPC is initiating a major new research project on the process of globalization and its effects on domestic economic, social and political structures. The *IPC Globalization Project* builds on work by faculty associated with the IPC including the 1989 *Made in America* study and the 1997 *Made by Hong Kong* study, as well as IPC-based work on globalization published in 1996 in the volume*National Diversity and Global Capitalism.*

New books published by IPC-affiliated faculty this year include, *The Productive Edge: How U.S. Industries are Pointing the Way to a New Era of Economic Growth* by Richard K. Lester.

RESEARCH

The Center's research is organized around four major themes: (1) Technology and the American Worker; (2) Measuring Industrial Performance; (3) New Approaches to Organizational Integration; and (4) Globalization and the Location of Core Production Functions. In addition to the new projects mentioned above, several continuing research projects addressing specific topics under these themes are also underway.

Professor Frank Levy continues his work with Professor Richard Murnane of the Harvard School of Education on computers' impact on the demand for labor. In June of this year, Levy and Murnane were awarded two grants - one from the Sloan Foundation (to MIT) and one from the Russell Sage Foundation (to Harvard) to begin a series of case studies on the computerization of work beginning with a bank and a hospital. Levy is working with Anne Beamish, a Ph.D. candidate in the Department of Urban Studies and Planning, on a project for Ford Motor Company on the organizational obstacles to developing an extranet connection between Ford and its dealers to improve two-way information flow. The project is part of the MIT-Ford research collaboration. Finally, Levy is finishing updating "Dollars and Dreams", his 1987 book on the U.S. income distribution. It will be published this November by the Russell Sage Foundation.

Professors Richard Lester and Michael Piore and their graduate students are continuing their studies of design and product development. Their main focus is on the development of a new theory of interpretive organization applicable to product development and more generally to the management of modern business enterprise. Their research is built on empirical foundation of case studies of new product development in the cellular telephone, apparel, medical device and automobile industries.

Professor Charles Fine and his students continued their research on Technology Supply Chains and held a major conference on *Creating and Managing Corporate Technology Supply Chains: Value Chain Design in the Age of Temporary Advantage.* This symposium introduced a new lens for strategic business analysis, an expanded scope for the focus of that analysis, and a new implementation framework for incorporating the resulting insights into managerial practice. The lens is that of clockspeed analysis -- harnessing the speed of industrial change for insights into the continual evolution of competitive threats and opportunities. The focus of clockspeed analysis is the chain of capabilities -- from the customer needs all the way upstream to knowledge creation and mineral extraction. Rather than focusing on individual core capabilities, clockspeed analysis examines the entire capability set embedded in the value supple chain to the final customer. The implementation framework is three-dimensional concurrent engineering, which elevates and integrates the "third dimension" of supple chain design into traditional concurrent product and process design, thereby extending strategic vision deeper into these critical business processes.

Professor Locke and his students are continuing their research on new practices and organizational forms now underway in the broad range of local and international unions. They are analyzing the organizational and institutional factors that promote and hinder innovation in the American Labor movement.

OTHER ACTIVITIES

The Center sponsors a Doctoral Fellowship program that provides opportunities for highly qualified doctoral students to pursue independent thesis research. Candidates are selected on a competitive basis and are drawn from across the Institute. This year the Center was fortunate to have received a large number of excellent submissions and the fellowship committee awarded an unprecedented four Fellowships: Susan C. Eaton, *Integrating Work and Family in Forms of the Future- How Firm Practices Affect Research Workers in BioTechnology*; Teresa M. Lynch, *After America- Foreign Production and Domestic Employment in U.S. Manufacturing*; Aya Okada, *Workers' Learning Through Inter-Firm Linkages in the Process of Globalization- A Case of the Automobile Industry in India*; and J. Gunnar Trumball, *The Politics of Market Regulation and its Impact on Product Innovation.*

The IPC Faculty Seminars continued with a series of research seminars focusing on *Producing in Asia.*

The Center continues to play a role in helping to develop intellectual connections and research collaboration among the Sloan Foundation's national network of Industry Studies. The Center is responsible for the Sloan Human Resource Network, directed by Professor Thomas A. Kochan.

More information on the Industrial Performance Center can be found on the World Wide Web at http://web.mit.edu/ipc/www/

Richard K. Lester

INTEGRATED STUDIES PROGRAM

The Integrated Studies Program (ISP) offers a curriculum for first-year students built around the study of a variety of technologies practiced in different cultures and historical periods. ISP promotes a form of education that seeks to show students the connections among ideas and processes in the sciences, humanities and social sciences. Hands-on learning is emphasized as a complement to the theoretical work that is a typical component of the first-year curriculum. ISP strives to provide students the academic and social foundation for success at MIT and beyond by creating a community devoted to team approaches to design and problem solving, inquiry, enhanced communication skills, and life-long learning.

The fall and spring HASS-D subjects that form the core of the ISP curriculum focused on technologies ranging from time keeping devices, food production and preparation, and blacksmithing (fall) to weaving, textile dyeing, and engine design (spring) within a variety of cultural contexts. Professor Arthur Steinberg and Dr. Peter Dourmashkin held primary responsibility for these subjects during the past year, with Frederica Steinberg coordinating the integrated writing component. ISP continued to modify approaches within existing modules to improve students' competencies in all modes of communication, and in working as part of a team to develop and promote an idea. In fall, students analyzed how common objects work in a new unit focused on design. In spring, student teams wrote and presented business plans for construction of textile mills in the mid-nineteenth century Merrimack Valley.

Workshops connected to the humanities subjects allowed students the opportunity to practice all the technologies studied. Guest presenters included Toby Bashaw, blacksmith, Debbie Watson, weaver and dyer, and Dr. Ed Franquemont, anthropologist and specialist on Incan weaving.

ISP continues to focus attention on developing a strong writing curriculum under the leadership of Ms. Steinberg. Beginning with spring semester, ISP has received provisional approval to offer credit for Phase I of the Writing Requirement to students earning an acceptable grade in the written component of the humanities subjects.

ISP hosted a weekly luncheon for freshmen with speakers from MIT and the greater community speaking about their work.

Students attended lectures in math and science subjects with the rest of the freshman class, but were able to choose ISP-sponsored recitations in some subjects.

A highlight of the year was ISP's move from building 20 to refurbished quarters on the first floor of building 16. Students returned from spring break to new facilities that included faculty and staff offices, classroom, kitchen, computer lab, and lounge.

ISP welcomed the return of Marshall Hughes as part-time support for the program.

33 students (20 male; 13 female) enrolled in fall. 37 students (26 male; 11 female) enrolled in spring.

ISP is overseen by Arthur Steinberg, Director, and Debra Aczel, Program Administrator.

More information about the Integrated Studies Program can be found on the World Wide Web at the following URL:http://web.mit.edu/isp/www/

Arthur Steinberg

LABORATORY FOR COMPUTER SCIENCE

The MIT Laboratory for Computer Science (LCS) is an interdepartmental laboratory whose principal goal is to create forefront computer-communications technologies of high social utility with equal attention to technological underpinnings and human use.

Founded as Project MAC in 1963, the Laboratory developed one of the world's earliest time-shared computer systems: the Compatible Time Sharing System (CTSS) and its successor, Multics, which laid the foundation for many of today's systems and approaches, such as virtual memory, tree directories, on-line scheduling algorithms, line and page editors, secure operating systems, access control techniques, computer-aided design, and two of the earliest computer games, space wars and computer chess. Our partner in the Multics effort, AT&T, used many of the early ideas in their design of Unix.

These early developments laid the foundation for the Laboratory's work on knowledge based systems -- the Macsyma program for symbolic mathematics -- natural language understanding, and (with BBN) the development and use of packet networks in the Arpanet. In the late 1970s, Project MAC, renamed as the MIT Laboratory for Computer Science, embarked on research in clinical decision making, public cryptography, distributed systems and languages and parallel systems. These led to the RSA encryption algorithm, data abstractions which served as foundations of object oriented programming, the Clu and Argus distributed systems, the dataflow principle and associated languages and architectures of parallel systems (Monsoon, Id and StarT), local area networks, program specification and workstation development, where the Laboratory contributed the earliest UNIX ports and compilers and the Nubus architecture. This research also led to the X Window System, a computer intercommunication and user interface system which was further developed by the Laboratory's X-Consortium and was widely used in over one thousand different software products. Since 1994, LCS has been the principal host of the World Wide Web Consortium of some 260 organizations that helps set the standard of a continuously evolving world wide web.

The Laboratory's current research falls into four principal categories: Information Infrastructure and Distributed Systems; Human-machine interaction; Science and Computer Science research; and Theory. The principal goals of these four categories are as follows:

In the areas of *Information Infrastructure and Distributed Systems*, we wish to understand principles and develop technologies for the architecture and use of highly scaleable information infrastructures that interconnect human-operated and autonomous computers. Transactions among such distributed systems involve the purchase, sale and free exchange of information and information work toward electronic commerce and shopping, health care, education, business, government and many other uses as well as increased automation of human work. We wish to explore new emerging forces such as groupwork across space and time and automation of computer-to-computer actions. We also expect this overall research to have a broad impact on future systems because virtually every machine will be connected to some information infrastructure and such infrastructures are expected to last for a very long time. The Laboratory's World Wide Web Consortium is a significant and major focus of our work in this area.

In the *Human-Machine Interaction* area, our technical goals are to understand and construct programs and machines that have greater and more useful sensory and cognitive capabilities so that they may communicate with one another and with people toward useful ends. The two principal areas of our focus are conversational spoken dialogue systems between people and machines and graphics systems used predominantly for output. In this area, we also strive to construct tomorrow's servers by harnessing the power and economy of numerous processors working on the same task; relevant research spans parallel hardware and software architectures, that yield cost-performance improvements of several orders of magnitude relative to single processors.

In the *Science and Computer-Science* area, we are interested in exploring opportunities at the boundary of traditional science and information technology. Our research includes an extensive program of clinical decision systems research between medicine and computer science, and several research activities in biology and computer science.

Taken together, these three thrusts define the Laboratory's overarching goal: development, understanding and better human communication with tomorrow's information systems. In the Laboratory's fourth category of research, *Theory*, we strive to discover and understand the fundamental forces, rules, and limits of Information Science and Technology. As a result, theoretical work permeates our research efforts in the other three areas; for example, in the pursuit of parallel algorithms, fault tolerant computer networks, and privacy and authentication of communications. Theory also touches on the logic of programs, the inherent complexity of computations, and the use of cryptography and randomness in the formal characterization of knowledge. The Laboratory expends a great deal of effort in theoretical computer science because its impact upon our world is expected to continue its past record of improving our understanding and helping us pursue new frontiers with new models, concepts, methods, and algorithms.

Highlights during the reporting period are as follows:

COMPUTER AIDED AUTOMATION GROUP

During this period, we created a new research group under the leadership of Professor Srini Devadas. The objective of this group is to develop technologies for automating certain low-level tasks, now being carried out by people. We believe that successful research in this area can increase human productivity significantly over the next few decades.

GRAPHICS GROUP

This group has significantly expanded its activities during the past year. Professors Dorsey and Teller have been joined by Professor McMillan, a new faculty member in EECS. We have constructed a new graphics research laboratory, and the group recently won a National Science Foundation CISE Research Infrastructure Grant for $1.65M to build the computational infrastructure for this facility. The group research involves the automatic acquisition of 3D urban scenes; computational video techniques for organizing and interacting with video objects; in exploration, including research in immersive image-based virtual environments, hybrid geometry and image-based representations, and hardware for accelerated walk-throughs; research in computer-aided lighting and acoustic modeling, interactive high-fidelity rendering, weathering and surface appearance, and photomontage. The group is also developing a new curriculum in computer graphics and visualization and a system for collaborative pedagogy of algorithmic concepts.

SPOKEN LANGUAGE SYSTEMS

This group is pursuing a new approach to human-machine interaction via LCS-35, a handheld system that accepts input only via human speech and delivers both spoken and visual output, while communicating with a network for its computational needs. Technically, this approach calls for creation of a speech driven switch (or operating system) that replaces the traditional screen/keyboard input and that switches among several domains of specialized services depending on what the speaker says. Socially, we are interested in exploring how such systems may significantly reduce the burden of human-machine communication by relying on means of interaction that are already familiar to people.

WORLD WIDE WEB CONSORTIUM (W3C)

As of this report, 264 organizations have joined the consortium in order to participate in and contribute to the orderly evolution of the World Wide Web (W3). In 1998, we introduced the notion of W3C Offices, which deal with the member organizations in their respective regions, but do not carry out technical development, like the hosts. The key W3C technical development has been *metadata*, through which people and machines will be able to represent and, therefore, write and read characterizations about information such as its quality, veracity and appropriateness for designated purposes.

During this reporting period. Mr. Tim Berners Lee, director of the W3C, was awarded the prestigious MacArthur Award. The Laboratory's Distinguished Lecturer Series included presentations by Dr. James Gosling, Sun Microsystems, Inc., Dr. Robert Morris, retired, National Security Agency, Professor Randy H. Katz, United Microelectronics Corporation Distinguished Professor and Chairman, Electrical Engineering and Computer Science Department University of California, Berkeley, Eckhard Pfeiffer, President and CEO Compaq Computer Corporation, and Professor Patrick Hanrahan, Department of Computer Science, Stanford.

The Laboratory is organized into 15 research groups, an administrative unit, and a computer service support unit. The Laboratory's membership comprises a total of 511 people, including 77 faculty and research staff, 158 graduate students, 146 undergraduate students, 99 visitors, affiliates, and postdoctoral associates and fellows, and 31 support staff. The academic affiliation of most of the Laboratory's faculty and students is with the Department of Electrical Engineering and Computer Science (EECS). About 65% of the Laboratory's funding comes from the US Government's Advanced Research Projects Agency. The Laboratory is also funded by and has extensive links with industrial organizations. These include partnerships for the construction of major hardware systems, consortia for the development and maintenance of standards, such as the World Wide Web, and joint studies on research areas of common concern.

More information about the Laboratory can be found on the Web at http://www.lcs.mit.edu

Michael L. Dertouzos

LABORATORY FOR ELECTROMAGNETIC AND ELECTRONIC SYSTEMS

The mission of the Laboratory for Electromagnetic and Electronic Systems (LEES) is to be the focus for research and teaching in electric energy from its production through its processing to its utilization, and in electromechanics from the macroscopic through the microscopic to the molecular levels. Electric energy and electromechanics are defined broadly to include power systems monitoring and operation; automatic control; power electronics; high voltage engineering; and conventional, continuum and biological electromechanics. Much of the work of the laboratory is experimental, and industrial sponsorship represents a large fraction of the laboratory's support. The laboratory's professional staff consists of 10 faculty from EECS, one Senior Lecturer, 2 Senior Research Engineers, 5 research staff, and approximately 50 graduate students. The laboratory faculty and most of the staff are heavily involved in both undergraduate and graduate teaching. Faculty from the departments of ME, CE, MS&E and NE are collaborators in many of the laboratory's programs, and there are extensive joint activities with the Microsystems Technology Laboratory (MTL) and the Energy Laboratory. LEES is also an active participant in the Leaders for Manufacturing Program, and the Technology and Policy Program (TPP). During the past year the laboratory has experienced a continued expansion of its automotive related research, demonstrated a sensor technology capable of detecting plastic landmines, demonstrated an actively controlled polymer gel synthetic muscle, and successfully applied advanced signal processing techniques to the evaluation of insulation integrity in high voltage power cables.

AUTOMOTIVE ELECTRONICS AND ELECTRICAL SYSTEMS

Professor John G. Kassakian and Dr. Thomas M. Jahns lead the laboratory's work in automotive electrical and electronic systems. This work is sponsored primarily through the laboratory's Consortium on Advanced Automotive Electrical and Electronic Components and Systems. Seven new members were added to the consortium in the past year, bringing the membership to 20. The consortium sponsored three two-day meetings, one of which was hosted by Siemens and held in Regensburg, Germany.

Under the auspices of the consortium, the multi-attribute trade-off analysis tool MAESTrO has been licensed to a commercial software developer. Professors James L. Kirtley and Jeffrey H. Lang, Dr. Jahns and graduate student Edward C. Lovelace have continued their investigation of high-power starter/alternators for future cars. After comparing the performance of several candidates, they have selected the interior permanent-magnet synchronous machine for further investigation. The analysis and optimized design of this machine is now in progress, with the fabrication and testing of a prototype machine planned for later this year. New consortium research projects have been initiated on protection and fusing for a 42 V system, a comparative study of practical 42 V architectures, an evaluation of EMI and mitigation techniques, and an economic analysis of the process of transitioning the industry to the proposed 42 V standard, this last in collaboration with the MIT Material Systems Laboratory and the Sloan School.

Also under the auspices of the consortium, Prof. Kassakian participated in a three-day BMW technology workshop and a strategic review of Ford's internal electrical system development program, and Dr. Jahns participated in, and presented the work of the consortium to, the first General Motors Technology Fair.

The Laboratory's strategic alliance with Ford to accelerate the adoption of a 42 V standard has been expanded to include Daimler Benz, Siemens and Motorola. This group has been actively engaged in developing the tools and techniques for remote collaboraton. As part of this activity, Prof. Kassakian has organized a technical session at Convergence 98 - an international conference devoted to automotive electrical/electronics - to present the international status of the transition to 42 V.

MODELING, MONITORING AND CONTROL OF POWER SYSTEMS

Utility industry restructuring has placed an intense focus on achieving economically optimal system operation by employing new and more sophisticated control and monitoring strategies. LEES has been making significant contributions to the solutions of problems of power system modeling, economic control, and apparatus monitoring.

MODELING AND CONTROL

Professor Bernard C. Lesieutre has conducted new research in the area of uncertainty analysis of large scale power system simulations. He has applied a promising probabilistic technique to help evaluate load model uncertainties

when estimating maximum power transfer limits between areas. Given a power transfer level, he has calculated the probability that the response to a contingency (unexpected system event) will exceed some voltage, frequency, or thermal limit. The "probabilistic colocation method," which is employed in this study, was originally developed to study uncertainty in global climate change research. In the power system problem, this computationally efficient method is approximately three orders of magnitude more computationally efficient than the common Monte Carlo approach, and a single order of magnitude more efficient than other variance reduction techniques. Prof. Lesieutre's continuing work will identify the critical uncertain parameters for a particular system.

Professor George C. Verghese and Prof. Lesieutre have received a third round of funding from Electricité de France to further develop their ideas for reduced-order dynamic modeling of power systems. Their work so far has shown that traditional models can be substantially reduced in complexity without significantly compromising accuracy. The next phase of research is focused on obtaining comparable (order-of-magnitude) reductions in simulation time, with a view to enabling a variety of real-time applications in power system operation.

In collaboration with colleagues from Northeastern University and the University of Padova (Italy), Profs. Verghese and Lesieutre have further developed the notion of dynamic phasors models for efficient representation of nearly periodic dynamics in power electronic and electrical machine components of large power systems. This approach has led to novel and tradctable dynamic models of components such as thyristor controlled series compensators, which are finding increasing use in power systems.

Senior Scientist Marija Ilic, in collaboration with Professor Francisco Galiana of McGill University and the Energy Laboratory's Electric Utility Program, continues to grow the Consortium on Transmission Provision and Pricing Under Open Access. The consortium is studying issues related to the operational stability of the regional power grid in the face of the relaxed control over individual generators implied by the deregulation of the electric utility industry. A very successful workshop on this topic was hosted by Dr. Ilic and her colleagues this year.

ADAPTIVE MONITORING OF TRANSFORMERS

New methods for the early detection of defects in on-line power transformers developed by Principal Research Engineer Chathan Cooke have now been applied to several field study cases. The system uses advanced pulse signal measurement at multiple locations followed by time and frequency domain signal processing to identify and locate incipient partial discharge events. Further development, including commercialization of the method is proceeding. Research Engineer Wayne H. Hagman and Dr. Cooke have initiated a program with Entergy Services, Inc. to use adaptive modeling to enable more effective use of capital intensive power transformers, and to develop sensors and models for the detection and quantization of deterioration in transformer load tap changers.

Mr. Hagman continues his long-standing association with Boston Edison to deploy the MIT transformer monitoring system into the Edison network. His successful training of Boston Edison employees has enabled the transfer of operational and maintenance responsibilities for the installed systems to Boston Edison. Under Boston Edison funding, Mr. Hagman is developing means of performing on-line intelligent diagnosis of anomalous behavior in power transformers.

The laboratory continues its search for an appropriate partner with which to commercialize and continue the development of the MIT monitoring system. Discussions with two companies in the US and one in Great Britain are underway.

NON-INTRUSIVE LOAD MONITORING

Professor Steven Leeb, graduate student Steven Shaw and former student Umair Khan were this year awarded a second patent on an advanced hardware platform for nonintrusive load monitoring. Custom hardware constructed in the laboratory implements a parallelized indetification algorithm and computation platform using an array of inexpensive microcontrollers. A field portable version of the nonintrusive monitor was designed using a digital signal processing chip and a Pentium class processor. Four of these units have been constructed, and field testing has begun. Some of these units will be installed in MIT's Next House dormitory to assist the MIT Physical Plant with electrcial end-use load monitoring and diagnostics.

ELECTROMECHANICS

ELECTRICAL MACHINES

Professor James L. Kirtley and graduate student Ujjwal Sinha have produced the final version of the Novice Design Assistant, a computer aided tool for designing three-phase induction motors, and delivered it to the sponsor, Magnetek. Mr. Sinha has also developed a new optimization technique that uses multi-dimensional adaptive regressive splines, fitted to the pareto frontier data produced by the Novice Design Assistant.

GEL POLYMER ACTUATORS

Professor Leeb, in collaboration with Professor Toyoichi Tanaka of the Center for Materials Science and Engineering, and with graduate students Ahmed Mitwalli and Tim Dennison, continues to explore applications of polymer gels as actuators and sensors. Responsive polymer gels have been successfully employed as electrophoretic and chromatographic media in which distributions of phase transition temperatures in a gel can be used to identify ionic components in a mixture. A remarkably descriptive and accurate model of responsive gels as linear actuators was developed this year and used as a basis for control design. A simple synthetic muscle was actively controlled using this model and a microcontroller. Professor Leeb was awarded a patent this year for the design of gels that exhibit a phase-transition in response to an applied magnetic field, a result of work that was described in last years report.

MICROELECTROMECHANICS

Professor Jeffrey H. Lang, Principal Research Engineer Stephen D. Umans and graduate student Steven F. Nagle, in collaboration with many faculty, staff and students from across the School of Engineering, have continued their development of motors and generators for microturbomachinery. Optimized machines have now been designed and are under fabrication. Professor Lang and graduate Jo-Ey Wong, in collaboration with Professor Martin A. Schmidt of the MTL have continued their development of microelectromechanical relays for power witching. Prototype relays are currently under fabrication. Finally, Professor Lang, Professor Anantha P. Chandrakasan, and graduate students J. Oscar Mur-Miranda, Rajeevan Amirtharajah and Scott E. Meninger have begun the development of microelectromechanical devices designed to convert ambient vibration energy into electric energy to power autonomous electronics. Initial devices have been designed and are now under fabrication.

POWER ELECTRONICS

Postdoctoral Research Associate David J. Perreault, working with graduate students Vahe Caliskan and Tim Neugebauer, completed the design and construction of a prototype dc/dc converter for use in the new 42 V automotive electrical system being developed by Ford. The design is based on the cellular converter concept which was the subject of Dr. Perreault's doctoral thesis, and takes advantage of interleaving to reduce filter requirements, and subsequently cost. The converter has been delivered to Ford and is being tested as part of their 42 V prototype system.

Professor Leeb and former graduate student Deron Jackson completed development of an inductively coupled power supply system for servomechanical systems. This power electronic drive has been used to charge electric vehicle batteries, and to run servomechanisms including a water bath and a rotational velocity servo. Adaptive control was designed, implemented, and tested using this power electronic drive. Undergraduate student Ben Douts has applied the inductive techniques to the development of a magnetically coupled "smart card" system, which demonstrated power transfer and bidirectional serial communication at 9600 baud over a common magnetic path.

HIGH VOLTAGE AND INSULATION RESEARCH

Dr. Cooke and graduate student Robert Lyons have further developed signal processing for ultrasonic inspection methods, including one specific application to high-voltage power cables under sponsorship of the Tokyo Electric Power Company. Through signal processing, improved spatial resolution and better localization of features have been achieved. The method has been demonstrated on the ultrasonic measurement of space-charges within plastics. In one case electrons directly implanted into a polymer were clearly located and their motion within the dielectric was tracked. Another example concerns ultrasonic observation of the dielectric failure process called "treeing." Here simultaneous micro-video and ultrasonics enable new information about this basic failure mechanism.

Professor Markus Zahn has extended his work on Kerr electro-optic field mapping to develop a complete three-dimensional mathematical formulation of optical tomography. Using this formulation, the magnitude and direction

of an applied electric field for any arbitrary electrode geometry can be determined from light intensity measurements that depend on electric field induced birefringence.

Professors Lesieutre and Zahn, under a joint NSF/EPRI initiative, have continued work on developing a sensor and algorithms to estimate spatial profiles of conductivity and permittivity in materials. Over the past year they have redesigned the sensor to improve its performance and have conducted experiments to study the diffusion process of moisture between oil and pressboard to better understand and quantify the flow electrification problem in transformers. This process can lead to transformer failure when a cold transformer is energized. In the process of this investigation, Profs. Lesieutre and Zahn have also identified and are correcting errors and shortcomings that appear in the literature concerning moisture diffusion. Professors Zahn and Lesieutre have also extended their work on interdigital dielectrometry sensors to show that these sensors can detect plastic landmines that current metal detectors cannot detect. They have received a US Army contract to further develop dielectrometry technology for landmine detection.

PERSONNEL CHANGES

Professor Martha Gray has left the laboratory to assume the permanent role of co-director of the MIT/Harvard joint program in Health Sciences and Technology (HST). Dr. David Perreault, formerly a graduate student in the laboratory, completed his doctoral program and has joined the laboratory as a Postdoctoral Research Associate.

Professor Gerard Hurley of University College, Galway, Ireland, has been on sabbatical in the laboratory as a Visiting Professor. Dr. Stephan Guttowski who recently received his degree from the Technical University of Berlin has joined the laboratory as a Postdoctoral Research Associate.

HONORS AND AWARDS

Professors Verghese and Lang were elected to the grade of Fellow in the IEEE.

Professor Leeb was this year's recipient of the Harold Edgerton award for excellence in undergraduate teaching.

Professor Kassakian received the IEEE Power Electronics Society's Distinguished Service Award, and the Dikran K. Kabakjian Science Award from the Armenian Students Association of America.

John Kassakian

LABORATORY FOR INFORMATION AND DECISION SYSTEMS

The Laboratory for Information and Decision Systems (LIDS) is an interdepartmental research laboratory of the Massachusetts Institute of Technology. Its staff includes faculty members, full-time research scientists, postdoctoral fellows, graduate research assistants, and support personnel. Undergraduate students participate in the research program of the Laboratory through the Undergraduate Research Opportunities Program (UROP). Every year several research scientists from various parts of the world visit the Laboratory to participate in its research programs.

The fundamental research goal of the Laboratory is to advance the field of systems, communication, control, and signal processing. In doing this, it explicitly recognizes the interdependence of these fields and the fundamental role that computers and computation play in this research. The Laboratory is conducting basic theoretical studies in communication, control, and signal processing, and is committed to advancing the state of knowledge in technologically important areas.

As an interdepartmental laboratory, LIDS reports to the Dean of the School of Engineering, Professor Robert A. Brown. The Co-Directors of the laboratory are Professors Robert G. Gallager, Sanjoy K. Mitter, and John N. Tsitsiklis (Acting Co-Director).

The Center for Intelligent Control Systems, an inter-university, interdisciplinary research center operated by a consortium of Brown University, Harvard University, and MIT, resides administratively within LIDS.

Twelve faculty members, several research staff members, and approximately 60 graduate students are presently associated with the Laboratory and the Center. Currently, the Laboratory and the Center provide some 50 research assistantships to graduate students. Undergraduate students also participate in research and thesis activities. A number of postdoctoral and visiting appointments are made.

Financial support is provided by the Air Force Office of Scientific Research (AFOSR), the Army Research Office (ARO), the Advanced Research Projects Agency (ARPA), C.S. Draper Laboratory, Motorola University Partnerships in Research, the National Science Foundation (NSF), the Office of Naval Research (ONR), Siemens AG, Tellabs, Inc., and the University Research Initiative Program (ARO).

RESEARCH

The current research activities of the laboratory cover a wide range of theoretical and applied areas in systems, communications, control and signal processing. These areas include the following:
Communication

WIDEBAND ALL-OPTICAL NETWORKS

Researchers from LIDS, RLE, Lincoln Laboratories, ATT Bell Laboratories and Digital Equipment Corporation have collaborated as part of a Consortium on All-Optical Networks. Funding for the Consortium was provided by DARPA. The goal of the Consortium was to pursue research and development on the optical technologies, the architectures, and the application interfaces required for a scalable, universal, wide-area, wideband, all-optical network. A key element of the Consortium's work was the construction of an extensive test bed linking the Consortium members and demonstrating the feasibility of the design concepts. The Consortium was viewed as a long-term effort paving the way to the national and international information infrastructures of the future. Professor Robert G. Gallager, Dr. Steven G. Finn, and a number of graduate students have been involved in the Consortium, which continues to strive towards this end.

In continuation of this research, Dr. Steven G. Finn, Professor Robert G. Gallager, and a number of graduate students from LIDS are collaborating with Lincoln Laboratory on All-Optical Networks. They are working on wavelength division multiplexing (WDM) wide area networks, particularly with respect to their use in backbones, and on very high speed local area time division multiplexing (TDM) networks. The work at LIDS is focused on the system and architectural aspects of these networks. Also, a node of a WDM network testbed is located at LIDS for experimental work.

COMMUNICATION UNDER CHANNEL UNCERTAINTY

In many applications, e.g., mobile wireless communication and military communication in the presence of jamming, the channel characteristic and the nature of the noise are unknown in the design stage of the communication link. For such applications it is imperative to design robust receivers and codes that allow reliable communication over each of a wide family of channels. To this end Professor Amos Lapidoth is studying universal receivers that do not require precise knowledge of the channel law, and yet perform asymptotically as well as the best receivers that could have been designed had the channel been known in advance. Professor Lapidoth is also studying the ultimate bounds on the rates at which reliable communication can be guaranteed over a channel that is only known to belong to some given family of channels.

DATA COMMUNICATION NETWORKS

The major objective of this work is to develop the scientific base needed to design data communication networks that are efficient, robust, and architecturally clean. Both wide-area and local-area networks, both high-speed and low-speed networks, and both point-to-point and broadcast communication channels are of concern. Some specific topics of current interest are multi-access interference, routing in wireless networks, quality of service control, diverse traffic mixes, the communication complexity and delay of distributed algorithms, failure recovery, and topological design. Professors Dimitri P. Bertsekas, Robert G. Gallager, Dr. Steven G. Finn, and their students are conducting this research.

WIRELESS COMMUNICATION

Professors Robert G. Gallager and Mitchell D. Trott, together with several students, have ongoing projects in mobile communication aimed at developing a cohesive theory and set of insights for wireless multiple access. Specific research includes multiple-antenna transmission diversity, the capacity of fading channels, joint source/channel coding for broadcast channels, the transmission of bursty sources over a shared time-varying channel, transmitter power allocation across many cells, and capacity improvements through joint decoding.

CODES ON GRAPHS AND ITERATIVE DECODING

Professor G. David Forney, Jr. and several students and colleagues have been studying codes defined on graphs and iterative decoding algorithms, such as turbo codes, low-density parity-check codes, and tail-biting codes. Some of these codes have been shown to be able to approach the Shannon limit remarkably closely, using implementable decoding algorithms. However, understanding of the construction of such codes and of the behavior of these decoding algorithms is still in a fairly primitive state.

COLLABORATION WITH TELLABS

The Laboratory for Information and Decision Systems and Tellabs Operations, Inc., a telecommunications equipment manufacturer, are developing a novel approach to collaborative research. In this approach, LIDS and Tellabs integrate industrial research interests with MITís research and educational environment. The key difference between this new model of collaboration and traditional approaches is the focus on human resources as the primary enabler. Toward this end, LIDS provides Tellabs with access to faculty, students, visitors, facilities, and infrastructure support, while Tellabs dedicates resident corporate research positions to the effort, assuming responsibility for technology transfer as an internal corporate process. LIDS benefits from the persistent presence of industrial researchers, and Tellabs benefits from the leveraging of LIDSís staff. LIDS and Tellabs have been jointly working on this new research model for three years and look forward to its growth and refinement.

ESTIMATION AND SIGNAL PROCESSING

For some time now there has been considerable interest in algorithms for processing signals or images at multiple resolutions. A theory involving the so-called wavelet transform has been recently developed for the deterministic representation of signals at multiple resolutions, and this has sparked a considerable response from the research community in exploring potential applications in a variety of areas ranging from computer vision to the fusion of multispectral measurements. An essential element in the development of a systematic methodology for the design of multiscale algorithms is the development of a statistical theory for multi-resolution signals. Continuing efforts to develop and apply such a theory are underway by Professor Alan S. Willsky and Dr. Hamid Krim, together with their students and a group of researchers in Rennes, France. Through other collaborations with Professor Stephan Mallat, attempts are being made at the fusion of statistical and wavelet-based approaches to signal processing. The initial results that have been obtained, together with the considerable attention these topics are receiving from the

research community, give reason to believe that this will be an extremely fruitful area for some years to come. In addition considerable progress has been made towards a unifying framework and the so-called scale space analysis with the wavelet and wavelet-packet-based denoising. The robustness achieved in a newly introduced class of edge enhancement algorithms has been shown theoretically as well as experimentally, and the results are extremely promising.

EFFICIENT ESTIMATION OF SPACE-TIME PROCESSES

Part of the research of Professors Alan S. Willsky and his students on multidimensional statistical signal processing and estimation focuses on the development of efficient and highly parallelizable algorithms for multidimensional estimation. Essentially all multidimensional estimation problems involve potentially explosive computational demands, caused both by working in multiple spatial dimensions and by the compounding lack of an obvious notion of causality and hence recursion (in contrast to traditional time series analysis). Results obtained so far deal with new notions of recursive computation in multiple dimensions; parallelization achieved by data partitioning and a generalization of the technique of nested dissection for solving partial differential equations; and effective methods for handling processes that evolve in time as well as in space. In particular, in the realm of multidimensional spatial processing a new approach using radial recursion of boundary conditions has been developed and demonstrated to yield efficient and accurate solutions. This approach may then be coupled with spatial data partitioning to produce a new class of multidimensional parallel processing algorithms.

In the area of space-time processes, a key contribution of this work has been the recognition that the major computational problem in space-time filtering, namely that of calculating error covariance functions for predicted spatial fields and using these covariances in the incorporation of new measurements, can be viewed as a problem of statistical modeling of random fields. This insight has led to very effective methods for reduced-order modeling allowing the solution of space-time estimation problems of very high dimension. Novel approaches have been developed to the dynamic computation of spatial Markov random field models as they evolve in time, and for the use of these models for the efficient assimilation of spatial data over time. Areas of application for these methodologies are currently being explored, including such areas as global ocean circulation estimation, remote sensing, real-time image sequence analysis, multidimensional filter design and analysis, and fast partial differential equation solution and simulation.

GEOMETRIC-BASED ESTIMATION

Professor Alan S. Willsky and his students are engaged in research on the estimation and reconstruction of geometric features in multidimensional data. Interest in this area is motivated by the need to develop radically different methods for problems in which the focus is on geometric rather than pixel-by-pixel features. Major contributions of this work include the development of a methodology for the reconstruction of 3-D objects from their 2-D silhouettes, and the tracking of objects with time-varying shape. This methodology has been tested in practice, resulting in a new approach to temporal imaging of the heart given very low-dose (and thus low SNR) imagery. New approaches have also been developed to the characterization and parameterization of geometrically-described random fields and to the direct extraction of geometric information from tomographic data -- providing new algorithms in computational geometry that directly accommodate, and hence are robust to, uncertainties and errors in the observed data. These methods are applied to such problems as the estimation and tracking of geophysical and oceanic features from sparse data, the nondestructive evaluation of materials, the detection and quantification of atherosclerotic plaques, and the evaluation of cardiac structure and function. Extension and fusion of these methods with multiresolution approaches promise to allow multiscale descriptions of object geometry.

CONTROL

Multivariable and Robust Control

The systematic design of multiple-input, multiple-output systems, using a unified time-domain and frequency-domain framework to meet accurate performance in the presence of plant and input uncertainty is an extremely active research area in the Laboratory. Various theoretical and applied studies are being carried out by Professors Michael Athans, Munther A. Dahleh, Gunter Stein, and their students. Theoretical research deals with issues of robustness, aggregation, and adaptive control. The aim of the research is to derive a computer-aided design environment for the design of control systems which can address general performance objectives for various classes of uncertainty. Furthermore, new results on the robustness of nonlinear feedback systems, using feedback linearization, have been obtained for unstructured uncertainty model errors. Recent application-oriented studies

include the control of large space structures, helicopters, submarine control systems, issues of integrated flight control, control of chemical processes and distillation columns, and automotive control systems.

In related research, the quick maturation of robustness concepts when applied to linear systems has led Professor Eric Feron to redirect his efforts in this area towards other classes of systems. In particular, Professor Feron is now interested in systematic analysis and design methods for the robust nonlinear control of systems subject to "hard" nonlinearities such as actuators with position and rate saturations, as well as other nonlinear systems. The main tools for robust stability and performance analysis are Lyapunov's stability theory as well as the theory of approximation of difficult, nonconvex problems via positive semidefinite programming. The current applications of this research include Unmanned Aerial Vehicle (UAV) control as well as vehicle anticollision problems arising in Air Traffic Control.

Feedback Control Using Approximate Dynamic Programming
Feedback controllers for nonlinear systems are often driven by potential (Lyapunov) functions, whereby the controller at each step steers the system in a direction of decrease of the potential function. The optimal cost-to-go function that results from dynamic programming formulations of control problems is a suitable such Lyapunov function, except that it may be difficult to compute. This research investigates whether recent approximate dynamic programming methods, that rely extensively on simulation and neural network training, can lead to a viable methodology for designing Lyapunov functions and controllers for nonlinear feedback systems. This research is carried out by Professors Munther A. Dahleh and John N. Tsitsiklis, and their students.

Identification And Adaptive Control
Determining the fundamental limitations and capabilities of identification and adaptive control is an active area of research, carried out by Professors Munther A. Dahleh, John N. Tsitsiklis, and their students. This research program draws upon areas such as information-based complexity theory and computational learning theory, as well as upon the theory of robust control. One aim of this research is to develop a theory that combines both system identification and robust control within the same framework, in which a controller that meets given performance specifications can be designed based on finite noisy data. Issues studied include the representation of uncertainty in both noise and model, design of experiments, sample and computational complexity, as well as implementation of optimal algorithms.

NONLINEAR SYSTEM ANALYSIS

Professor Alexandre Megretski and his students are working on the development of new methods of nonlinear system analysis, and application of these techniques in various control systems, (flight control, firm control, animation control, hybrid systems, etc.). The work involves a broad spectrum of system-theoretic topics including modelling, identification, stability analysis, and optimization. One important objective is to learn how simplifications necessarily made in nonlinear system modelling affect the validity of nonlinear control design.

CONTROL OF HYBRID SYSTEMS

Hybrid systems are compositions of continuous systems (described by ordinary differential equations) and discrete systems that are event-driven. A theory of optimal control of such systems, based on the theory of impulse control and piecewise-deterministic processes, has been developed by Professor Sanjoy K. Mitter in collaboration with Professor Michael Branicky, currently at Case Western Reserve University, Professor Vivek Borkar, visiting from the Indian Institute of Science, and Dr. Nicola Elia, a post-doctoral scientist. Numerical methods for the dynamic programming inequalities arising out of the optimality conditions for these systems have also been developed. Incorporation of the model in the simulation package OMULA/OMSIM has been undertaken in joint work with Prof. Astrom and his group at Lund, Sweden. Professor Mitter has been working with Professors Borkar and Chandru of the Indian Institute of Science, Bangalore on solving questions and problems in logic using mathematical programming. It is planned to unify this work with the previously mentioned work on Hybrid Systems.

ALGORITHMS

This project focuses on analytical and computational methods for solving broad classes of optimization problems arising in engineering and operations research, as well as for applications in communication networks, control theory, power systems, computer-aided manufacturing, and other areas. Currently, in addition to traditional subjects in nonlinear and dynamic programming, there is an emphasis on the solution of large-scale problems involving network flows, as well as in the application of decomposition methods. Professors Dimitri P. Bertsekas and John N. Tsitsiklis and their students perform this work.

NEURODYNAMIC PROGRAMMING

Problems of sequential decision making under uncertainty are all-pervasive; for example, they arise in the contexts of communication networks, manufacturing systems, logistics, and in the control of nonlinear dynamical systems. In theory, such problems can be addressed using dynamic programming techniques; in practice, however, only problems with a moderately-sized state space can be handled. This research effort deals with the application of neural networks and other approximation and interpolation methodologies to overcome the curse of dimensionality of real-world stochastic control problems. The objectives driving this research are twofold. First, to develop the theoretical foundations and improve the understanding of such methods, using a combination of tools from approximation theory, dynamic programming, and stochastic algorithms. Second, to use these methods for solving some large-scale problems of practical interest. Application areas being currently investigated include problems in logistics (resource scheduling and assignment), finance (pricing of high-dimensional derivative instruments), and communications (dynamic channel allocation). Professors Dimitri P. Bertsekas and John N. Tsitsiklis and their students perform this work.

PERCEPTUAL SYSTEMS AND MACHINE LEARNING

The problem of inferring information about complex objects in a natural scene from visual information requires appropriate models to represent the available knowledge, and efficient inference algorithms capable of achieving acceptable guaranteed performance in the face of the variability and unpredictability of the environment.

To incorporate the available knowledge about the relationship between objects and data without introducing arbitrary assumptions, one can adopt a coarse probabilistic approach where the class of measurable events is somehow restricted and uncertainty in the probability measure itself is explicitly represented. This leads to a formulation of the inference problem which contains ingredients both from classical Bayesian estimation and from robust set-based approaches based on the sup norm. Coarse probabilistic models can represent model uncertainty in a natural way and, at the same time, capture the information about the relative probabilities of events.

In developing efficient and robust algorithms it is important to exploit the hierarchical and distributed nature of the real world. Complex objects are composed of parts which can be further decomposed into smaller parts (hierarchical nature). Moreover, a typical scene contains elements which influence the data independently from each other (distributed nature). This suggests that the description of the world generated by the inference algorithm (and the nature of computation itself) should also be hierarchical and distributed, that is, consisting of a pyramidal network of descriptors.

Hierarchical computation requires that uncertainty be represented explicitly, for the simpler and more local knowledge modules used at the lower levels can only generate uncertain information, to be further elaborated by the higher levels. To this end, the classical single-state optimal estimators are inadequate whereas multi-state covering estimators seem more appropriate.

Recently, we have been developing a general mathematical framework to describe robust compositional inference systems and to design efficient algorithms achieving guaranteed performance. The major challenge is to obtain complete coverings of the hypothesis space without incurring combinatorial complexity during the aggregation and compositional stages. To secure a certain performance level, the coarse probabilistic model of the problem is transformed into a set-based system whose set of behaviors has high probability. Then, covering estimates are derived in a set-based setup. In general, the choice of the high-probability "safe" set of behaviors and the design of the covering algorithm are done in parallel.

The major application area for this framework is the problem of visual recognition of occluded targets in highly variable and cluttered environments. We claim that some problems usually considered belonging to the realm of signal-processing, and thus just a pre-processing stage of recognition (e.g. edge detection), should instead be treated as recognition problems themselves. In the last few years we have been developing a hierarchical and compositional edge detector based on a hierarchy of representations (from the bottom level up): raw image; tangent vectors; regular visible "shapeless" curves; general curves with shape and singularities; partially invisible curves; layered regions (representing occlusion). Descriptors at one level are composed "bottom-up" from descriptors at the previous levels, while "top-down" feedback loops ensure that global knowledge and constraints are incorporated. This work is supervised by Professor Sanjoy Mitter and Dr. Stefano Casadei.

Problems of speech recognition (speaker-independent), handwritten character recognition (on- and off-line), and robust vision system design have turned out to be much more difficult than originally thought, owing to the richness and variability of the data and the resulting complexity of the problem of representation. Moreover, the precise characterization of similarity between objects poses major challenges. Professor Sanjoy K. Mitter, Dr. Mohamad Akra and their students have recently proposed a new paradigm for pattern recognition, where primary emphasis is placed on representation. These ideas are being tested in the domains of character recognition, speech recognition, and image analysis. Current efforts consist of developing highly efficient algorithms using ideas of computational geometry and a computing environment where feasibility of multi-font character recognition using this methodology can be demonstrated. A patent incorporating these ideas has been obtained.

MUSICAL AND IMAGE VARIATION VIA NONLINEAR DYNAMICS AND CHAOS

In prior work (Dabby, Chaos, AIP 1996), a chaos-based technique was designed for generating musical variations of an original work. The variations can be close to the original, mutate almost beyond recognition, as well as achieve degrees of variability in between these two extremes. A virtually infinite set of variations is possible. The goal is to make music that changes from one hearing to the next --- not in random ways --- but rather by musical choice of the composer. Accordingly, the musical score becomes dynamic, not fixed. The technique employs two chaotic trajectories, each corresponding to a different set of initial conditions for the Lorenz system. These trajectories map the pitch sequence of a musical score into a variation based on the pitch events of the original piece. The mapping tempers the sensitive dependence of chaotic trajectories to initial conditions via two mechanisms --- linking and tracking --- to help the variations maintain a tie with the original. At present, the chaotic mapping has been extended to generate rhythmic, as well as pitch, variations. The chaotic mapping can also be used to infuse a given work with the attributes of another, e.g., Bach can metamorphose into Gershwin. The design reflects dynamic system concepts, especially those found in nonlinear and chaotic dynamics, coupled with the rich tradition of Western music theory. That the technique produces variations capable of being analyzed and used for musical means --- despite the highly context-dependent nature of music --- suggests the chaotic mapping might be applicable to other context-dependent sequences of symbols, e.g., symbol sequences from scanned art work. Algorithmic development for extension of the chaotic mapping to image and other applications is underway. Research conducted by Diana Dabby, PhD EECS, MIT, and Visiting Assistant Professor of Music at Middlebury College.

CENTER FOR INTELLIGENT CONTROL SYSTEMS

The Center for Intelligent Control Systems (CICS) combines distinguished faculty from MIT, Harvard University, and Brown University in interdisciplinary research on the foundations of intelligent machines and intelligent control systems. Established in October 1986, CICS is headed by Professor Sanjoy Mitter, Director; Professor Roger Brockett, Harvard University, Associate Director; and Professor Donald McClure, Brown University, Associate Director. The research activities of the Center are loosely grouped in five areas: Signal Processing, Image Analysis, and Vision; Automatic Control; Mathematical Foundations of Machine Intelligence; Distributed Information and Control Systems; and Algorithms and Architectures. A number of outstanding graduate students are appointed Graduate Fellows. The Center also hosts several senior visitors for varying lengths of time each year.

Speakers in the Colloquium and Seminar Series included: Dr. Mohamad Akra, LIDS MIT; Dr. David Forney, Motorola Inc. and LIDS, MIT; Dr. Richard A. Barry, MIT Lincoln Laboratory; Dr. Gerald S. Goodman, University of Florence; Prof. Alan Wilskey, LIDS, MIT; Dr. Albert Benveniste, INRIA-IRISA, Rennes, France; Peter Carr, Morgan Stanley; Dr. George D. Stamoulis, University of Crete; Dr. Demonsthenis Teneketzis, University of Michigan; Professor Murad S. Taqqu, Boston University; Professor Balagi Praphakar, LIDS, MIT; Professor W. Wonham, University of Toronto; Professor Ernst Dickmanns, Munich Germany; Dr. Tom Richardson, Bell Labs;

Dr. Frederic Guichard, Paris-Dauphine University; Professor Jetendra Malik, University of California Berkeley; Professor David Tse, University of California Berkeley; Professor Andy Lo, MIT; Professor Pierre A. Hamblet, Eurecom Institute; Dr. David Clark, MIT; Professor John Baras, University of Maryland; Professor Eduardo D. Sontag, Rutgers University; Professor P. R. Kumar, University of Illinois; Professor Nick McKeown, Stamford University;

HIGHLIGHTS

Visitors to the Laboratory for Information and Decision Systems included: Professor John S. Baras, University of Maryland; Dr. Agnes H. Chan, Northeastern University; Dr. Eugene Feinberg, Northeastern University; Dr. Gunter Stein, Honeywell; Dr. Jun Zhang, University of Wisconsin.

In July 1997, Professor Athans delivered an invited plenary talk on Issues on Robust Control at the Robust Control Conference in Budapest, Hungary.

In July 1997, Professor Athans delivered an invited plenary talk on How to Teach Multivariable Control systems at the IFAC Control Education Conference in Istanbul, Turkey and another one on Progress in Multivariable Control synthesis at the Conference on Intelligent systems, also in Istanbul, Turkey.

In August 1997, Professor Athans delivered an invited paper on Multivariable Robust Control at the IEEE Mediterranean Conference, Paphos, Cyprus.

From September 1997 till January 1997, Professor Athans was a Visiting Scientist at the Institute for Systems and Robotics, Instituto Superior Tecnico, Lisbon, Portugal, where he presented a series of lectures on Robust Multivariable Control Synthesis to interested faculty and students. He also presented an invited seminar control Theory for Dummies at the Department of Computer Science of the New University of Lisbon.

In May 1998, Professor Athans presented an invited keynote address Distributed Decision Problems at the World Automation Congress, Anchorage, Alaska.

Robert G. Gallager, Sanjoy K. Mitter

LABORATORY FOR MANUFACTURING AND PRODUCTIVITY

The Laboratory for Manufacturing and Productivity (LMP) is an interdepartmental laboratory in the School of Engineering with two major goals: 1) the development of the fundamental principles of manufacturing systems, processes, and machines, and 2) the education of engineering leaders in these areas. With 11 faculty and senior research staff and 70 graduate students, the laboratory conducts research in the areas of design, analysis, and control of manufacturing processes and systems.

This research is conducted through industrial consortia, sponsored research projects, and government grants. There are nine LMP consortia: the Production System Design Program, the Precision Engineering Group, the 3-D Printing Consortium, the Reconfigurable Tooling Program, the Droplet-Based Manufacturing Consortium, the Continuous Casting Monitoring Program, the Tribology Program, the Microcellular Plastics Program, and the Composites Manufacturing Program. In addition LMP works closely with the Leaders for Manufacturing Program (Research Group 5 -- Design and Operation of Manufacturing Systems), and the Lean Aerospace Initiative (Factory Operations Group). Many of our research projects are also with individual companies. In total, the laboratory works with about 50 different companies worldwide. Our government support comes from a variety of agencies including; DOD, NSF, NASA and DOE and is often coordinated with industrial support.

The Laboratory for Manufacturing and Productivity enjoyed its second best year in 1997-98 with a research volume of $3.7 M. This is down slightly from $4M in 1995-96. A few projects contributed disproportionately to this volume. These included the work of Professor Ely Sachs (3D Printing), Professor David Trumper (Precision Engineering), Professor David Cochran (Production Systems Design), and Professor Sanjay Sarma (Automated Manufacturing)

The LMP faculty and staff provide many important manufacturing subjects at MIT ranging from machine and process design through manufacturing system design and analysis. In addition, we provide annual summer courses for industry in new process technology, triboligy, composites, precision engineering and manufacturing system design.

In the past year several significant new and/or continuing research programs were funded, and several new educational initiatives were started:

Professor David Cochran's successful new program in Production System Design continues to grow at a significant rate. This program has captured important new funding from industry, including major awards from Ford and Bosch. In addition Professor Cochran's two new courses in production system design at both the undergraduate and the graduate level, 2.812 and 2.82 have been greeted by enthusiasm by our students.

Professor Sanjay Sarma has obtained significant new funding from NSF and industry (Ford and Suzuki) in several important new areas of automated manufacturing, including a New Universal Fixturing Technology, and a Haptvc Interface for NC Tool Path Generation. He is also developing a new undergraduate subject (2.31) which integrates F.E.M. and C.A.D.

Professor David Trumper was honored this year by receiving MIT's Spira Award for Excellence in Teaching. He has also received several new grants and continued funding in important areas of precision engineering. These include; Magnetic Levitation Stage for Electron Beam Lithography, Magnetic Suspension Control of Precision Motion, High Speed Diamond Turning, Noncontact Processing of Fibers, Beams, Webs and Plates, and High Density Linear Motor Development. Professor Trumper continues to innovate his popular course 2.737 Mechatronics.

Professor Emanuel Sachs has continued to maintain his primary focus on the Three Dimensional Printing project. One measure of the impact of this work is the continued success in commercializing the technology. At the present time there are six licensees for this technology in different fields of use. This year two new licenses have been issued: one to ExtrudeHone of Irwin, Pennsylvania for metal parts and tooling and one to AMP, Inc. of Harrisburg, Pennsylvania for electrical connector applications. In addition, an option has been issued to TDK Corporation of Japan for some classes of electronic applications. Currently under negotiation is an option for the application of the

technology to the fabrication of tungsten carbide cutting tools. In addition, Professor Sachs is developing a new important course on the Development of Manufacturing Processes and Equipment (2.815).

Professor David Hardt, who is also co-director of the Leaders for Manufacturing Program, has recently completed a major national program to develop, with U.S. industry leaders, the national vision for the Next Generation Manufacturing System. This was a multi-agency sponsored effort conducted over the last three years. In addition, Professor Hardt continues to received steady support for his programs in Reconfigurable Tooling for Rapid Response Forming of Aerospace Structures.

Professor Alex Slocum was honored this year by the Society of Manufacturing Engineers for his outstanding contributions to Manufacturing Engineering with the prestigious Frederick Taylor Research Medal. Professor Slocum has also received 6 R&D 100 Awards in the past four years. Professor Slocum received continued support from the U.S. Naval Research Lab to study Lean and Agile Precision Machining. In addition, he receives significant support in various areas of Precision Machine Design, including ongoing support from Teradyne.

Professor Jung-Hoon Chun was acting director of the LMP during the spring term of this year and has taken on a new leadership role in the Manufacturing Institute, negotiating significant new research agreements with Korea and SVG. Professor Chun has received significant new funding from NSF on Micro-Droplet Deposition in Droplet Based Manufacturing, and continues to develop his new program on Continuous Casting Monitoring (based on a new gamma ray attenuation technique). He has also received new awards and continued support in the area of his Droplet Based Manufacturing.

Dr. Stanley B. Gershwin became a Fellow of the IEEE for "pioneering work and leadership in the development and implementation of system and control approach to manufacturing". He also shared Honorable Mention in the INFORMS (Institute for Operations Research and the Management Sciences) Edelman Award Competition for Management Science Achievement in 1997. In addition, Dr. Gershwin has received continued support in the area of design and operation of manufacturing systems and he has received a significant new award in the area of Wafer Fab Operations: Modeling, Analysis, and Design (funded jointly by NSF and the Semiconductor Research Corporation).

Professor Timothy Gutowski has received significant new funding from NSF in the area of Design for Manufacturing with Advanced Composite Materials. In addition, he continues to work with Boeing on the development of new forming technologies for advanced composites applications for commercial and HSCT type aircraft. Professor Gutowski published a book entitled "Advanced Composites Manufacturing" with John Wiley in 1997.

Stanley B. Gershwin, Timothy G. Gutowski

LEADERS FOR MANUFACTURING

The Leaders for Manufacturing Program (LFM) is a partnership between MIT and 20 U.S. manufacturing firms to discover and translate into teaching and practice principles that produce world-class manufacturing and manufacturing leaders. This partnership is motivated by our shared belief that excellence in manufacturing is critical to meeting the economic and social needs of individuals, firms, and society, and that the health of U.S. based companies operating in global markets is essential to the nation's well-being.

The purpose of the program is identify, discover, and translate into practice the critical factors that underlie world-class manufacturing in a way that:

- attracts potential leaders with a global perspective and develops them to bring about world-class manufacturing
- establishes and verifies a new set of principles and practices for manufacturing
- stimulates new and innovative modes of operation for academia and industry with high levels of cooperation
- integrates technical, managerial, human and organizational dimensions of manufacturing
- establishes collaborative industry-academia processes for knowledge discovery and transfer

LFM is a partnership between the School of Engineering, the Sloan School of Management and leading manufacturers. Launched in 1988 with significant industry funding, the program emphasizes collaboration and knowledge sharing with its partner companies across the entire spectrum of "Big-M" manufacturing enterprise issues. LFM supports students both as fellows in the program and as research assistants throughout the institute. Both groups of students participate in a research program that is directed by a joint faculty-industry committee. The largest component of the educational efforts is the Fellows Program, a 24-month dual-masters degree (engineering and management) experience involving a single integrative research project carried out on site in partner firms.

This year marks the 10th year of operation for LFM. Beginning with an educational program, it has become a joint education and research program with increasing emphasis on outreach activities that foster more effective two-way knowledge transfer between MIT, the partner companies, and the larger global manufacturing community.

ACADEMIC PROGRAM

48 Students in the class of 1998 completed the Fellows program and 90% have taken positions in manufacturing firms. 26 students have taken positions with one of the LFM partner companies. AlliedSignal, Qualcomm, and Dell were notable for a large number of hires from the class. Industry continues to show strong support for hiring LFM graduates.

Each of the 48 graduates completed an internship at a partner company during the summer and fall of 1997. Internships are focused projects of concern to the partners, accomplished by interns with company support and MIT faculty guidance. Representative projects this past year include: at Bay Networks, modeling and optimizing the supply chain resulting in cutting major inventories in half; at ITT, an implementation of the "Critical Chain" method of task management to product development resulting in up to 25% reduction in project lead times. These internships have provided significant immediate economic benefit to partner companies. They also have increased faculty involvement in current industrial problems and as a result have impacted both MIT on-campus research and classroom teaching.

42 students (Class of '99) completed their first year of on-campus studies and are starting their 6 month internships. 48 new students (Class of '00) were admitted and have begun an intense summer session. All of these students have significant practical work experience.

LFM has worked with the Deans of the Sloan and Engineering schools to create a position of Director of Leadership for the Sloan School and LFM. A search process to fill the position is underway. This person will integrate and coordinate the various aspects of LFM's leadership curriculum, and will work to expand the leadership offerings for the Sloan School as a whole.

RESEARCH PROGRAM

Research has been conducted with seed funding from LFM in the following areas: Product Life Cycle Analysis, Scheduling and Logistics Control, Variation Reduction, Design and Operation of Manufacturing Systems, Integrated

Analysis and Product Development, Culture and Organizational Change, and the Next Generation Manufacturing project. Each area has both a faculty and an industry leader. The groups focus on detailed issues of benefit to several member companies, but with implications for many companies. On-site student interns have played a valuable role in teaming with on-campus researchers to more effectively define problems, gather data, and analyze it. Mid-stream and end-of-internship presentations convey research results to MIT and partner company personnel.

The Organization Change group has focused on how LFM companies change, and specifically, how they utilize the LFM program to accomplish change. This initiative has resulted in an assessment of the real value of LFM to companies and provided recommendations back to the program and partner companies for better utilization of graduates of the program. To date, studies at seven of the partner companies have been completed.

The Next Generation Manufacturing project is an effort within LFM to address its mission statement challenge of discovering the principles for future world-class manufacturing. Phase one of the project, completed in January, 1997, was partly funded by NSF. This past year LFM partner companies committed funds to continue the project and have adopted NGM's framework as the guide against which the curriculum and research of LFM be mapped.

A collaborative project by LFM and Stanford's SIMA program on remote diagnostics has been continued for its second year. The second annual conference on remote diagnostics was held in May of 1998. Partner companies have strongly supported such research performed jointly by multiple universities.

OUTREACH

LFM has added Celestica as an internship partner of the program. Chrysler Corporation will not continue as an active partner this coming year. LFM has teamed with MIT's Whitehead Institute to apply manufacturing expertise to the operations of the Human Genome Mapping research project. Students this year have also taken a number of internships in foreign countries as part of LFM's efforts to reflect the global nature of its member companies.

LFM continues its efforts to extend the educational experience to other audiences in our partner companies beyond the Fellows. A six day Industry Leaders Course on Product Development was held at MIT for 40 partner company personnel with sessions spread over a two month period. The course schedule and the content were tailored to an industry audience and were well received.

Within MIT there have been actions which have brought increased collaboration between a number of programs with similar missions. A Dean of Engineering Systems was appointed and LFM and six other industry related programs were joined to form a nucleus for a possible future Engineering Systems Division. Within this group, LFM is working closely with the Systems Design and Management Program, sharing class offerings and support staff. LFM also jointly developed internships with the Center for Innovation and Product Development (CIPD), placing two LFM students in projects sponsored by industrial partners of CIPD.

The National Coalition for Manufacturing Leadership (NCML), a partnership of 14 Universities with joint management and engineering programs, hosted a joint recruiting forum at the University of Michigan. This has been very popular with Coalition partner companies and will be repeated each year.

A series of sessions were held during the year bringing MIT faculty and partner companies together. The LFM Governing Board met at both Kodak and Alcoa plants, focusing on issues of specific concern to these companies. Two workshops were held for company people to come to campus to review the results of the Fellows research projects as well as LFM sponsored research group activities.

GOALS

In May 1998, partner company representatives and MIT faculty participated in a workshop to review the Knowledge Transfer aspects of our program, resulting in the following recommendations for the coming year:

Explicit steps for dissemination of the learning of internships will be built into the definition process for the projects. There is a strong feeling that the internships are very valuable as they are, but that the inter and intra company dissemination of learnings will be significantly improved.

LFM will work with its industry partners to better define those learnings which are gained through real-life, on-the-job experiences which are critical to successful manufacturing leaders. Having better defined these usually implicit expectations of company leaders, LFM will work with the partners to bring these in an accelerated fashion to those people the companies look to as future leaders, both LFM students and current company personnel.

The Director of Leadership will be brought into LFM to integrate the leadership curriculum into a more continuous, reinforcing set of experiences. Leadership is an ongoing area of emphasis for LFM.

As recommended by the partner companies, the Next Generation Manufacturing (NGM) project will be mapped against our current curriculum and research activities, including the Fellows theses completed to date, to assess the fit between our current activities and the framework set out in NGM. The study of graduate utilization will be continued, completing the assessments of the remaining original partner companies. Seed funding will also continue for the seven LFM research groups listed above.

The activity to involve a non-US company in the program will be continued. It is expected that one or two new companies will join the program this year, one of which will likely be a European company, with Siemens being the leading candidate. Collaboration with Universities in Singapore is also actively being pursued as a way to extend the impact of LFM to a set of academic institutions which can help our partners with their operations abroad.

Within MIT, LFM is actively sharing staff and resources with the System Design and Management program. Both programs have similar missions and overlapping partner companies. These efforts will provide better service to the industry partners and reduce operations costs through shared infrastructure.

The Knowledge Transfer Committee will repeat and enlarge its course for Industry Leaders on product development. The initial course was quite successful and has created a call for more such offerings.

Personnel changes this year included the addition of Gail Cheney as Fellows Program Assistant. Staff members Valerie Aquaviva, Michele Brodeur, Nancy Pratt and Romana Runtas have moved on from their positions with LFM.

Current Program Directors are: Stephen C. Graves, Management; David E. Hardt, Engineering; William C. Hanson, Industry.

More information about LFM can be found on the World Wide Web at the following URL:
http://web.mit.edu/lfm/www/

Paul Gallagher

MATERIALS PROCESSING CENTER

The Materials Processing Center is an interdisciplinary center within MIT's School of Engineering directed by Prof. Lionel C. Kimerling. It was established in 1980 in response to a recognized national need to improve the materials processing knowledge base and streamline the process of translating materials research results into industrial innovations and applications. Center research covers a broad range of materials and processes focused on the following six basic industrial sectors: biomaterials; primary materials; structural materials; electronics; transportation; and energy.

Our metric for the value of this research is its impact on commercial and defense applications.

The mission of the Materials Processing Center (MPC) is to provide an environment where students and professionals from industry, government, and academia collaborate to identify and address pivotal multidisciplinary issues in materials processing and manufacturing in a way that: creates new knowledge; produces knowledgeable people; and promotes exchange of information in the service of our nation in the context of a global community.

Because of the interdisciplinary nature of the field of materials processing, faculty and research staff affiliated with the Center come from a range of fields beyond the traditional materials science and engineering group. Significant contributions are being made by specialists in chemical engineering, electrical engineering, mechanical engineering, physics, aeronautical and astronautical engineering, civil and environmental engineering, chemistry, nuclear engineering, and ocean engineering. Center research involves approximately 150 faculty, research staff, visiting scientists, and graduate and undergraduate students.

The MPC builds upon MIT's history of close ties with industry. We have a 43-member Industrial Collegium of domestic and international companies, which provides a window on the state-of-the-art in materials research and development at MIT, and provides an outlet for our research results to industry. In this way, the Collegium provides a technology transfer pathway between university research and industrial innovation. Part of our strategy is to leverage core federal research funding into expanded industrial collaborations. MPC Industrial support currently stands at 45% of our total budget.

CENTER INITIATIVES

The MPC initiates programs to enhance the intellectual vitality of the materials processing community at MIT. By measuring the value of these initiatives in terms of the intellectual core they create, we hope to define our materials community strengths, collaborate in new and creative ways, and pursue the most meaningful research. In 1998, we expanded our Materials Day at MIT celebration to include a workshop, poster session and dinner with our students, faculty and industrial guests. The theme was *Design Paradigms in Materials Processing: Real Solutions to Real Problems* — the engineering process through which science is converted effectively into technology. It highlighted the unique intellectual breadth and depth of our interdisciplinary materials community and its focus on industrial applications.

The MPC sponsors three research-funding initiatives: the MPC Visiting Scholar Program; the MPC Young Faculty Seed Program; and the MPC Research Initiative Seed Program.

The 1998 MPC Visiting Scholar is Dr. Kazumi Wada of NTT, who is working with Professor Kimerling in the area of microelectronics. Professors Sandra Burkett, Paul Laibinis and William Green received separate MPC Young Faculty Seed awards to launch research and develop program initiatives with industrial and national laboratory collaborators. The MPC also provides initiative funding to the faculty leaders of each of our six basic industrial sectors to facilitate core intellectual, development, and research program initiatives.

The MPC continues to maintain the MPC Short Course Library. This listing of short technical seminars led by MIT faculty and senior research staff, offers MIT's industrial partners a concise and focused guide to the expertise of MIT's materials community, spanning several School of Engineering departments.

Other highlights from the past year include nearly $2.1M in new industrial research support initiated by the faculty research staff of the MPC in FY98, as well as four new members to the MPC Industry Collegium.

RESEARCH

Research highlights from the past year are too numerous to report in detail here but available at our web site http://web.mit.edu/mpc/www/. One specific example that highlights both the interdisciplinary and the collaborative intensity of our programs is the NSF funded ERC for Environmentally Benign Semiconductor Manufacturing. The program is designed to address back end processes with an emphasis on interconnects, front end processes emphasizing surface preparation, etching and cleaning, and factory operations including water and energy usage. This ERC includes Stanford and UC Berkeley where the focus is on process and atomistic modeling, and Arizona is primarily responsible for educational outreach. Altogether, over 25 companies, 35 faculty and research staff, and 40 students are participating in this 5-year effort. The MIT faculty consist of Professor Lionel Kimerling in Materials Science & Engineering, Professors Karen Gleason and Herbert Swain in Chemical Engineering, and Professors Rafael Reif and Duane Boning in EECS.

NEW INDUSTRIAL PROJECTS

While the scientific foundation of the materials processing community at MIT has been established with federal research support, our future success will be measured by our ability to leverage this knowledge base into industrially relevant applications. Our 43-member Industry Collegium provides the MPC faculty and senior research staff with the necessary gateway to industry. The staff of the MPC works closely with both our Industry Collegium and Industrial Advisory Board members to understand their needs and match these with the expertise of our faculty. During the past year, MPC faculty and research staff have acquired nearly $2.1 million in industrial research support from a total of 12 individual companies and federally funded industrial collaborations. This includes:

- Dr. Robert O'Handley's magnetic shape-memory materials initiative continues to expand beyond its DataCity Center Consortium founding effort to include both a major DARPA-funded program led by Boeing and a separate application initiative with Lord Corporation which involves the development of innovative smart materials and actuators.

- Prof. Lionel Kimerling has launched a major DARPA supported MURI program in "Photonic Crystal HIDE (Highly-Controlled Infrared Dielectric Emissivity) Materials Engineering" with an interdisciplinary team of MIT physicists, materials engineers and electrical engineers in collaboration with PPG, Lockheed Martin-Sanders, ARO's Fort Monmouth and Wright-Patterson Air Force Base's Wright Laboratories.

- Prof. Donald Sadoway has launched a major initiative with the EPA and domestic primary aluminum producers' Voluntary Aluminum Industrial Partnership (VAIP) to research the fundamentals of electrode processes. Prof. Sadoway's efforts will contribute to VAIP's goal of reducing annual emissions of PFCs form aluminum smelters by 45% of 1990 levels by the year 2000. In the US, the aluminum industry represents the number one point source of fluorocarbon emissions, which have high global warming potentials.

The MPC provides an active industrial outreach function for the broad, interdepartmental materials community at MIT, and leverages the Industry Collegium to expand our relationships with industry and capitalize on the link between university research and industrial innovation. Our success is reflected by increased industrial research volume in the face of increasing academic and industrial competition for shrinking federal research support. Given that research represents 75% of graduate education, the health of our academic community is dependent upon our ability to work effectively to serve the needs of industry. Downsized U.S. companies are increasingly dependent upon out-sourced solutions to current problems and are actively seeking future growth opportunities via longer term exploration of new products, processes, and directions. Our ongoing challenge is to reach directly into industrial operating units where timely solutions are needed and ideas become commercial innovations.

Internally, we are structured to focus on establishing specific research program areas based on strong external industrial partnerships. It should also be noted that this approach requires our continued expansion of our direct interaction with other MIT labs, centers, and departments including LEES, RLE, MTL, the OR Center, LFM, the Manufacturing Institute, TELAC, and the Chemical Engineering, Electrical Engineering, and Physics Departments.

Our overall research objective is to add at least an additional $2M in industrial support in FY99. This target is clearly obtainable with currently identified industrial partnership opportunities.

ACADEMIC INITIATIVES

The Materials Processing and Manufacturing Institute, launched in partnership with the Department of Materials Science and Engineering, continued during FY98 with projects at Allegheny-Ludlum Corporation and Lord Corporation.

This program provides both MIT faculty and students with the opportunity to participate in high priority, proprietary industrial-site projects. Students receive the combined benefits of an MIT academic experience and industrial research practice. This program provides us with the additional opportunity to have significant impact in the real world while educating the faculty-student teams to this goal.

The MPC continues its Summer Research Internship with the Center for Materials Science and Engineering. This 16th class includes ten. The program provides the faculty with much needed seed support for exploratory research projects and continues to meet our goal of providing undergraduates with an array of multidisciplinary research opportunities in materials.

CONCLUSIONS

MPC is one of few, and by far the largest, university research centers with a materials processing emphasis. Our Collegium represents the strongest industry research interface at MIT. The MPC is ideally positioned to take advantage of the national shift in emphasis to engineering practice and out-sourced research and development. We have restructured internally to identify Research Program Areas and externally with stronger industrial partnerships. We are successful if we maintain a strong, dedicated Industry Collegium; motivate faculty and students to address pivotal issues in materials processing and manufacturing; involve women and minority faculty and students; and continue to increase the research throughout the Center in the next year.

More information about the Materials Processing Center can be found on the World Wide Web at the following URL: http://web.mit.edu/mpc/www/

Lionel C. Kimerling

MICROSYSTEMS TECHNOLOGY LABORATORIES

The Microsystems Technology Laboratories (MTL) are organized to provide facilities and a working environment to support undergraduate and graduate education through teaching and research in the area of microsystems technology.

The MTL carries out graduate research activities in the fabrication and study of small (i.e., micron, submicron, and nanometer) structures and their use for the implementation of interesting integrated systems from X-ray lenses to VLSI circuits to micro-gas turbine engines. The expanding and dynamic research program covers solid state devices, integrated circuits and systems, materials for electronic applications, novel process technologies, MicroElectroMechanical Devices, and computer-aided fabrication. The MTL houses three clean room facilities (the Integrated Circuits Laboratory - ICL, the Technology Research Laboratory - TRL, and the NanoStructures Laboratory - NSL), and associated non-clean laboratory space (the Research Group Laboratories - RGL), and the Computational and Communication Network facility. The centerpiece facility of the MTL is the Integrated Circuits Laboratory, a state-of-the-art class-10 clean lab with full capabilities for modern IC fabrication. The lab is operated by a full time technical staff and graduate students. The facilities of the MTL are also utilized for the laboratory component of the undergraduate microelectronics processing course (6.152J). Additionally, project laboratory courses on MEMS are offered utilizing this facility. Approximately 110 students per year are educated through these course offerings.

The Microsystems Technologies Laboratories (MTL) has embarked upon a major capital/facilities conversion during 1997/1998 with a capital/facilitization budget of approximately $12M. This conversion is industrially and institutionally supported. The focus of the upgrade is to replace aging 100mm diameter silicon wafer processing technology with 150mm diameter silicon wafer processing technology. The conversion plan upgrades the facilities of the MTL to a level comparable with the industrial state-of-the-art, but is structured such that we maintain the same CORE technologies as at present. The upgrade plan places us in the position to integrate new or emerging technologies as they become available, and enhances our ability to perform research at the industrial state-of-the-art. As in the past, we plan that new and emerging technologies will be added to the MTL tool set as a result of specific contract needs, and will be funded through the specific support of sponsored research programs, or through industrial donation. This upgrade will ensure that MIT faculty can continue to attract and to perform research at the leading edge of technology, and that we can continue to attract faculty, students, and sponsored research programs of the highest caliber.

As part of the upgrade plan, MTL received several major equipment donations this year: Advanced Micro Devices (AMD) donated both a 6î-compatible Matrix asher and a LAM Rainbow metal etcher. The former is installed and functioning in ICL where it replaced our old Drytek asher, which was decommissioned. Users appreciate the Matrix's fast through-put and ease of operation. The installation in ICL of the LAM Rainbow metal etcher is on hold pending the full 6" conversion, because the machine is not 4"-compatible and it requires space to be made available later in the year. Applied Materials donated an Endura Metal Deposition cluster tool. It is 6"-ready, but capable of processing 4" wafers. We are in the process of facilitizing its installation in ICL, with support from the Offices of the Provost and the Dean of Engineering. This tool will satisfy our post-conversion metal deposition needs. Motorola and Applied Materials jointly donated a Centura high-density plasma etch system. It will be upgraded to 6" from its current 5" configuration and installed in ICL. This tool complements our present etch capabilities. Several research groups have already expressed interest in using this machine, and doing collaborative work with the donors.

With a $500,000 equipment grant from Intel obtained in 1997, MTL purchased state-of-the-art metrology equipment from KLA-Tencor-Prometrix: a P10 profilometer, an SM-300 film thickness measurement system to be used to characterize the CMP processes and a UV-1280 spectroscopic ellipsometer. All are installed and operating in ICL. The Dektak and Nanospec they replaced were moved up to TRL, to extend its metrology toolset. This additional characterization capability will further MTL's educational mission by allowing users to examine in greater detail the results of their processes. It also contributes to our remote metrology program since these machines have been networked so students can view their data outside the lab and even use it their coursework. In addition, Semitest, Inc, made available, on a permanent loan basis, a Surface Charge Analyzer. It is installed in the diffusion area and has been used extensively to characterize dielectric thin films. Among the research-driven equipment acquisitions

were an STS deep-trench Si etcher and an Electronic Visions wafer aligner/bonder. They are installed in TRL and being extensively used by the MEMS group as well as many other users.

This upgrade plan positions MTL and MIT to take a leadership role in university microelectronics and microfabrication research activities, and will ensure that MIT can continue to provide world class educational and research experiences in the areas of microelectronics and microfabrication well into the next millennium.

Personnel involved in ongoing research activities at the MTL include over 50 Faculty, 16 Senior Research Staff, 260 Graduate Students, 120 Undergraduate Students, 17 Post-doctoral Fellows, 16 Visiting Scientists, 28 Research Affiliates, 26 Technical Support Staff, and 15 Administrative and Support Staff. These faculty, students and staff represent affiliations including the Departments of Aeronautics and Astronautics, Brain and Cognitive Sciences, Civil Engineering, Chemistry, Chemical Engineering, Electrical Engineering and Computer Science, Materials Science and Engineering, Mechanical Engineering, and Physics; the Center for Materials Science and Engineering, the Center for Space Research, the Gas Turbine Laboratory, the Laboratory for Electromagnetic and Electronic Systems, the Laboratory for Information and Decision Systems, the Laboratory for Computer Science, the Research Laboratory of Electronics, the Sloan School, the Turbulence Research Laboratory, the Media Laboratory and the Center for Biomedical Engineering. The facilities of the MTL are also open to external users under the Outreach Program (government and academia), and through several industrial programs. Current external users of the MTL include Analog Devices, Digital Semiconductor, Motorola Corp., Hewlett-Packard, Polaroid Corporation, Hitachi, Sharp Corporation, Sony Corporation, Institute for Advanced Engineering, Boston University, Case Western Reserve University, Harvard University, Kanazawa University, Northeastern University, Princeton University, the Smithsonian Astrophysical Observatory, Tufts University, the Shriners Burn Institute, University of Utah, Princeton University, the University of Utah, and the University of Tokyo. During the 1996-1997 academic year, 16 Ph.D., 20 S. M. and 11 M. Eng. degrees were awarded in conjunction with research activities whose primary area of focus was microfabrication and which were strongly coupled to the facilities of the MTL. MTL has continued to serve the microfabrication needs of the MIT community, working on projects from many departments (e.g., Biology, Chemical Engineering, Mechanical Engineering, and Physics). As a result, this year saw a substantial increase in lab activity as evidenced the number of students using the labs, as well as the amount of processing.

Research in the MTL may be grouped into three major interdisciplinary, interactive research themes: Microsystems, Nanoscale Technology/Devices, and Manufacturing, and further divided into the following ten categories:

Integrated Circuits and Systems include analog and digital integrated circuit (IC) design as well as advanced process development for "mixed analog/digital signal" IC applications.

Microelectromechanical Devices include technologies for micromachining, design of microsensors and microactuators, and the application of these devices to physical and chemical measurements.

Electronic Devices include research on novel devices operating in the semi-classical regime.

Quantum-Effect Devices include novel device structures designed specifically to study and explore quantum mechanical effects arising from carrier interactions with features of sub-100 nm dimensions.

Submicron and Nanometer Structures include some "nanofabrication" projects that are not directly related to electronic devices. The NanoStructures Laboratory develops techniques for the fabrication of surface structures with feature sizes in the range of nanometers to micrometers, and uses these structures in a variety of research projects.

Modeling and Simulation covers the use of numerical techniques that solve complex problems of carrier transport and device operations as well as physical problems that arise during materials and device processing.

Fabrication Technology covers a broad area of processing and device fabrication with two main themes: novel processes for integrated circuit and device fabrication in silicon and compound semiconductors, and fundamentals underlying materials processing effects.

Manufacturing includes computer-based modeling and simulation of fabrication processes and execution in a realistic fabrication environment; work flow scheduling; process equipment modeling and process control; and microstructure/mechanical property simulation.

Materials, with the common theme of growth and characterization of thin films for electronic applications, include research of novel silicon and silicon-germanium epitaxy, the formation of heterostructures in compound semiconductors, polyimides in microelectronics, and the study and control of the crystalline structure of very thin films.

Optoelectronics covers a variety of novel structures such as laser diodes, quantum well structures, and distributed-feedback lasers, both in Si and in compound semiconductors.

The MTL facilities are supported in part by members of the MIT Microsystems Industrial Group (MIG), whose current members include: Advanced Micro Devices (AMD); Analog Devices, Inc.; Applied Materials, Inc.; Digital Semiconductor; Ford Microelectronics, Inc.; Hewlett-Packard Company; IBM; Intel Corporation; Lucent Technologies; Motorola, Inc.; Novellus Systems, Inc.; Texas Instruments; and Taiwan Semiconductor Manufacturing Corporation (TSMC), as well as members of the Microsystems Affiliates Program whose members are Kokusai/BTI Corporation and Sony Corporation.

Outreach activities carried out by the MTL include a weekly VLSI Seminar Series and an MTL Memo Series. The MTL also publishes a comprehensive Annual Report.

More information about the Microsystems Technology Laboratories can be found on the World Wide Web at the following URL: http://www-mtl.mit.edu/

Rafael Reif

PROGRAM IN POLYMER SCIENCE AND TECHNOLOGY

PPST, the Program in Polymer Science and Technology, is an interdepartmental graduate education program. The program provides an opportunity for students at MIT to pursue an intensive polymer-centered education that ranges from molecular to continuum concepts in both engineering and science. The program, consisting of a core curriculum and a written and oral qualifying procedure, is administered by faculty from many diverse disciplines located in the departments of Materials Science and Engineering, Chemical Engineering, Mechanical Engineering and Chemistry. Although essentially an academic program, PPST also functions as a fostering community supporting polymer related activities at MIT. In this capacity, the program functions as an intellectual facilitator, bringing together polymer-interested scholars from within the MIT community and from outside academic and industrial institutions. The program also provides an opportunity to coordinate and enhance the material presented in the many different polymer subjects offered throughout the institute.

The PPST weekly seminar program continues to be an active and important component of the program. This past year, attendance at the weekly seminars typically ranged from 60-80 students/faculty from many different departments at MIT. In addition, a special PPST/Amoco student poster competition was coupled to one of the seminars. The poster competition, sponsored by the Amoco Foundation, had 30 student and post-doctoral participants and was attended by about 100 people. Cash prizes totaling $2000 were awarded for "Best in Show" graduate student and post-doc, "Technical Creativity" and "Contribution to Scientific Knowledge". By all accounts, the poster competition was a great success. Amoco has already signed-up to sponsor this event in the coming year.

On the curriculum front, the PPST faculty have been working to implement new changes to the core program involving the addition of a biomaterials and a surface science subject. The surface science subject is now integrated into the program, however, students were not able to take the biomaterials subject this year due to a sabbatical problem.

In the Fall Term 97, eight new PPST students were admitted into the program from the departments of Chemical Engineering (3), Materials Science and Engineering (4) and Mechanical Engineering (1).

A PPST web site has been created for the first time and will go "on-line" shortly.

The PPST faculty will continue to work to strengthen the core curriculum and to integrate a biomaterials subject into the program. We also plan to distribute a newly designed PPST recruiting flier to major universities around the country. This coupled with our newly established web site will insure that the program continues to attract the best of the polymer inclined students. Another PPST/Amoco poster competition is currently being organized for the upcoming fall term.

More information about the Program in Polymer Science and Technology can be found on the World Wide Web at the following URL: http://web.mit.edu/ppst/

Michael Rubner

SYSTEM DESIGN AND MANAGEMENT PROGRAM

The mission of the Systems Design and Management Program is to educate future technical leaders in architecting, engineering, and designing complex products and systems, preparing them for careers as the technically grounded senior managers of their enterprises; to set the standards for delivering career-compatible professional education using advanced information and communication technologies.

The System Design and Management Program is a joint offering of the School of Engineering and the Sloan School of Management, leading to a Master of Science degree in Engineering and Management. During 1997-98, John R. Williams, representing the School of Engineering, served as the program's codirector, and Thomas A. Kochan served as acting Management codirector during Thomas L. Magnanti's sabbatical leave.

Targeted for professional engineers with three or more years of experience, the program centers on a 13-course curriculum in systems, engineering, and management, including a project-based thesis. It offers two curricular options: a 13-month in-residence format and a 24-month distance education format, requiring one academic semester in-residence at MIT. The program was conceived as an alternative to the MBA for professional engineers, allowing working professionals to pursue a degree without interrupting their careers and relocating themselves and their families.

This year the SDM program admitted its second class, enrolling 58 students in January. An additional 35 students admitted in 1997 continued in the program. In all, 22 companies sponsored students, including four sustaining enterprise companies: United Technologies Corporation sponsored 26 students, Ford Motor Company sponsored 17, Eastman Kodak sponsored 8, and Xerox Corporation sponsored 4. Allied Signal, IBM and ITT each sponsored 2 students, and each of the following companies sponsored one student: Aerospace Corporation, Cummins Engine Company, Elcotel, Fidelity, Fuji Xerox, HP, Intel, Lockheed Martin, Los Alamos National Labs, PictureTel, Raytheon, Silicon Graphics, Sun Microsystems, and Texas Instruments.

SDM STUDENT STATISTICS

	1997	1998
ADMITTED	35	58
ON-CAMPUS	8	16
SELF-SUPPORTED	3	1
RESEARCH ASSISTANT	3	12
DISTANCE EDUCATION	27	42
COMPANY SPONSORED	29	45

The program begins in January with an intensive month in residence for new students, including completion of one and one-half courses, leadership and teamwork exercises, and projects and activities designed to promote student cohort-building, to mitigate the isolation of the remote education experience.

This year, the SDM program confronted new issues and challenges related to its increased popularity, the demand for increased growth, the need to expand the distance education offerings to accommodate two simultaneous student groups, and changes in staff. The program grew by enrolling more students, by offering a more extensive array of courses at a distance, by introducing a new track in product development, and by beginning a formal process to transfer the curricula to other universities.

In addition, the small staff worked to continue to improve the program's quality, to provide a greater range of services to students, to incorporate new communications technology in course delivery, and to respond dynamically to the changes in staffing requirements of both the program and the Institute.

Specific program accomplishments included:

STUDENTS

- Admitting the second class of 58 SDM students and enrolling two additional sustaining enterprise partners, bringing our sustaining partnerships to four companies: Eastman Kodak, Ford Motor Company, United Technologies Corporation, and Xerox Corporation.
- Graduating six students from the 1997 on-campus program for new careers in systems. Most of the remainder of the 1997 entering class, approximately 30 students, will graduate in February 1999, most continuing with their sponsoring companies in expanded roles.
- Establishing an SDM student council to work on student concerns and issues that are unique to the SDM program, including the initiation of a student honor code that will apply to both on-campus and remote students.

CURRICULUM DEVELOPMENT

- Continuing the development of three new SDM core courses in system architecture, system engineering, and system and project management; adding distance education engineering electives for the spring term in axiomatic design, computer science engineering, and product design and development; adding specially adapted half-semester summer session courses in robust design and system dynamics.
- Successfully developing a new program option, allowing two half-semester summer session segments to fulfill the MIT residency requirement (approved by the MIT faculty in November 1997). SDM created this option as a mechanism for retaining the benefits of combined on-campus and off-campus instruction while better accommodating the workplace needs of any single company enrolling a large numbers of SDM students .

COLLABORATION AND OUTREACH

- In collaboration with the Center for Innovation in Product Development (CIPD), developing a product development track to serve as the academic component of CIPD's research program. The track aims to develop a consistent set of concepts and language for describing the end-to-end product development process within enterprises. The CIPD sponsoring companies (Ford and Xerox) are now enrolling approximately 20 students in SDM, and several additional companies have expressed an interest in this curricular specialty.
- Developing a staffing plan for SDM in concert with the Leaders for Manufacturing program that incorporates the sharing of staff resources. SDM and LFM will begin sharing two staff positions, a Communications Coordinator and a Financial Administrator, and a member of support staff, a Financial Assistant, in FY1999, as a possible first step to establishing enhanced administrative coordination.
- Developing a placement program for the SDM non-sponsored graduates, in conjunction with the Sloan School of Management Career Services Office (CSO). Although the majority of SDM graduates will return to their companies, each year a number of graduates seek new careers in systems engineering and product design. CSO worked with SDM to tailor a program to meet the needs of these students.
- Continuing to work with other MIT administrative units, including the Graduate School, the Bursar's Office, and the Registrar's Office, to develop polices and procedures for incorporating non-standard students into the MIT system.
- Leading an effort to replicate the SDM product development track at other universities. Because the demand for this program is greater than SDM's capacity to accommodate student enrollments, SDM has been working with Ford and Xerox to replicate the SDM curriculum at the University of Detroit Mercy College and Rochester Institute of Technology. Together with Ford, IBM, ITT, RIT, UDM, the US Navy, and Xerox, SDM and CIPD have formed a consortium called PD21: The Education Consortium for Product Development Leadership in the 21st Century, to disseminate the product development curriculum to other universities.

DISTANCE EDUCATION DELIVERY

- Delivering the full range of SDM course offerings to both on-campus and remote students, including three core systems courses, six fundamental courses, and five elective courses satisfying SDM's design, engineering, and management elective requirements. One of these courses was new to MIT (Robust Design), especially designed to satisfy the SDM's design elective requirement. The faculty have substantially adapted other courses for the distance education medium of multipoint videoconferencing to as many as 15 simultaneous company sites.
- Incorporating the latest in web technology into SDM distance education. With support from Lotus Development Company, SDM has developed the COMMAND system, which has been running since January, to support distance education courses on the web. The program now supports approximately 40 courses from 10 departments, serving nearly 700 students. Collaborating with Lotus on the 3rd release of the system, we are striving to incorporate video streaming. Release 2, scheduled for the end of July 1998, was in final testing at the

end of the fiscal year. COMMAND will also support the PD21 product development courses at Rochester Institute of Technology and University of Detroit Mercy. Lotus will award SDM a fellowship to continue this work.

- Initiating the retrofitting of two new distance education classrooms in the Engineering School, to accommodate course offerings with larger enrollments to remote students.

While SDM is still adjusting to the challenges of significant growth, the year was full and satisfying. The program looks forward to FY1999 to further enrich and improve the curricula, to serve an expanded set of students and company employees, to come closer to achieving the goal of excellence in distance education, and to realize more organizational stability.

Thomas A. Kochan, John R. Williams

TECHNOLOGY AND POLICY PROGRAM

The Technology and Policy Program is a graduate educational program in the School of Engineering. It educates men and women for leadership on the important technological issues confronting society. It prepares its graduates to excel in their technical fields, and to develop and implement effective strategies for dealing with the risks and opportunities associated with these technologies.

The Technology and Policy Program aims to be the educational leader in the field. With about 150 students on campus and about 650 graduates, it is the largest of its kind in the world. With its extensive international connections with other universities, it is building a network of relationships to define the field.

The Technology and Policy Program sponsors both a Master of Science and an Interdepartmental Doctoral Program. This year's class for the Master of Science in Technology and Policy included about 60 students. Dr. Judith Cardell was the recipient of the 1997 Award for Best Thesis in Technology and Policy for her dissertation that was directed by Maria Ilic and Richard Tabors. The winners of the Alumni Award for Leadership and Excellence in Technology Policy were the founding members of the Technology and Policy Student Society (TPS2), for their initiative in forming this innovative student group.

The interdepartmental doctorate in Technology, Management and Policy, enrolls about 25 students in their 2nd to 5th year of graduate school. Five participants received their doctorates this year and proceeded to positions in the government, industry and academia.

The Technology and Policy Program internship program is an integral part of the TPP curriculum. This second year of activity placed over 30 interns in major policy centers in the United States, Europe and Asia.

The internship program is funded by major corporations and by individuals who generously support public service internships, including the US Congress, the Massachusetts legislature and non-profit organizations. New endowments were those of: Far East Organization; and The Francis Yew Ho Chin Award for Public Service.

The Technology and Policy Program actively maintains relations with many universities and educational agencies, particularly in France, Japan, the Netherlands, Portugal, and the United Kingdom. Professor Nicholas Ashford has arranged to spend his sabbatical this spring with the Technical University of Delft (Netherlands), and Dr. John Ehrenfeld obtained a Fulbright Award to be a visiting professor at the Instituto Superior Technico of Portugal. More information about this Program can be found on the World Wide Web at the following URL: http://web.mit.edu/tpp/www/

Richard de Neufville

TECHNOLOGY, MANAGEMENT AND POLICY PROGRAM

The Technology, Management, and Policy Program (TMP), established in 1992, is a multidisciplinary doctoral program that focuses on research intended to improve methods used in defining and implementing policies for the intelligent use of technology. Currently having 25 doctoral candidates, the Program brings together and coordinates several MIT research centers and educational programs in technology, management, and policy issues linked to large-scale systems.

Together with its master's program, the Technology and Policy Program doctoral program involves over 40 faculty and research staff, US $10 million of annual research funding, and about 200 graduate students. Graduates from this program go on to work for industry or government from Tokyo to Paris to Washington, D.C.

The participants in this Ph.D. Program share a common vision. Each emphasizes dual competency—in a technical area and in management and policy—as the basis for the effective design of large-scale systems. Together they are developing a new paradigm for the planning and design of engineering systems, a paradigm that blends technical expertise with competence in economics, management, and policy to achieve a better adaptation of technology to societal goals. A primary purpose of TMP is to diffuse throughout the education and practice of engineering the expertise in systems technology and policy that has been developed in the individual centers involved in the Program.

The centers and laboratories that constitute the Program have each achieved considerable worldwide recognition in their specialized fields over the past 20 years. By working together they can pursue research on large-scale systems and establish interdisciplinary curricula more easily than they could individually.

The Program's objectives include:

- Participation in major research projects in close cooperation with national laboratories and international organizations;
- Establishment of a significant team of faculty and staff who work closely together in technology, management, and policy;
- Creation of new educational opportunities in large-scale systems by building on the existing capabilities of the Technology and Policy Program.

CENTERS AND LABORATORIES

Center for Technology, Policy, and Industrial Development: The very name of the CTPID was selected to underscore the important linkages between technology, policy, and industrial development. The central objective of the Center is to define these linkages and to develop policy alternatives that meet pressing social concerns.

Center for Construction Research and Education: CCRE was established at MIT in 1982 to provide a research environment conducive to the development and application of innovative construction technologies and management principles; to offer graduate programs in construction engineering and management; and to act as a facilitator and catalyst for improving the productivity and competitiveness of the engineering and construction industry and to enhance its contribution to the economy and society in general.

Center for Transportation Studies: CTS was established in 1973 to develop and coordinate a wide range of transportation-related activity at MIT. It provides a focal point for transportation education, facilitates transportation research, conducts an outreach program to the transportation industry, and encourages a sense of common purpose among the many departments, centers, and laboratories involved in transportation at MIT. The interchange of information, ideas, and inspiration among its faculty, students, and research staff makes it one of the most dynamic centers of activity in the transportation field.

The Materials Systems Laboratory: MSL is internationally recognized for its innovative work on the competitive position of materials and products in automotive, aerospace, electronic, and environmental applications. It fosters a

unique combination of knowledge of the design and production processes used in industry together with managerial economics.

Program for Environmental Education and Research: PEER explores the relationship between technology and a sustainable environment. This new initiative builds upon MIT's extensive strengths in environmentally oriented education and research activities.

Daniel Roos

SCHOOL OF HUMANITIES AND SOCIAL SCIENCE

The School of Humanities and Social Science (SHSS) continues to focus its efforts on affirmative action, fund-raising, and faculty recruitment in departments and sections which are experiencing retirements and resignations, in particular, Economics, Linguistics & Philosophy, and Political Science. The faculty within the School received a number of honors and awards, and some important administrative changes within the School have occurred.

UNDERGRADUATE EDUCATION

Discussion continued on the proposed new Communication Requirement. The goal is to cooperate as effectively as possible with the subcommittee of the CUP charged with overseeing the proposed requirement. To this end, the "HASS Overview Committee" solicited recommendations from all academic units in SHSS and will propose approximately 10-12 HASS subjects as pilot Communication Intensive subjects for 1998-99.

The HASS Overview Committee (formerly the HASS-D Overview Committee) oversees the entire HASS component of the General Institute Requirement. It continues to monitor the change in the HASS-D Requirement -- implemented in order to include Category 3 (Visual and Performing Arts) in the requirement -- to see what, if any, impact it has had on enrollments in Categories 1 and 2, the Humanities. A review of the HASS system, planned for 1998-99, will include this and other aspects of the HASS-D Requirement.

NEW INITIATIVES

The Comparative Media Studies Committee's proposal for a new Masters of Science degree in Comparative Media Studies in Course 21 (The Humanities) was approved by the MIT Faculty in May. The program's first class of graduate students will enter in Fall 1999. Meanwhile, a half million-dollar grant from the Markle Foundation, which focuses in large part on the new media and communications, is helping to enrich media studies in the School. New faculty appointments connected to the Comparative Media Studies Program are anticipated in the coming years.

MIT has made important contributions to knowledge over the past half-century in a variety of areas, including the social sciences. In order to help ensure that the social sciences remain strong at the Institute, the Dean appointed a Working Group on the Future of the Social Sciences, chaired by Professor Paul Joskow (Head of Economics). The Working Group completed and submitted its report on the state of the MIT social sciences and offered its recommendations for how to strengthen them at MIT. The report was presented this spring to School Council and to the President and Provost.

AFFIRMATIVE ACTION

The affirmative action record of SHSS continues to appear strong relative to the rest of the Institute, but this is mainly because the representation of women within the fields of humanities and social science is relatively large. The School's record relative to the pool, however, is about average. Within the School for 1997-98 there were 42 women faculty, which represents 29 percent of the total faculty. Of these, 24 are tenured (26 percent of the tenured faculty). Over the past five years, the total number of women faculty has steadily increased (35 in 1992-93), and the School is making every effort to continue this trend. We were successful in recruiting five women to the faculty for next year, including one tenured associate professor in Linguistics & Philosophy and four assistant professors in Foreign Languages & Literature, History, Political Science, and Science, Technology and Society. The number of women faculty in 1998-99 will be 46. Of the five faculty promoted internally and tenured in AY98, three are women.

The School's record with respect to minority faculty is less satisfactory. Our efforts toward increasing the minority representation on the faculty led to the successful recruitment of two minority candidates (one Asian-American woman and one Asian-American man) as assistant professors in the Foreign Languages and Literature Section and the Department of Economics next year. However, this gain is offset by the loss of two Asian-American assistant professors (one woman and one man) to the Harvard Business School and Boston College. With the help of the Provost's Initiative, we will continue our efforts to recruit qualified minority candidates. The total number of minority faculty in the School, including Asian Americans, holds steady at 22 (15%).

We remain committed to increasing the minority representation of the administrative staff. Currently, we have only three minorities (one Hispanic and two Asian-Americans) of a total of 23 (13%). However, we are working closely

with the Departments and Programs in the School and with the Personnel Office in order to strengthen our affirmative action recruitment efforts.

HONORS AND AWARDS

The faculty within the School of Humanities and Social Science garnered an array of honors and awards this year. The most notable among them were the following: Pauline Maier, William R. Kenan Professor of History, received the MIT Killian Faculty Achievement Award for outstanding achievements in professional scholarship, teaching, and Institute service. Professor Maier was also awarded membership in the American Academy of Arts and Sciences. In the Music and Theater Arts Section, Institute Professor John Harbison was awarded one of the five annual Heinz awards by the Heinz Family Foundation; Class of 1949 Professor Ellen Harris was awarded membership in the American Academy of Arts and Sciences; and Assistant Professor James Makubuya was awarded the Class of 1948 Career Development Chair. Professor Ruth Perry of the Literature Section was elected President of the American Society for the 18th Century Studies. The Department of Linguistics and Philosophy's Professor Wayne O'Neil was awarded the George Watson Fellowship from the University of Queensland; Institute Professor Noam Chomsky was awarded an honorary degree from McGill University; Professor David Pesetsky was appointed to the Advisory Committee for the Directorate of Social Behavioral and Economic Sciences, at the National Science Foundation, and honored as "Education Partner" of the Portsmouth, New Hampshire School District; Assistant Professor Ralph Wedgwood was awarded the Humanities Center Fellowship sponsored by the National Endowment for Humanities and the Andrew Mellow Foundation; and Assistant Professor Michel DeGraff was honored with the Levitan Prize in the Humanities. Associate Professor of Political Science and Director of the Center for International Studies Kenneth Oye received the MIT Graduate Student Council Teaching Award. The Department of Economics' Professor Bengt Holmstrom received an honorary doctorate from the Stockholm School of Economics. In addition, James and Elizabeth Killian Professor of Economics Paul Joskow received the very first MIT Dean's Award for Distinguished Service to the School of Humanities and Social Science; and Professor Michael Piore received an honorary doctorate from the Universite des Science et Technologie de Lille in France. Among the Foreign Languages and Literature faculty, Associate Professor Margery Resnick was elected President of the International Institute in Spain; Assistant Professor Nicolas Wey-Gomez was appointed Senior Fellow at the Dibner Institute for the History of Science and Technology and an NEH Fellow at the John Carter Brown Library in Providence, Rhode Island; and Professor Shigeru Miyagawa was honored with the International Cultural Award from the Foundation for Promotion of Traditional Costumes.

FUNDRAISING

FY98 proved to be one of the most successful fund raising years in the history of SHSS. This was due in large part to the Starr Foundation's gift of $6 million to the School to support student internships in East Asia, including China, under MISTI (the MIT International Science and Technology Initiative) and the MIT Japan Program, which are part of the Center for International Studies (CIS). These funds will be administered by CIS to strengthen and expand the student internship programs.

The Fang Endowment received a new pledge of $1.5 million, bringing the total amount of gifts and pledges to the endowment to $2.5 million. This will enable us to establish the Fang Professorship in Chinese Language and Culture, and a search to fill this new professorship will begin in FY99.

In partnership with the Political Science Department, the Washington Post hosted a reception in Washington, DC at which several presentations were made by Political Science faculty addressing events of current national interest. It is hoped that this reception may become a regular means of showcasing some of the activities of the Political Science Department and strengthening the ties to program donors. The Department has also continued to raise funds toward its ongoing Washington Internship program for MIT undergraduate students.

The World Economy Laboratory of the Department of Economics continues to raise several hundred thousand dollars per year to support student and faculty research in the department.

A variety of new gifts from individuals and sponsored research funding from foundations, the U.S. government, and U.S. and Japanese corporations came into the Foreign Languages and Literature Section, the Program in Writing and Humanistic Studies, the Music and Theater Arts Program, and the Center for International Studies. These include

major funding from the Mellon, MacArthur, Carnegie, Ford and Freeman Foundations, the NSF, NEH, the U.S. Air Force, the Ford Motor Company, and the German Ministry of Education.

The School produced a four-part plan to support a variety of new and ongoing activities in SHSS that we hope will become part of the new Capital Campaign which MIT plans to launch in the coming year or two and which is now in its "silent phase." The School would like to raise $150 million in new gifts and pledges during the campaign. Toward this end, the School has hired a new development officer, Martha Fuller. She comes to us from Radcliffe College where she was Director of Development and will assume her new appointment as Assistant Dean for Resource Development in August 1998.

FACULTY PROMOTIONS, ADMINISTRATIVE CHANGES, RETIREMENTS

The School saw one retirement and four resignations this year, including two due to the denial of tenure and/or promotion. A total of five faculty members were promoted to tenure this year. One faculty member (Evelynn Hammonds of the Program in Science, Technology and Society) was promoted effective February 1, 1998. The remaining four members were promoted effective July 1, 1998: Michael Kremer of the Department of Economics, Anne McCants and Elizabeth Wood of the History faculty, and James Buzard of the Literature Section.

The School was successful in recruiting 13 new members to the faculty effective 1998-99. These appointments include nine made at the assistant professor level, three as associate professors with tenure, and one professor jointly appointed in the Sloan School. The assistant professor appointments were made in the following departments: one in Economics, two in Political Science, one in Foreign Languages and Literatures, one in History, one in Literature, one in Music and Theater Arts, and two in Science, Technology and Society. The associate professors with tenure include two members appointed in Linguistics and Philosophy and one in Political Science. The professor was given a primary appointment in the Sloan School, with a joint appointment in the Department of Economics. In addition, an appointment as Professor of Anthropology and first holder of the title "Genevieve McMillan-Reba Stewart Professor of the Study of Women in the Developing World" was made effective January 1, 1998.

Class of 1941 Professor of Economics Olivier Blanchard will become the next Head of the Department of Economics, replacing Professor Paul Joskow. We will miss the insight and administrative wisdom of Professor Joskow and wish him well as he returns to a professional life focused on full-time scholarship and teaching.

Sadly, we report the death of Professor Martin Diskin, a valued colleague in the Anthropology Program. Professor Diskin, an expert on the agrarian economies for Latin America and an advocate for social reform in the region, passed away on August 3, 1997, after a long bout with leukemia.

More information about the School of Humanities and Social Science can be found on the World Wide Web at the following URL: http://web.mit.edu/shss/www

Philip S. Khoury

HUMANITIES, ARTS, AND SOCIAL SCIENCES OFFICE

A new undertaking this year has been integrating the HASS-D Lottery into electronic pre-registration, with the goal of providing students with a conflict-free schedule each term. The HASS Office worked closely with the Registrar's Office, Information Systems, and others to implement this integration for the 1998 Spring Term. It went smoothly; preparations then began for the more challenging task of including incoming freshmen in Fall 1998. As part of this effort, the HASS Office produced a new publication, *The Freshman HASS Guide*. Switching software from Excel to Filemaker Pro for such things as databases and mailing lists has led to a more efficient and flexible operation in the HASS Office. The HASS-D Overview Committee, to which the Coordinator, Dr. Bette Davis, serves as staff, got a new Chair (Prof. Peter Child), a new name (HASS Overview Committee), and an accompanying broadened charge this year. In addition to the traditional responsibilities for approving proposals for HASS-D subjects and overseeing the HASS-D system, the Committee is now involved in all aspects of the HASS program, including concentrations, minors, and the pilot Communication Intensive (CI) initiative. This has been interesting, but has resulted in a greater time commitment and heavier workload.

In addition, the HASS Office has continued to serve multiple functions, including the administration of the eight-subject HASS requirement, the HASS Minor, the Harvard Cross-Registration Program, provision of statistics for the School of Humanities and Social Science, and the publication of *The HASS Guide* (hard copy and electronic versions) each term. This office also continued to record proposals and completion forms for HASS Concentrations and Minors in MITSIS, on behalf of the Registrar's Office, in addition to maintaining a HASS Minor data base and paper files. Petitions for HASS credit for subjects which are not so coded in MITSIS, including Harvard and Wellesley subjects, graduate subjects, etc., are submitted here for approval. Information concerning any of the above, as well as HASS transfer credit and general Institute information, was provided to the MIT community and in response to inquiries from outside the Institute.

ENROLLMENT STATISTICS

Total enrollment in all HASS subjects dropped from 10,592 last year to 10,253 in AY98. The number of HASS subjects offered was almost exactly the same as last year—457 in 1997-98, compared to 455 in 1996-97. The number of autonomous sections decreased from 591 to 574. The number of HASS-Distribution subjects offered increased very slightly, from 113 to 117. The largest overall enrollments were in the same fields as last year, in the same order: 1927 in Economics (up from 1898 last year) and 1521 in Foreign Languages and Literatures. Writing (983) was again third, followed by Literature (912), Music (750*), and Psychology (748). (*Six-unit music performance subjects are not included in these statistics.) Archaeology had the largest increase over last year in terms of percentage (from 85 to 118), followed by Urban Studies (221 to 268), Women's Studies (66 to 75), Linguistics (82 to 93), and the History of Art and Architecture (138 to 156).

CONCENTRATIONS

In 1997-98, students submitted 2351 HASS Concentration proposals and 1281 completion forms, compared to 2195 proposals and 1222 completion forms last year. Once again, Economics and Foreign Languages led in the number of completed HASS Concentrations: in 1997-98, 356 (compared to 320 last year) students completed concentrations in Economics, and 220 (compared to 222 last year) completed concentrations in Foreign Languages & Literatures. (For a breakdown by languages, see Table II.) The next two most popular HASS Concentration fields are Music, with 113 completed concentrations, and Psychology, with 90, followed by Literature (68),Writing (64), and Anthropology (46).

MINOR PROGRAMS

1997-98 showed an increase in the total number of HASS Minor applications from all graduating classes, but a decrease in the number of HASS Minors received by the Class of 1998. There were 483 applications, compared to 440 last year and 416 in 1995-96. 194 members of the Class of Õ98 received minors in twenty fields in HASS, down from 222 last year. The two most popular fields in terms of applications filed were the same as last year: Economics (148) and Music (73). There were 70 minors in Foreign Languages (26 in French, 20 in German, and 24 in Spanish). Other popular HASS Minors, in order, were Psychology (31), Political Science (24), Literature (23), and Writing (22).

HARVARD CROSS REGISTRATION

Fewer MIT undergraduates cross-registered for courses at Harvard in 1997-98. 186 students took 196 subjects at Harvard, compared to 213 students enrolled in 235 subjects in 1996-97. There was no obvious explanation for this rather sizable decrease. As usual, foreign languages were by far the most popular field of study. One hundred and three of the 196 subjects were in 18 different foreign languages. The two most popular languages were Chinese (21), Korean (16), and Urdu-Hindi (14); enrollments in other languages were spread fairly evenly. The most popular fields outside foreign languages were Art/Visual Studies (18) and Religion (10).

S.B. DEGREES

Ninety-five students received the S.B. in SHSS this year, up from 82 last year. Of these, 59 degrees were in Economics, Course 14, and five were in Political Science, Course 17. During the same time period, September 1997 through June 1998, a total of 26 students completed the S.B. Degree in Humanities, Course 21. Eight of these received joint degrees, three in 21-E and five in 21-S. Another 12 received degrees in a specified field within Course 21. Six undesignated Humanities degrees (for "Major Departures") were granted. Five students received the S.B. in Philosophy.

UNDERGRADUATE MAJORS

The four departments in SHSS had 239 undergraduate majors this year, compared to 187 in 1996-97. For all departments, these figures include all degreesÑsecond and third as well as first degrees. The Economics Department has 137 of these majors, and 32 undergraduate students are majoring in Political Science. There were 58 Humanities majors in 1997-98; of these, 23 were joint majors (13 in 21-E and 10 in 21-S.) Writing had the most majors (14), followed by Literature and Music, with 12 each. (These figures include joint degrees and full degrees in those fields.) Twelve undergraduates have declared a major in Philosophy.

HONORS AND AWARDS

Among the more notable honors achieved by SHSS majors this year were:

Todd Anderson Undergraduate Teaching Award	Kevin Simmons, '98; Noemi Giszpenc, '98
Boit Manuscript Prize	Joaquin Terrones, '98 (second prize); Peixiang Ye (first prize, short story category), '98
Robert A. Boit Writing Prize:	Anna Dirks, '99 (first prize, poetry category); Joaquin Terrones, '98 (first prize, essay category)
Burchard Scholars:	Sarah Anderson, '99; Lucia Breierova, '99; Petra Chong, '99; Amalia Miller, '99; Samuel Sidiqi, '99; Ami Vasanawala, '99
William Everett Chamberlain Prize	Lin-Ann Ching, '98
Peter J. Eloranta Award	Kevin Simmons, '98
Joseph D. Everingham Award	Lin-Ann Ching, '98
Parke A. and Ann L. Hodges Prize:	Lucia Breierova, '98
Philip Loew Memorial Award	Nicole Lee, '98
Outstanding Service to the DMSE Community	Ryan Kershner, '98
Phi Beta Kappa	Lin-Ann Ching, '98; Marcos d. Chamon, '98; Robin S. Chhabra, '98, Winnie W. Choi; '98, Peter I. Chu, '98; Robin M. Greenwood, '98; Rujikorn Pavasuthipaisit, '98; Syed Farhan Zaidi, '98,
William L. Stewart Award	William Shen, '01
Louis Sudler Prize	Stephen Tistaert, '98
Gregory Tucker Memorial Prize	Petra Chong, '99
Laya and Jerome B. Wiesner Award	Kevin Simmons, '98

More information can be found on the World Wide Web at the following URL: http://web.mit.edu/hass/www/

Bette Davis

ENROLLMENT IN HUMANITIES, ARTS, AND SOCIAL SCIENCE SUBJECTS, 1997-98

Field	Elective Subjects			HASS-Distribution			Total Enrollment		
	#Subjects	(#Sections)	#Students	#Subjects	(#Sections)	#Students	#Subjects	(#Sections)	#Students
Anthropology	11	(11)	128	4	(4)	178	15	(15)	306
Archaeology	6	(6)	86	1	(1)	32	7	(7)	118
Economics	25	(36)	1,872	2	(2)	55	27	(38)	1,927
Foreign Languages & Literature	61	(89)	957	24	(40)	564	85	(129)	1,521
History	31	(31)	285	13	(13)	291	44	(44)	576
History of Art & Architecture	3	(3)	29	4	(4)	127	7	(7)	156
Linguistics	6	(6)	93	0	(0)	0	6	(6)	93
Literature	29	(30)	329	18	(25)	583	47	(55)	912
Music*	10	(26)	319	10	(15)	431	20	(41)	750
Philosophy	14	(14)	164	6	(6)	308	20	(20)	472
Political Science	26	(26)	302	8	(8)	208	34	(34)	510
Psychology	10	(11)	400	1	(1)	348	11	(12)	748
STS	11	(11)	86	5	(5)	148	16	(16)	234
Theater Arts*	20	(23)	246	3	(3)	29	23	(26)	275
Urban Studies	15	(15)	199	3	(3)	69	18	(18)	268
Visual Arts	9	(9)	84	2	(5)	105	11	(14)	189
Women's Studies	12	(12)	31	5	(5)	44	17	(17)	75
Writing	35	(60)	862	5	(6)	121	40	(66)	983
Other Subjects	6	(6)	56	3	(3)	84	9	(9)	140
Totals	**340**	**(425)**	**6,528**	**117**	**(149)**	**3,725**	**457**	**(574)**	**10,253**

Notes:

1. Figures were obtained from the MITSIS system, which shows the final tally for each class.
2. The numbers shown are for undergraduate subjects which normally satisfy the HASS Requirement; they do not include subjects allowed by petition.
3. (#Sections) refers to the number of autonomous class sections; it does not apply to subjects which meet in a single lecture and divide into discussion sections.
4. For joint subjects, figures are given for the subject number under which students enrolled.
5. HASS-D Language Option subjects (Level III or IV languages) are included in the HASS-D figures.

* Music and Theater Arts 6-unit performance subjects are not included in these statistics.

CONCENTRATIONS IN ALL THE FIELDS OF HUMANITIES, ARTS, AND SOCIAL SCIENCE*, JUNE 1998

Fields of Concentration	Class of 2001		Class of 2000		Class of 1999		Class of 1998		Totals in Fields	
American Studies	(0)	0	(0)	0	(2)	0	(6)	6	(8)	6
Ancient & Medieval	(0)	0	(2)	0	(4)	1	(9)	6	(15)	7
Anthropology	(0)	0	(7)	0	(17)	5	(46)	41	(70)	46
Archaeology	(0)	0	(0)	0	(1)	0	(0)	0	(1)	0
Black Studies	(0)	0	(0)	0	(1)	0	(2)	2	(3)	2
Constitutional Tradition	(0)	0	(1)	0	(1)	0	(0)	0	(2)	0
East Asian Studies	(0)	0	(14)	0	(17)	1	(45)	41	(76)	42
Economics	(2)	0	(119)	3	(189)	47	(327)	306	(637)	356
Ethnic Studies	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0
Film & Media Studies	(0)	0	(3)	0	(9)	0	(19)	17	(31)	17
Foreign Languages**	(6)	0	(94)	11	(137)	25	(199)	184	(436)	220
History	(0)	0	(19)	2	(28)	7	(35)	35	(82)	44
History of Art and Architecture	(0)	0	(2)	0	(8)	2	(5)	2	(15)	4
Labor in Industrial Society	(0)	0	(0)	0	(0)	0	(0)	0	(0)	0
Latin American Studies	(0)	0	(1)	0	(9)	1	(5)	5	(15)	6
Linguistics	(0)	0	(5)	0	(3)	1	(7)	7	(15)	8
Literature	(0)	0	(14)	1	(41)	7	(66)	60	(121)	68
Middle Eastern Studies	(0)	0	(1)	0	(0)	0	(1)	1	(2)	1
Music	(1)	0	(38)	1	(65)	15	(103)	97	(207)	113
Philosophy	(0)	0	(7)	0	(25)	7	(38)	34	(70)	41
Political Science	(0)	0	(16)	1	(43)	6	(37)	35	(96)	42
Psychology	(2)	1	(23)	0	(53)	20	(72)	69	(150)	90
Religion	(0)	0	(1)	0	(1)	0	(1)	1	(3)	1
Russian Studies	(0)	0	(1)	0	(0)	0	(3)	3	(4)	3
Science, Technology, & Society	(0)	0	(6)	0	(13)	1	(19)	17	(38)	18
Theater Arts	(1)	0	(9)	0	(16)	2	(30)	30	(56)	32
Urban Studies	(0)	0	(7)	0	(4)	2	(18)	18	(29)	20
Visual Arts & Design	(0)	0	(4)	0	(7)	0	(14)	13	(25)	13
Women's Studies	(0)	0	(2)	0	(14)	5	(10)	9	(26)	14
Writing	(1)	0	(18)	0	(32)	3	(64)	61	(115)	64
Special Concentrations	(0)	0	(0)	0	(0)	0	(3)	3	(3)	3
TOTALS	**(13)**	**1**	**(414)**	**19**	**(740)**	**158**	**(1184)**	**1103**	**(2351)**	**1281**

* The parenthetic figure is the number of proposed concentrations in the given class and field; the figure to its right is the number of these concentrations that have been completed.

** Figures for subfields of Foreign Languages and Literatures are below:

Chinese	(0)	0	(10)	1	(15)	3	(15)	14	(40)	18
ESL	(0)	0	(0)	0	(1)	1	(4)	4	(5)	5
French	(1)	0	(32)	5	(34)	7	(53)	49	(120)	61
German	(3)	0	(15)	2	(24)	4	(28)	25	(70)	31
Japanese	(0)	0	(12)	1	(26)	7	(43)	41	(81)	49
Other Languages	(0)	0	(1)	0	(4)	0	(8)	7	(13)	7
Spanish	(2)	0	(21)	2	(29)	3	(45)	41	(97)	46
SILC	(0)	0	(3)	0	(4)	0	(3)	3	(10)	3
Totals	**(6)**	**0**	**(94)**	**11**	**(137)**	**25**	**(199)**	**184**	**(436)**	**220**

edited a special issue of the *SSRC-McArthur Newsletter* on "Science, Technology, and International Security." He published two notes this year and has three articles in press, with five more submitted for publication.

Professor Howe was principal consultant for a major exhibition, "The Art of Being Kuna," which opened at the UCLA Fowler Museum in November 1997. The exhibition was moved to the Smithsonian Museum of the American Indian in 1998, and will be moved to the Field Museum in 1999.

Representative of the wide range of talks given by program members are: "Symbols of Indianness: Contrast between Columbia's and Guatemala's Indigenous Rights Movements," read by Professor Jackson at the International Congress of Americanists, in Quito, Equador, July 1997; "Iraqnophobia: America's Racist Discourse on Nuclear Proliferation," presented by Professor Gusterson at the Stanford University Center for International Security and Arms Control in June 1998; and a talk by Professor Slyomovics in March 1998 at the Trinity College Symposium on "Borders/Partitions and Statism" entitled "The Borders of Memory: Palestinian Memorial Books."

More information about this department can be found on the World Wide Web at the following URL: http//web.mit.edu/anthropology/

James Howe

FOREIGN LANGUAGES AND LITERATURES

Foreign Languages and Literatures (FLL) is dedicated to providing MIT students with the tools for a sensitive and successful involvement in the global community by contributing to the internationalization of an MIT education. During the academic year 1997-98, FLL faculty continued to provide national and international leadership in the fields of foreign language pedagogy, technology in the humanities, language acquisition, and literary and cultural studies, while demonstrating their commitment to excellence in education within the Institute. Several members of the section were recognized by colleagues in their fields and by other educational institutions. Nicolas Wey-GÛmez, Assistant Professor of Hispanic Studies, was named both a Senior Fellow at the Dibner Institute for the History of Science and Technology (1998-1999), and an NEH Fellow at the John Carter Brown Library in Providence, RI for 1998-1999 (declined), as well as an Old Dominion Fellowship, also for 1998-1999. Margery Resnick, Associate Professor of Hispanic Studies, was elected President of the International Institute in Spain. Takako Aikawa, Assistant Professor of Japanese, received an Old Dominion Fellowship for Fall 1997. Shigeru Miyagawa, Professor of Linguistics and Japanese, was given the International Cultural Award from the Foundation for Promotion of Traditional Costumes. Gilberte Furstenberg, Senior Lecturer in French, and Shoggy Waryn, Lecturer in French, received the Prix Special du Jury, Concours Innovalangues for Dans un quartier de Paris at Expolangues in Paris in January of 1998. Lecturer Waryn was also awarded the L'Ordre des Palmes AcadÈmiques (Chevalier) by the French Ministry of National Education and Culture.

FLL faculty and lecturers have, over the last few years, been actively developing and refining materials and new technology to enhance the teaching of foreign languages and culture, as well as pioneering in the fields of theoretical linguistics and acquisition. Suzanne Flynn, Professor of Linguistics and Second Language Acquisition and head of FLL, launched a new online and print journal, Syntax: Theoretical, Experimental, and Interdisciplinary Approaches, (S. Epstein, co-editor). Senior Lecturer Furstenberg and Lecturer Shoggy Waryn, (co-Principal Investigators (PI)), and Sabine Levet, Lecturer in French, have been working on Cultura, a multimedia/hypermedia cross-cultural project for CD-ROM and Web, funded by the National Endowment for the Humanities (NEH). Douglas Morgenstern, Senior Lecturer in Spanish (editor), Margarita Ribas Groeger, Lecturer in Spanish, and Adriana GutiÈrrez, Lecturer in Spanish, continue their work on the nearly-completed FORMA electronic journal. Ellen Crocker, Lecturer in German, and Kurt Fendt, Research Associate, have been refining the Berliner sehen interactive CD-ROM, funded by NEH and the Consortium for Language Teaching and Learning, including its incorporation and testing with "Web Lingua." Senior Lecturer Morgenstern and Lecturer Groeger are nearing completion of No recuerdo, a CD-ROM simulation for third-semester Spanish students funded by NEH. Monika Totten, Lecturer in German, is developing a new CD version of Survivors of the Holocaust: Conversations with German-Jewish Women Writers that is linked to a web site via CD-Link. And, Assistant Professor Aikawa, Senior Lecturer Furstenberg, Lecturer Groeger, Lecturer Levet, and Lecturer in Japanese Yoshimi Nagaya have all been creating online coursework for students at MIT and other institutions of higher education.

Professor Miyagawa secured additional funding from the U.S. Department of Education (DOE) for StarNet; substantial funding for JP-NET from Canon Information Systems, Canon Business Machines and the Nippon Foundation; and funds from Fujitsu Corporation for the Lexicon Project. Associate Professor Resnick received funding from the Abby Mauze/Rockefeller Fund for an IAP project.

Research in the areas of literary and cultural studies, linguistics and language pedagogy continues to be of the highest caliber, with articles published in internationally respected journals. Professor Flynn published a print version of the electronic journal Syntax: Theoretical, Experimental, and Interdisciplinary Approaches in April 1998, and was co-editor (with G. Martohardjono and W. O'Neil) of Generative Studies in Second Language Acquisition, for which she also contributed the Introduction and co-wrote (with S. Epstein and G. Martohardjono) the chapter entitled "Full Access v. Partial Access in Adult L2 Acquisition." Isabelle de Courtivron, Professor of French Studies, has been working as a guest editor of a special edition of SITES: The Journal of 20th Century/Contemporary Women Writers, and has written book reviews for The New York Times and The Women's Review of Books. Associate Professor Resnick had her article "The Destruction of the Myth of Spanish Homogeneity: Marginal Characters in Carme Riera's Palabra de Majer" published in Proyecciones Sobre la Novela. And Hollywood Diva: A Biography of Jeannette McDonald by Edward Turk, Professor of French and Film Studies, is in press and will appear in the Fall of 1998 (University of California Press, Berkeley).

This year FLL sponsored a distinguished visiting scholar: Professor Widdig organized the visit of German writer Katja Lange-M¸ller, the second Max Kade Distinguished Visitor in German Studies at MIT.

FLL faculty were invited to several national and international conferences. Among them, Professor Flynn presented "Redefining the Initial State in L2 Acquisition" at the European Second Language Society (EUROSLA) in Barcelona, Spain, "L1 and L2 Acquisition: What We Mean by End State Competence" at the Linguistic Society of America (LSA) annual meeting in New York, and two papers at LSA Puerto Rico, "The Multi-Culture Classroom" with Lecturer in ESL Jane Dunphy, and "Interactive Video Programs for ESL" with G. Martohardjono. In addition, Professor Flynn was an invited colloquium speaker at Pennsylvania State University and at Vittorio University in Balbao, Spain, as well as visiting the Ortega Y Gasset Institute in Madrid as an invited professor and serving as Chair of the Program Committee at the LSA annual meeting. Professor Turk delivered a presentation on Henieszka Holland's film Total Eclipse at the French Library in Boston. Bernd Widdig, Associate Professor of German and Head of the MITGermany Program was an invited panelist at Brandeis University's "German LiteratureóJewish Critics: An International Symposium" and a commentator at the 21st Annual Conference of the German Studies Association in Washington, DC, as well as being an invited lecturer at Deutsches Haus at Columbia University in New York City. Assistant Professor Aikawa presented "Interface Between Language Pedagogy and Computer Technology" at the 12th New England Japanese Pedagogy Workshop in Wesleyan, CT. Assistant Professor Wey-GÛmez visited New York University to present The Procession of Our Lady of Carmel: Trauma, Repetition, and Religious Performance in Contemporary Peru and delivered Nuestro Padre el Sol: Scholastic Cosmology and the Cult of the Sun in Inca Garcilaso's "Royal Commentaries of the Incas" at John's Hopkins University and at Georgetown University. He also served as Session Chair at the Third Biannual Conference of the Society for Renaissance and Baroque Hispanic Poetry in Rochester, NY. Associate Professor Resnick gave her papers Models for Mentoring Women at the LSA annual meeting in New York City, New Paradigms for Women in the World of post-Franco Spain at Northeastern University, and Teachers as Scholars: Partnership Between Public School Teachers and University Professors at the Woodrow Wilson Foundation. Senior Lecturer Furstenberg's From Interactivity to Interaction or The Role of the Teacher was presented at the conference of the American Council on Teaching Foreign Languages (ACTFL) in Nashville. She also collaborated with Research Associate Fendt on a paper entitled "Multimedia in Foreign Language and Culture Education" given at Rice University. Professor Miyagawa, Senior Lecturer Morgenstern, Lecturer Ellen Crocker and Research Associate Fendt collaborated on Multimedia as an Interactive Narrative Environment for Learning, also given at ACTFL in Nashville. Senior Lecturers Morgenstern and Furstenberg, Lecturer Crocker and Research Associate Fendt all contributed to a presentation at the University of Wisconsin called Expanding the Learning Experience: Design, Development and Use of Interactive Multimedia for Foreign Languages at MIT. Lecturers Groeger and GutiÈrrez gave a talk at a meeting of Sine Nomine (a regional organization of professionals dedicated to foreign language teaching) at Merrimack College, entitled "The WEB as Tool and Resource: Some Ideas for the Foreign Language Classroom." Lecturer GutiÈrrez also gave a presentation at Bentley College on El nuevo zapatismo (The New Zapatismo) centered on recent political and social developments in Chiapas, Mexico. Shoggy Waryn, Lecturer in French, presented Satellites in the Wrong Orbit at a conference of the Society for the History of Technology (SHOT). Research Associate Fendt was invited to speak at a University of Bern, Switzerland workshop called "TextóHypertextóCybertext" and was an invited presenter at a workshop conducted by the American Association for Teachers of German named "Project-Oriented Learning: Skills, Content, Media" in Bar Harbor, ME, and also presented two talks as an invited speaker at Fairfield University, Dynamic Content: Reconfiguring Texts in Print and Multimedia and Expanding the Learning Experience: Narrative Models for Interactive Media in Foreign Languages. He also was an invited speaker at the Goethe Institut in Munich, at a seminar entitled "Interactivit‰t = Interaktion?"

There have been a number of cultural and educational events that our faculty have planned and participated in at MIT and around the Boston area. The entire French group participated in the planning and execution of "Francophone April at MIT," a month-long series of events that included visits by distinguished scholars including Assia Djebar, Alain Gresh, Genevieve Sellier, and Whitney Chadwick and a descriptive web site created by Lecturer Waryn, who also served as coordinator for Francophone April; Professor Turk coordinated the film events. Professor Miyagawa conducted an MIT workshop on the future of the Japanese language field, specifically addressing policy and funding issues. Associate Professor Widdig gave a lecture titled Daily Explosions: Culture and Inflation in Weimar Germany for an MIT History and Literature Faculty Workshop. Associate Professor Resnick arranged a visit and talk by Cuban author Excilia SaldaÒa and participated in MIT Technology Day with a talk called Roofwalkers: MIT Women and the American Dream, as well as overseeing two MIT/UROP outreach programs that

bring MIT students into closer contact with the local community, one in association with the Read America Literacy Campaign, the other with Boston Public Schools' Gifted and Talented Program. Lecturer Totten organized a theater workshop, public talk, and class visits by Holger Teschke (dramaturg at the Berliner Ensemble, Germany) on the occasion of Bertold Brecht's 100th birthday, as well as a reading tour for Max Kade Distinguished Visitor Katja Lange-M¸ller which included stops at Dartmouth College, Harvard University, Wellesley College, Brown University, and the Goethe Institute in Boston.

Members of the FLL faculty also contribute to MIT through their service on a number of Institute-wide committees: The MIT CrossTalk Forum, the BAS Degree Committee, the Presidential Nominations Committee, the Burchard Scholars Selection Committee, the Committee on the Writing Requirement, the Teaching and Learning Lab Advisory Committee, the Special Presidential Committee on Undergraduate Living, the Faculty Officers' Committee, the Faculty Library Systems Committee, the Phi Beta Kappa Selection Committee, the Committee on Corporate Relations, the Committee on Campus Race Relations, the IBM-MIT Partnership Committee, the Corporation Joint Advisory Committee on Institute-wide Affairs (CJAC), the MIT Professional Institute Board, the Selection Committee for the List Arts Fellowship, the Race 2000 Organizing Committee, the Committee on Academic Performance, the Committee for Undergraduate Programs and the Committee on Curricula, among Others.

FLL has maintained its commitment to making full-time appointments and to attracting qualified candidates from minority groups. In order to achieve these goals, FLL has conducted national searches targeting historically black colleges and universities and has advertised in journals focusing on the minority community. This year, FLL conducted four national searches: one for an Assistant Professor of Chinese Studies, two for Lecturers in Chinese, and one for a Lecturer in Japanese. Emma Teng, accepting the Assistant Professor of Chinese Studies position, will teach two subjects for the History department as well. Tong Chen accepted one of the Lecturer in Chinese positions, and Nyan-Ping Bi accepted the other. Kasumi Yamamoto took the Lecturer in Japanese position. There was also a promotion within the section: Elizabeth Garrels was promoted to Professor of Hispanic and Latin American Studies, as of July 1, 1997.

While the number of majors in FLL remains low at two, the number of minors (89) has been steadily increasing and the number of concentrators (405) has remained stable. Spanish continues to have the largest enrollments at 501; followed by French, 326; Japanese, 254; English as a Second Language, 251; Chinese, 234; German, 185; and Russian (Literature), 7. Enrollments in Studies in International Literatures and Cultures (cross-cultural language and culture subjects taught in English) are subsumed under the language group to which the instructor belongs. FLL subjects also make up an important component of the Regional Minors Program. The Academic Year 1997-1998 saw 24 students pursuing minors in one of the Regional Studies programs.

More information about FLL can be found on the World Wide Web at the following URL:
http://web.mit.edu/fll/www

Suzanne Flynn

HISTORY

The History Faculty's mission is to promote advanced research and undergraduate teaching in a broad range of fields of study, modern and pre-modern, including American, Ancient, East Asian, European, Latin American, Middle Eastern, and Russian history. The Faculty includes joint appointments in Urban Studies and History of Science and Technology and participates in the joint Ph.D. program in the History and Social Study of Science and Technology.

RESEARCH AND PUBLICATIONS

1997 was a banner year for MIT historians. In the Fall of 1997, three members of the History Faculty published major books. Associate Professor Anne McCants' *Civic Charity in a Golden Age: Orphan Care in Early Modern Amsterdam* [University of Illinois Press] uses extensive quantitative data on nutrition and food prices to discuss the important role of charitable institutions in the new capitalist economy of the Netherlands in the seventeenth century. Arthur J. Conner Professor Harriet Ritvo's *The Platypus and the Mermaid and Other Figments of the Classifying Imagination* [Harvard University Press] examines popular and scientific taxonomies of animals, monsters, and legendary creatures to reveal how nineteenth-century English people conceived of the natural and social world; Associate Professor Elizabeth Wood's The *Baba* [grandmother] *and the Comrade: Gender and Politics in Revolutionary Russia* [Indiana University Press] analyzes the ambivalent role of women during the early years of the Russian Revolution. She has also nearly completed a second manuscript, "Performing Justice: Agitation Trials in Revolutionary Russia", which has been reviewed with great enthusiasm. Together with three books published in early 1997 by William R. Kenan Jr., Professor Pauline Maier, Associate Professor Ted Lendon, and Assistant Professor Heather Cox Richardson, this makes six books published by the History Faculty in one year, five of them by women.

Professor Ritvo also published "Mad Cow Mysteries" in the American Scholar, discussing the contemporary English debate on contaminated beef. Professor Peter C. Perdue presented a paper, "Culture, History, and Chinese Military Strategy", at a conference on Chinese military history at Cambridge University, England. Dean of the School of Humanities and Social Science, Professor Philip S. Khoury, published "The Paradoxical in Arab Nationalism: Interwar Syria Revisited" in James Jankowski and Israel Gershoni, eds., *Rethinking Nationalism in the Arab Middle East* [Columbia University Press].

PERSONNEL

Professors McCants and Wood were both promoted to Associate Professor with tenure, effective July 1. Since they have contributed so much to the History Faculty and the Institute by their research, teaching, and service, we welcome their permanent appointments with great enthusiasm. The fields in which they specialize: early modern European and Russian history, will benefit greatly from having a permanent presence in our Faculty. Both Professor McCants and Professor Wood have also been active participants in the development of Women's Studies at MIT. Professor Richardson was promoted to Associate Professor without tenure, effective July 1.

Assistant Professor Jeffrey Ravel began his first year of teaching. The subjects he taught included "Erasmus to E-Mail: Technologies of the Word, 1450-2000", and "The Age of Reason", and he completed his manuscript, "The Contested Parterre", on the political role of the theater in eighteenth-century France.

Jinhua Emma Teng was hired as Assistant Professor of Chinese Literature in the department of Foreign Languages and Literatures, but she will also teach two courses for the History faculty, one on Asian-American history and one on women in Asian America. She completed her dissertation at Harvard on "Travel Writing and Colonial Collecting: Chinese Travel Accounts of Taiwan from the Seventeenth through Nineteenth Centuries".

Professor Maier continues as the Affirmative Action officer. The department continues to search for target of opportunity appointments in all fields, but particularly in African and African-American history.

ACADEMIC PROGRAMS

Professor Bruce Mazlish and Professors Maier, Perdue, Richardson, Ritvo, Wood, and Associate Professor Christian Appy participated in the joint Ph.D. program in the History and Social Study of Science and Technology, by teaching graduate seminars, supervising general exams, or conducting tutorials. Professor John W. Dower and Dean Khoury advised advanced graduate students at Harvard in Japanese and Middle Eastern history, respectively.

Enrollments in history courses were 370 in Fall, 1997 and 333 in Spring, 1998. One student majored and [9] students minored in history. The most popular subjects included: 21H104J Riots, Strikes, Conspiracies in American History [31], the ever popular 21H301 Ancient World: Greece (61), and 21H302 Ancient World: Rome (63), 21H231J American Urban History [28] 21H433 The Age of Reason (30), 21H467 Soviet and Post-Soviet Politics and Society [25], 21H502 Revolution in China [23], and 21H536 Family, State, Economy in East Asian History [30].
Professor McCants and Dean Khoury led freshman advisor seminars on "History of Cosmology" and "Conflict and Peace in the Contemporary Middle East", respectively. Professors McCants, Perdue, Ritvo, Ravel, Khoury supervised UROP projects.
Lindsay Androski wrote a senior thesis in History on "A Singular Case: Boston and the Growth of Restrictionism in the Early Twentieth Century".

HONORS AND AWARDS

Professor Maier received the Killian Faculty Achievement Award, because of her outstanding achievements in professional scholarship, teaching, and Institute service. The announcement at the spring Faculty meeting was a total surprise to her, but a very gratifying one. Her recent book, *American Scripture: Making the Declaration of Independence*, won widespread professional and popular acclaim; her teaching about early American history has always drawn superb evaluations from students; and she has directed and served on many important committees at the Institute, especially the committee that designed the Humanities, Arts, and Social Sciences curriculum.

Monisha Merchant won the Truman Fellowship, a nationally competitive award that provides for support for students interested in careers in public service.

INSTITUTE AND PROFESSIONAL SERVICE

Professor McCants directed the Truman fellowship committee and served on the IAP Policy committee, the CUP subcommittee for Freshman Housing, Phi Beta Kappa Selection committee and as Housemaster at Green Hall.
Professor Ritvo chaired the Search committee for Director of the MIT Museum, served on the Committee on Animal Care and Use, and Committee on the Freshman Program. Professor Khoury chaired the Search Committee for Director of the Knight Science Journalism Fellowship Program.
Professor Mazlish chaired the Toynbee Prize Award Ceremony for Albert Hirschman at the Kennedy School of Government, Harvard University. He also convened an ongoing seminar on global history which brings together faculty from the Boston area. Professor McCants served on the Program Committee of the Economic History Association and as Editorial Reviewer for the Journal of Economic History. Professor Ritvo served on Editorial Boards of *Victorian Studies*, *Society and Animals*, and *Victorian Literature and Culture*. Professor Khoury is President of the Middle East Studies Association and serves on the editorial boards of the *Journal of Interdisciplinary History* and *Historical Abstracts.*

OTHER ACTIVITIES

Professor McCants directed the Kenan Sahin lecture series, which presented talks on European history this year: Laurie Kahn-Leavitt, a filmmaker from Blueberry Hill Productions, spoke on "The Making of *'A Midwife's Tale'*"; Sarah Maza, Professor of History at Northwestern University, on "Languages of Class in the French Revolution: The Problem of the Missing Bourgeoisie"; Deirdre McCloskey, Professor of Economics and History at University of Iowa, on "The Vices of Social Engineering"; Paul Slack, Principal at Linacre College, University of Oxford, on "Reactions to Plague in Early Modern Europe: The Dilemmas of Public Health"; and Carl Strikwerda, Associate Professor of History and Chair, European Studies, University of Kansas, on "From 19th to 21st Centuries: The Great War and the Re-Making of Modern History". Professor Mazlish again jointly ran the History and Literature Workshop series, and Dean Khoury directed the Bustani Seminar of Middle Eastern Studies.

More information about the History Faculty can be found on the World Wide Web at the following URL: http://web.mit.edu/history/www

Peter C. Perdue

LITERATURE

1997-98 was an exciting year for the Literature Faculty. A new graduate program in Comparative Media Studies was approved by the MIT Faculty, the Media in Transition project, sponsored by the Markle Foundation, was launched, a successful search for a Medievalist was conducted. Associate Professor James Buzard was promoted to tenure and Professor Henry Jenkins was appointed Ann Fetter Friedlaender Professor of Humanities. In the summer of 1998, renovations on the fourth floor of Building 14 began which will provide an integrated suite of headquarters offices for the Head of Literature, the Administrative Officer, the Administrative Assistant and secretarial staff. Literature will now have a much needed reception space for students and faculty, and we are grateful for the opportunity to serve MIT students and faculty more effectively in the new headquarters.

ACADEMIC PROGRAM AND STUDENT ENROLLMENT

During the past year, 959 students enrolled in Literature subjects, 13 were registered as Literature majors, 24 as minors, and 378 as concentrators in Literature for the HASS requirement. In addition, 8 students enrolled as majors in the Film and Media Studies major departure. Plans for a graduate program in this area, long in the making, were approved by the MIT Faculty at its May meeting. The Comparative Media Studies graduate program, offering an S.M. degree, will accept students in the Fall of 1999. Literature faculty, led by Professor Jenkins, have been instrumental in developing this new interdisciplinary program, along with faculty in FL&L, Writing and Humanistic Studies and the School of Architecture. The CMS program will extend Literature's longstanding commitment to the narrative and expressive media of the twentieth century, and will include subjects taught by Professors Jenkins, Peter Donaldson, David Thorburn, Associate Professor Diana Henderson, Assistant Professor Christina Klein and others. Literature has offered subjects in film and television as part of its own curriculum for many years, and more recently has offered subjects such as 21L708 Technologies of Humanism, in which new media are studied in conjunction with manuscript, print and theatrical forms. We welcome this extension of our work, and especially its humanistic and comparative focus. A number of Literature subjects will be offered for joint undergraduate/graduate credit as part of this initiative. A new subject, 21L010 Introduction to Textual Analysis, initially to be taught by Lecturer Wyn Kelley and jointly listed with Writing and Humanistic Studies, was approved this year. This subject will introduce students to focused textual study through in-class discussion and analysis, frequent writing and revision.

RESEARCH AND PUBLICATION

Professor Donaldson continues to work on the Shakespeare Electronic Archive which has now been installed at the Folger Shakespeare Library in Washington, D.C. The next phase will include a comprehensive collection of early Shakespeare quartos from the Huntington Library, an extensive digital film collection and a publically available web version of the Archive. The H.H. Furness Library of the University of Pennsylvania, Stanford University, and the Shakespeare Institute in Stratford, England, have joined MIT in plans to expand this digital resource. Professor Donaldson has also published articles in *Shakespeare the Movie,* ed. Lynda Boose and Richard Burt, *Electronic Text*, ed. Kathryn Sutherland, and the first peer reviewed online multimedia essay in Shakespeare studies, "Digital Archives and Sibylline Sentences: 'The Tempest' and the End of Books" in *Postmodern Culture* and a hypermedia essay "Let's Be Going: A Parent Reads GeekCereal" on the Media in Transition site. Professor Alvin Kibel is conducting research on literature and ethics, including environmental ethics, and on *fin de siecle* responses to technology. Professor Thorburn is continuing research on prime time television narrative of the 70s and 80s and has begun to publish on new media ("Web of Paradox" in *American Prospect*) . Professor Ruth Perry is completing her book on the family in eighteenth century English literature and has published several essays in *The Women's Review of Books*, *Crossings* and in several collections, including *L'education des femmes en Europe at en Amerique du nord de la renaissance a 1848*, ed. Guyon Leduc and *Women in the Eighteenth Century*, ed. Vivien Jones. Professor John Hildebidle published reviews in *Literature and the Arts* and continues to work on Irish literature and to write poems, stories and essays. Professor Stephen Tapscott's poetry has been reprinted in *Love Letters: An Anthology of Desire* and in *The Independent,* and an essay on Whitman appeared in *British and American Studies*. He is also translating the poetry of the recent Nobel Laureate Wislowa Szymborska and editing and translating the prose works of Gabriela Mistral. Professor Jenkins continues work on a book-length study of childhood in post-War American literature, film and media. He completed work on three anthologies: *The Children's Culture Reader* (NYU Press), *Hop on Pop: The Politics and Pleasures of Popular Culture* (coedited with T. McPherson and J. Shattuc, Duke University Press) and *From Barbie to Mortal Kombat* (coedited with Justine Cassell, MIT Press) and has published more than a dozen on-line essays on science fiction on the Media in Transition website. Associate Professor Mary

Fuller completed work on her second book on the literature of English travel and exploration in the sixteenth century, *Geography and Subjectivity: Travels and Identities in the English Renaissance.* Professor Buzard published articles in *Victorian Studies*, *Raritan* and *Modernism/Modernity* and continues work on his second book, a study of the "autoethnographic" impulse in nineteenth century British fiction. Professor Henderson published articles in *Renaissance Quarterly*, *Shakespeare the Movie*, ed. Lynda Boose and Richard Burt, and in *The New History of Early English Drama*, ed. David Kastan and John Cox. Assistant Professor Shankar Raman completed *Looking East: India in the Renaissance* and published an article in *Renaissance Drama* and "Performing Allegory" in *Allegorie: Zwischen Materialitat und Bedeutung.* Professor Klein has completed her book on Cold War Orientalism, and portions have been published in Japanese translation in *Doshisha Amerika Kenkyu*.

CONFERENCES AND INVITED ADDRESSES

Professor Donaldson gave the keynote address at the second international Teaching Shakespeare Conference of the National Council of Teachers of English in Chicago and delivered a series of lecture demonstrations at the Folger Shakespeare Library. Professor Perry gave the plenary address at a conference on eighteenth century literature at the University of Oregon. Members of the faculty have also presented their work at meetings of the American Studies Association, the Harvard Center for Literary and Cultural Studies, the MLA, the Shakespeare Association of America, the Group for Early Modern Cultural Studies, the Society for the History of Discoveries, the Camden Conference on Telecommunications, Rhode Island College, Radcliffe Women's Studies Consortium, Society for Cinema Studies, International Conference of the Marlowe Society, International Congress of the History of Science, The International Association for Irish Literature, the American Conference on Irish Studies. Literature faculty have also delivered public lectures and presentations at Wesleyan University, Doshisha University (Kyoto), University of Illinois, Indiana University, Vanderbilt University, University of California, Santa Cruz, University of Tennessee, Magee College (Derry, Northern Ireland), Duke University, CUNY Graduate School, University of Michigan, Cambridge University, Stonehill College, University of Liege, University of Nevada, Las Vegas, University of Massachusetts, University of Lisbon, University of Southampton (UK), University of Konstanz (Germany), and Columbia University.

SERVICE, GRANTS AND AWARDS

Professor Perry served as Head of the MIT Women's Studies Program and Chair of the Radcliffe Graduate Consortium in Women's Studies, and is president-elect of the American Society for Eighteenth Century Studies. Professor Jenkins serves as Director of Film and Media Studies at MIT and coordinator of the Comparative Media graduate initiative. Professor Thorburn is Chair of the MIT Communications Forum, and Director of the Media in Transition Project funded by the John and Mary R. Markle Foundation. Professor Buzard spent the year as resident Fellow of the National Humanities Institute in Research Triangle Park, N.C. Professor Raman holds a Research Fellowship at the University of Konstanz for 1997-98, as well as an Old Dominion Fellowship.

PERSONNEL

Janet Sahlstrom, Section Administrative Officer, resigned in 1997-98 to accept a position as Administrative Officer in Political Science, and Janice Ellertsen was appointed as her successor. Janice Ellertsen comes to us from Brain and Cognitive Sciences where she was Graduate Administrator, and she is warmly welcomed by faculty and staff. Professor Buzard was promoted to tenure beginning in July 1998. Professor Klein joined the faculty in 1997 as Assistant Professor for an initial three year term. Her interests include postcolonial literature, film, and the cultural history of the Cold War period and she is completing a book on images of Asia in American culture in the 1950s. James Cain, who completed his doctorate at Columbia, was appointed Assistant Professor of Literature for a three year appointment to begin in July, 1998. Dr. Cain is a Medievalist with strong credentials in classical languages and literatures. His dissertation deals with questions of performance and gender in the literary productions associated with Angevin kinship and court life in twelfth century England, and the role of literary and performance art in the creation of the courtly class.

Peter S. Donaldson

MUSIC AND THEATER ARTS

Music and Theater Arts continues to afford students at MIT the opportunity to experience the unique language and process of the arts in their integrity. The social and moral contexts of human experience also informs all our curricular and co-curricular offerings. Faculty and teaching staff help students understand art's particular demand for rigor and discipline, its non-quantitative standards of excellence and beauty. A strong, comprehensive program in both Music and Theater Arts, encompassing history, theory and performance--taught by a faculty and staff of the highest caliber whose ongoing professional activities inform their teaching--has been and will continue to be our hallmark. Because it is comprehensive, the academic program serves as a base for those who have the talent and desire to continue their education in Music or Theater beyond the undergraduate level.

HIGHLIGHTS OF THE YEAR

This year was the second under the leadership of Professor Peter Child as Section Head and of Associate Professor Janet Sonenberg as Director of Theater Arts. The music faculty completed a search for a new Music Director of the MIT Symphony Orchestra and selected Dante Anzolini, who will join the faculty as Assistant Professor on July 1. Opening ceremonies for the Endicott World Music Center took place during the 25th annual meeting of the Council for the Arts at MIT. The Center, a place of acoustic and aesthetic beauty, is already extensively used for world music classes and rehearsals, and for the storage of our African and Balinese instruments. Major performances this year included the January premier of *The Housewives of Mannheim* by Professor of Theater and Associate Provost for the Arts Alan Brody at the Boston Playwrights Theater. Assistant Professor Brenda Cotto-Escalera directed *Motherlands* at the Theater Offensive at the Boston Center for the Arts. The chamber ensemble SONOS, comprised of Bayla Keyes, violin; Professor Marcus Thompson, viola; Michael Richards, 'cello; and Senior Lecturer David Deveau, piano, presented a highly acclaimed performance of the three Piano Quartets of Brahms in June at Jordan Hall. A February piano recital by Senior Lecturer Deveau included music by Institute Professor John Harbison and a premiere by Professor Child. Assistant Professor James Makubuya gave his MIT debut as a professional performer of East African music with the Kiyira ensemble. MIT alumnus and internationally renowned cellist Carlos Prieto '59 returned to MIT to present a lecture-demonstration about the Bach 'Cello Suites and the history of the 'cello.

HONORS AND AWARDS

Professor Harbison was awarded one of the five annual Heinz awards by the Heinz Family Foundation. Class of 1949 Professor Ellen Harris was awarded membership in the American Academy of Arts and Sciences. Professor Makubuya was awarded the Class of 1948 Career Development Chair at MIT. Assistant Professors Cotto-Escalera and Thomas DeFrantz were awarded a grant from the Class of '51 Fund for Excellence in Education, the Class of '55 Fund for Excellence in Teaching, and the Class of '72 Fund for Educational Innovation to support their proposal to develop media applications in the teaching of theater. Steven Tistaert '98 (Major in Music and recipient of the Emerson Advanced Music Scholarship) received the Louis Sudler Prize in the Arts and Elaine Chew G (Recipient of the Emerson Advanced Music Scholarship) received the Laya and Jerome Wiesner Award.

PROGRAM HIGHLIGHTS

Enrollments in Music and Theater subjects dropped slightly this year to 1246 and 346, respectively, for a total of 1592. Professor Emeritus and Senior Lecturer David Epstein conducted his farewell concert with the MIT Symphony Orchestra in a performance of Beethoven's Ninth Symphony. The concert, presented before a capacity audience at Kresge Auditorium, was a highly successful collaboration with the MIT Chorus. A reception and ceremony in honor of Professor Epstein followed the concert at which he was appointed Senior Fellow of the Arts and Humanities by Dean Philip Khoury. An outstanding season of student chamber music concerts was capped by a performance of *Pierrot Lunaire*, a landmark work of the twentieth century by Arnold Schoenberg.

Theater Arts faculty and visiting scholars were active as directors of major student productions. Senior Lecturer Michael Ouellette directed Shakespeare's *Coriolanus*; Professor Sonenberg directed Tony Kushner's adaptation of Corneille's *The Illusion*; Professor DeFrantz directed the musical *Grand Hotel,* a production that involved significant collaboration with the Music Section; and Visiting Scholar Tony Simotes directed Shakespeare's *Macbeth.* Associate Provost Brody directed Playwrights in Performance in two evenings of one-act plays by MIT student playwrights.

ACHIEVEMENTS

The level of productivity by our faculty remained high. Professor Jeanne Bamberger was the invited speaker at the Seashore Symposium at the University of Iowa, guest lecturer at the University of South Florida and participated in workshops on teacher education in Washington D.C. and Copenhagen, Denmark. Professor Child had two new works premiered this year and performances included the Percussive Arts Society International Conference, the Boston Musica Viva, the Rockport Chamber Music Festival and the Brandeis Chamber Music Festival. Professor Harbison saw performances of his *Symphony No. 1* with the St. Louis Symphony, the *Viola Concerto* with the Chicago Sinfonietta, the *Concerto for Oboe, Clarinet and Strings* with the Metamorphosen Ensemble, the *Mirabai Songs* with Dawn Upshaw and Gilbert Kalish and *November 19, 1828* with the Mark Morris Dance Company. Professor Harbison was in residence at Ohio State University in February, the University of Alabama in March and at the Aspen Festival in June where he was Composer in Residence. Professor Harbison saw the release of new CD's including his *Suite for Solo 'Cello* on Deutsche Grammophon, *Violin Concerto* on Koch, *Olympic Dances* on Klavier and *San Antonio* and *Four Occasional Pieces* both on the Albany label. Professor Harris continues as Associate Editor of Musical Quarterly. She was faculty of Aston Magna Academy in July of 1997 where she presented three papers. She also presented papers at the International Musicological Society in England, the Hallische Handel Festival in Germany and the American Musicological Society in Phoenix. She has also completed 45 articles for the revised edition of the *Groves Dictionary of Music and Musicians.* Professor Lowell Lindgren delivered eight papers this past year at Oxford, England; Perugia, Italy; and Aston Magna Academy, Yale University. Professor Lindgren had papers published in *The Cambridge Companion to Handel* (Cambridge University Press), and in *Relazioni musicali tra Italia e Germania nell'eta barocca.* Professor Lindgren also chaired the seminar *Text, Reform and Drama in 17th century Italian Opera* at the annual meeting of the Royal Musical Association, New College, Oxford, UK. Professor Marcus Thompson played a concert of string sextets with members of the Cleveland Orchestra in Detroit, performed in Indianapolis with the Audubon String Quartet, in Phoenix and Houston with the Boston Chamber Music Society, and gave the Chicago premiere of Professor Harbison's Viola Concerto. His performances in Europe this year included a tour of Holland with the Amsterdam Chamber Music Society. Professor Thompson celebrated the 30th anniversary of his Boston recital debut with a performance at the Gardner Museum. Professor Cotto-Escalera is developing a new play *Teresias.* She was the respondent and documenter at Ayacucho 1998: International Group Theater Encounter, Ayacucho, Peru. She was a speaker at the Latin American Popular Theater conference in Glover, Vermont and the Redefining Theater History Conference at the University of Texas in Austin. Professor DeFrantz contributed the chapter *Stoned Soul Picnic: Alvin Ailey and the Struggle to Define Official Black Culture* to the book *Soul: Black Power, Politics, and Pleasure,* Monique Guillory and Richard C. Green, editors, NYU Press. He had three book reviews published in the Dance Critics' Association News. He lectured at the National Black Arts Festival in Atlanta, Georgia, at Duke University in Durham, North Carolina and at the National Museum of Dance, Saratoga Springs, New York. Professor DeFrantz is currently choreographing *Paul Robeson, All-American,* a new play by Ossie Davis. Professor Sonenberg continued her consultant work with the Hammerstein Entertainment Group. She presented the papers *Dreamwork and Acting* at the International University Theater Association in Montreal and *Toward a Field Understanding of Dreams* at the International Gestalt Conference in Cleveland. She lectured and taught master classes at Sam Christensen Studio in Los Angeles and continues work on her new book *Threshold of the Unconscious.* Professor Makubuya gave a concert performance and workshop at the World Music Institute Annenberg Center at the University of Philadelphia. He participated on the Triennial Conference Panel of the Arts Council of the African Studies Association and gave lecture-demonstrations at the Boston Museum of Fine Arts, New England Conservatory and the Amankwah Institute of Pan-African Cultures. Senior Lecturer Deveau continues as Artistic Director for the Rockport Chamber Music Festival. He did a series of performances with Richard Stoltzman, clarinet, and gave solo recitals in Ohio, Cambridge and Western Massachusetts. Lecturer Mark Harvey composed and premiered six new compositions with his jazz ensemble *Aardvark* and released his fourth CD recording with the group. Senior Lecturer Martin Marks was a McGregor Fellow Artist in Residence at Wabash College and received an Outstanding Academic Book award from *Choice* magazine for his book *Music and the Silent Film.* Senior Lecturer Ed Cohen traveled to St. Petersburg, Russia to attend performances of his Piano Sonata and Piano Trios at St. Petersburg Conservatory and to lecture on New Music from MIT. Lecturer William Cutter guest conducted at the Nova Scotia Music Festival Association and the Pennsylvania Music Educators Conference Choral Festival. Senior Lecturer George Ruckert gave performances at Connecticut State University, SUNY at Binghamton, New York, and the Nelson-Atkins Museum in Kansas City. In January he gave a series of eight performances in Calcutta, India.

PERSONNEL

Edward Darna retired from his position as Technical Director in Theater Arts after 34 years of service.

Music and Theater Arts affirms its commitment to diversity within its disciplines and among its staff. Eight members of our full-time faculty and teaching staff of twenty are under-represented minorities or women.

More information about Music and Theater Arts can be found on the World Wide Web at the following URL: http://mit.edu/mta/www/

Peter Child

PROGRAM IN WRITING AND HUMANISTIC STUDIES

The Program in Writing and Humanistic Studies is an interdisciplinary program concerned with writing as a means of communication of ideas, a means of creative expression, and a vehicle for exploring the cultural context of science and technology. Each year, approximately 900 undergraduates enroll in our subjects. Some subjects satisfy either Phase One or Phase Two of the Institute Writing Requirement.

In addition to its curriculum, the Program offers a number of cultural and literary activities to the MIT community. The distinguished critic Richard Eder was a Writer-in-Residence in the fall, taught a class in writing about the arts and spoke in our Writers Series in October. Also in our Writers Series, nature writer Edward Hoagland spoke in February and Writer-in-Residence Stephen Alter read from his recently published memoir, *All the Way to Heaven: an American Boyhood in the Himalayas,* in April. Poets Robert Creeley, Lisa Jarnot, Jennifer Moxley, Connie Deanovich, Charles North, Ann Lauterbach, and Joel Sloman spoke in our Poetry@ MIT series.

In research and writing, Professor Kenneth Manning continues to increase and document his large database on black physicians in his project on "Blacks in American Medicine, 1860-1980". Professor Anita Desai is completing a new work of fiction. Professor James Paradis co-authored an electronic handbook on writing (*The Mayfield Guide*) and continues his work on a biography of Samuel Butler. Professor Harriet Ritvo's new book, *The Platypus and the Mermaid and Other Figments of the Classifying Imagination*, was published by Harvard University Press in October 1997. Professor Cynthia Wolff continues work, under both a Guggenheim and a National Endowment for the Humanities grant, on a biography of Willa Cather. Professor Alan Lightman is completing a new novel. Associate Professor Susanne Klingenstein has completed her new book, *Enlarging America: The Cultural Work of Jewish Literary Scholars, 1930-1990*, which will be published by Syracuse University Press. Assistant Professor Helen Elaine Lee's new novel, *Water Marked*, will be published by Scribner in June 1999. Senior Lecturer Edward Barrett continues his work on the *Electronic Multimedia Online Textbook in Engineering Communication.* Writer-in-Residence Christopher Sawyer-Lauçanno is completing his research for a book on contemporary Yucatan. Writer-in-Residence William Corbett's memoir, *Furthering My Education,* was published in the summer of 1997 and *New York Literary Lights* was published in the spring of 1998.

In Institute service, Professor Paradis played a significant role in developing a new Undergraduate Communication Requirement, which the Institute faculty voted to explore in its May meeting. Professor Paradis serves on the CUP Subcommittee on the Communication Requirement, the Committee on the Writing Requirement, and the Committee on the Freshman Year Program.

In curricular matters, the Program will co-sponsor, with the Foreign Language and Literatures Section and the Literature faculty, a new Master's program in Comparative Media Studies. In another major project, the Program has received a Class of '51 development grant to restructure the Writing and Communication Center and to build a web site to promote Institute-wide tutoring in writing. The Program anticipates that this expanded center will help support increased communication instruction called for in a new Communication Requirement.

Professor Klingenstein has been promoted to associate professor without tenure. Professor Youngme Moon has left the Program for a position on the faculty of the Harvard Business School. The Program continues its national search for a distinguished science journalist. A new search for an assistant professor of technical communication will begin in the fall. The headship was transferred from Professor Lightman to Professor Paradis.

We had 50 percent women on our total staff and 58 percent women in our core faculty. We have three African-Americans in our teaching staff, a lecturer, an assistant professor, and a full professor.

More information about this Program can be found on the World Wide Web at the following URL:
http://web.mit.edu/humanistic/www

James Paradis

DEPARTMENT OF LINGUISTICS AND PHILOSOPHY

The Department of Linguistics and Philosophy is made up of two sections consisting of twenty-five faculty members (five of them jointly appointed), sixty-four graduate students, two dozen or so visiting scientists and scholars, an administrative officer, and seven support staff members. Each section operates quite independently of the other; yet between them there is a significant overlap of intellectual interests in education and research, both among the faculty, graduate students, visitors. In the most recent (1995) National Research Council rating of graduate programs in the United States, Linguistics and Philosophy were ranked first and tenth, respectively, on faculty quality: and second and seventh, respectively, on program effectiveness.

RESEARCH: LINGUISTICS

The linguists continue to pursue an account of natural language in terms of principles of computational economy. The Minimalist Program for Linguistics Theory, Optimality Theory, and the Theory of Distributed Morphology offer somewhat different yet sometimes complementary suggestions for the course that the pursuit might follow. These ideas continue to be explored, developed, and challenged in research on syntax, semantics, morphology, phonology, and on the interfaces between these modules of the grammar of natural language by MIT graduate students, faculty, and visitors.

Neurolinguistics research, in addition to rapidly developing work on language growth and use, is now a central piece of linguistics research at MIT, and has led directly to the Mind Articulation Project--a five year, joint MIT Linguistics/Tokyo University Physiology project supported by the Japan Science and Technology Corporation.

RESEARCH: PHILOSOPHY

Research in philosophy is not so neatly programmatic as it is in linguistics; thus it is best simply to list the wide range of topics pursued in current research in philosophy at MIT including but not exhausted by the following: theories of consciousness and the mind-body problem; causation and laws of nature; analysis of fundamental metaphysical concepts: substance, attribute, essence, set, identity, etc.; problems at the intersection of ethics and historical sociology; foundational questions of quantum physics; analysis of natural laws and their role within scientific theories; applied aesthetics; the foundations of "possible worlds" semantics for modal and conditional logics; the ontology of events; the identity across time of people and other physical objects; the principles of rationality governing ethical reasoning; and the role of evaluative thoughts in practical reasoning.

PUBLICATIONS

As in the past, the faculty on both sides of the department participated in a large number of colloquium and acted as keynote speakers at conferences and workshops in various parts of the United States and the world. They also published an equally large number of journal articles, book chapters, and reviews. In addition, the following books appeared during the year: Irene Heim's *Semantics in Generative Grammar*, Blackwell: Oxford, 1998 (co-authored with A. Kratzer); P. Barbosa, D. Fox, P. Hagstrom, M. McGinnis and D. Pesetsky (eds.) *Is the Best Good Enough*, MIT Press, 1998; George Boolos' *Logic, Logic, Logic*, Harvard University Press, 1998. In addition, there are several other books in progress.

HONORS AND AWARDS

Wayne O'Neil was awarded the George Watson Fellowship, The University of Queensland. Noam Chomsky was awarded an honorary degree from McGill University. David Pesetsky was appointed to the Advisory Committee for the Directorate of Social, Behavioral and Economic Sciences, at the National Science Foundation. He was also honored as "Education Partner," Portsmouth, New Hampshire School District. Ralph Wedgwood was awarded the Humanities Center Fellowship sponsored by The National Endowment for Humanities and the Andrew Mellon Foundation. Michel DeGraff is the recipient of the Levitan Prize in Humanities for his research project "Whence Language Creation Elucidating the Mental Processes Underlying Creole Genesis."

LEAVES OF ABSENCE

Prof. Wayne O'Neil was on sabbatical leave for the fall semester. Prof. Alex Byrne was on Old Dominion Leave for the fall semester. Prof. Edward Hall was on Old Dominion Leave for the spring semester.

PERSONNEL

It is with great pleasure that we note the promotion of Kai von Fintel to the rank of Associate Professor without tenure and the appointment of Assistant Prof. Alexander Byrne as the Class of 1947 Development Professorship. The appointments of Prof. Sally Haslanger and Prof. Stephne Yablo as Associate Professor with tenure in the Philosophy Section of the Department begin July 1, 1998.

With the appointment of Sally Haslanger, the representation of women on the faculty has increased to five. We are now within one appointment to reaching our revised affirmative action goal of six women on the faculty.

Robert Stalnaker

DEPARTMENT OF POLITICAL SCIENCE

The MIT Department of Political Science aims to offer a broad-based undergraduate curriculum in political science; provide graduate education and research training at the highest level of excellence; foster understanding and evaluation of political behavior, processes, and institutions by maintaining an environment in which faculty and advanced students can carry out original and outstanding research; contribute to the capacity of governmental and private organizations at the local, national, or international level to deal effectively and humanely with the issues they confront; and create a community within the Department of men and women—senior and junior scholars, students, and staff—that is rich and diverse in terms of gender, race, and national origin.

Each of these goals is important, but the key to success in all lies in recruiting, keeping, and nurturing an outstanding faculty, devoted both to research and teaching. Success in such recruitment will also play an essential role in restoring the Department to the very top ranks of the profession.

EDUCATIONAL INITIATIVES

MIT stands in a unique place in American higher education to combine the concerns of science and engineering with public service. The Department is helping MIT take the lead nationally in enhancing the education of technologically sophisticated undergraduates by exposing them to the practical world of politics and policymaking, while maintaining a high degree of academic rigor. Since 1994-95, we have provided a summer internship in Washington, DC for MIT students from across all disciplines. The internship's purpose is not to enhance job skills, like many internships, but rather to provide a closer and more realistic look at policymaking than is possible in classroom settings. Students are required to enroll in a new subject that introduces them to the contexts of policymaking. To date, forty students have been placed in such organizations as: the U.S. Department of Energy - Office of Fossil Energy, the U.S. Department of Commerce - Office of Technical Competitiveness, The White House - Office of Science and Technology, American Enterprise Institute - Economic Policy Division, The Heritage Foundation, and the American Association for World Health. Associate Professor Charles Stewart directs the program and teaches the substance of the spring semester material. That faculty member continues to be responsible for the seminar in the fall, but it is best if the weekly sessions focus on material presented with the help of an invited speaker drawn from the MIT faculty, in the area of that faculty member's expertise. This program allows MIT's technically-oriented students to see up close how institutions vital to their later success operate. And, it gives the federal government and other policymakers early access to the best young scientists and engineers in America.

Many new subjects were developed this past year on both the graduate and undergraduate level. Professor Suzanne Berger developed a new subject: "Globalization." Lecturer Margaret Burnham offered a new course on "Gender, Race and American Law." Assistant Professor Susan Giaimo offered a new graduate seminar: "State vs. Market in the Western Welfare State," and next year will offer a new undergraduate course: "Politics of Germany." Associate Professor Dan Kryder has a project underway to integrate audiotapes (recorded in the White House during the Kennedy, Johnson, and Nixon administrations) into an undergraduate course on the modern presidency. Associate Professor Kenneth Oye established the "Working Group on Chinese Environmental Issues," which is a biweekly research seminar integrating engineering and social science faculty and graduate students. Professor Richard Samuels offered a new graduate seminar on political change in Italy and Japan, and redesigned and offered the Junior Colloquium on Political Science. Professor Harvey Sapolsky has developed two summer professional institute subjects - one on security studies, the other on innovation - both of which will be offered during the summer session 1998. Assistant Professor Frederic Schaffer offered a new undergraduate subject: "The Politics of Change in the Third World" and a new graduate seminar: "Introduction to Contemporary African Politics." Assistant Professor Stuart White developed two new undergraduate subjects, "Ethics, Economy, and Social Policy" and "Foundations of Modern Political Thought."

We have also initiated discussions of a complete overhaul of our undergraduate curriculum, with an eye to making it more coherent, with clearer tracks through the program. And we have also begun discussions of a more crisply defined graduate track in political economy. We expect both discussions to result in proposals in the Fall term.

STUDENT RECRUITMENT, ENROLLMENT, AND PLACEMENT

The Department continues to compete successfully with other major departments in the recruitment of graduate students. We attracted an excellent class of incoming Ph.D. students. Of the 11 students who accepted our offer of admission, three are female, and seven are international students. The Department will also enroll eleven Masters students in September 1998.

Our graduating doctoral students continued to find positions at leading research universities and institutions such as Princeton University, Harvard University, University of Maryland, the Council on Foreign Relations, Rand Corporation, and leading institutions in Europe and Asia.

Undergraduate enrollments declined very slightly in 1997-98 to 779 from 783 in 1996-97, while the number of undergraduate majors was 30. There were 28 minors, and 42 concentrators. Graduate student enrollment for 1997-98 was 120.

FACULTY

Two new Assistant Professors and one tenured Associate Professor joined the Department effective July 1, 1998. Assistant Professor Brandice Canes, from Stanford University, joined the Department in the field of American Politics and Public Policy. Assistant Professor Chappell Lawson, from Stanford University, works on comparative politics, with a particular interest in the effects of technology on regime change. Associate Professor Thomas Christensen, from Cornell University, is primarily interested in Security Studies/Asian Studies.

Professor Daniel Kryder, who specializes in American Politics, has been promoted to Associate Professor, effective July 1, 1998.

Increasing the presence of minorities and women in the Department remains a major concern. All three search committees this past year made special efforts to identify outstanding women and minority candidates. The Department received and reviewed a total of 455 applications for three open positions. Of those, 122 were women and 15 were minorities. Out of nine finalists invited to present seminars, six were women.

Search committees in the areas of Technology and Politics, Comparative Politics, and International Political Economy have formed and will evaluate potential candidates at both the junior and senior level during the coming academic year.

Faculty research activities include:

- "The Legislative Connection in Campaign Finance," and "The Dynamics of Party Positions," both with Professor James Snyder; and "Candidate Positions in Congressional Elections" with Professors Snyder and Stewart (Associate Professor Stephen Ansolabehere)
- "Project on Globalization" (Professor Berger)
- "The Joys of Busting Rocks: Massachusetts Prisons" (Dr. Burnham)
- "Deliberative Democracy," and "Democracy and Decentralization" (Professor Joshua Cohen)
- "Chinese Environmental Policy Implementation in Industry Boiler Sector," and "Corporate Reform in Chinese State Industry" (Assistant Professor Zhiyuan Cui)
- "Health Care Reform in Britain, Germany, and the United States" (Professor Susan Giaimo)
- "Dividend Arsenal" on race conflict and policy during WWII, and "Comparison of the Transition from Domestic Reform to War in the Presidencies of Woodrow Wilson (from the New Freedom to World War I), Franklin Roosevelt (from the New Deal to World War II), Harry Truman (from the Fair Deal to the Korean War), and Lyndon Johnson (from the Great Society to the Vietnam War)" (Professor Kryder)
- "Building Trust in a Rent-Seeking World: Political Strategies for Economic Development in Eastern Germany, Southern Italy and Northwest Brazil" (with Professor Judith Tendler in Northeast Brazil), and "Reconstructing America's Labor Market Institutes" (with Professors Tom Kordan, Michael Piore and Paul Osterman), and "International Changes in Industrial Innovation: Consequences for the American and German Research System" (with Professors Lester and Roberts) (Associate Professor Richard Locke)
- "Truth Commissions" (Assistant Professor Melissa Nobles)
- "Underprovision of Compensation," "Trade and Regulation," "Regionalization and Trade" and "Environmental Aid and Coal Combustion in China," with Professor Cui (Professor Oye)

- "Innovation in the US Army, 1970-1980" (Professor Barry Posen)
- "Energy and Security in Asia," "Leadership in Italian and Japanese History," and Theater Missile Defense in US-Japan Relations" (Professor Samuels)
- "A Study on Innovation in Antisubmarine Warfare during the Cold War," "The Political Economy of Defense," "A Study of Scientific Credibility in Environmental Disputes," and "A Study of Comprehensive Bloodbanking Policy" (Professor Sapolsky)
- "Can Freedom be Destroyed? Lessons from the Nazi Death Camps," "One-sided Diets, False Twins, and Other Pitfalls of Conceptual Reconstruction," and "Why Don't Political Scientists Coin More New Terms?" (Professor Schaffer)
- "Estimating Party Influence in Congressional Roll-Call Voting," "Referendums, Initiatives, and Legislative Partisanship" with PhD candidate Jeffrey Lewis; "The Relationship Between the Legislative Activity of Members of Congress and Interest-Group Campaign Contributions," and "The Electoral Benefits and Costs to Members of Congress for Supporting or Opposing the President," both with Professor Ansolabehere; and "The Legislative Connection in Congressional Campaign Finance," "Formal Models of Spatial Electoral Competition," and "Measuring the Extent to Which Money Buys Access" (Professor Snyder)
- "Politics of Climate Change" and "Science in the State Department" (Professor Skolnikoff)
- "Causes of War" (Associate Professor Stephen Van Evera)
- "The Civic Minimum; on Socio-Economic Rights," "Freedom of Association," "Religious Associations and Employment Discrimination," "The Future of Social Democracy in Europe and the So-Called 'Third Way'" (Professor White)

Political Science faculty continue to be prolific publishers of books and articles. Here we can list only a few. Professor Ansolabehere contributed four chapters in three forthcoming books: "Money and Office" in *Continuity and Change in Congressional Elections,* Stanford University Press; "Messages Forgotten: Misreporting in Surveys and the Mismeasure of Effects of Advertising" in *Political Advertising in Election Campaigns*; "Campaigns as Experiments" and "The Paradox of Minimal Effects" in *Do Campaigns Matter?* University of Michigan Press. A Chinese edition of Professor Berger' book (with Richard Lester) *Made by Hong Kong* is forthcoming, as is an Italian edition of her book *National Diversity and Global Capitalism,* Il Mulino.

Dr. Burnham contributed an article to the *Michigan Journal of Race and Law*. Professor Cohen has five edited collections forthcoming—*Representing Us All, The New Inequality, MetroFutures*, and *Money/Politcs* (all from Beacon Press, as part of the New Democracy Forum series), and *Feminism and Multiculturalism* (Princeton University Press); three of his articles have recently appeared, on "Democracy and Liberty," "Globalization and Equality," and "Directly-Deliberative Polyarchy." He has continued to serve as Associate Editor of *Philosophy of Public Affairs* and as Editor-in-Chief of *Boston Review*. Professor Giaimo co-authored a chapter for the book *Comparative Political Studies* (forthcoming), wrote a chapter for the book *The New Politics of the Welfare State* (forthcoming), and wrote "Cost Containment vs Solidarity in the Welfare State: the Case of German and American Health Care Reform," AICGS Working Paper #6.

Professor Locke co-authored articles forthcoming in the *European Journal of Industrial Relations*, and in *APSA-CP*, and co-authored chapters in the books *The Changing Place of Labor in European Society* (Berglahn Books) and *Negotiating the New Germany* (Ithaca: Lowell University Press), and wrote a chapter for *Hedging Bets on Growth in a Globalizing Industrial Order* (Seoul: Korea Development Institute). Professor Posen's work appeared in *Migrants, Refugees, and Foreign Policy* (Oxford: Berghahn Books), and he co-authored a chapter in *America's Strategic Choices,* an *International Security* reader.

Professor Samuels wrote a chapter for *The Japan Handbook* (London: Fitzroy Dearborn) and co-authored chapters in the forthcoming books *The U.S.-Japan Alliance: Past, Present, and Future* (Council on Foreign Relations) and *Unipolar Politics: Realism and State Strategies after the Cold War* (Columbia University Press). He also contributed an article to *Journal of Modern Italian Studies*. Professor Sapolsky wrote and co-authored several articles with several graduate students in the MIT Security Studies Program that appeared in the journals *Submarine Review, The Wall Street Journal,* and *Financial Times.* Professor Schaffer's *Democracy in Translation: Understanding Politics in an Unfamiliar Culture* has just appeared from Cornell University Press. Professor Eugene Skolnikoff co-authored *The Implementation and Effectiveness of International Environmental Commitments: Theory and Practice* (MIT Press).

Professor Van Evera completed *Causes of War, Volume I: The Structure of Power and the Roots of War* (forthcoming from Cornell University Press). He also contributed an article to the journal *International Security*, co-authored an article for *Security Studies* and co-authored a chapter for the *Oxford Companion to Military History*.

Professor Myron Weiner is co-editor of the books *Temporary Workers or Future Citizens: Japanese and U.S. Migration Policies* (NYU Press) and *People on the Move: International experiences of migration and refugee policies, and a South African case study* (Cassell Academic Press), and wrote a chapter *for Business and Democracy: Cohabitation or Contradiction* (Cassell Academic Press). He also authored articles that will be forthcoming in the *Journal of Policy Reform* and the *Journal of Refugee Studies*. Professor White's articles appeared in *The Journal of Political Philosophy, The British Journal of Political Science,* and *Renewal.* He also contributed a chapter to *Freedom of Association* (forthcoming, Princeton University Press, Fall 1998).

The Department's faculty continue to give many invited lectures, appear at conferences, serve on boards of professional organizations and editorial boards, in addition to serving as advisors for government, private, and international organizations and agencies. Professor Ansolabehere, with Professors Skolnikoff and Canizares, organizes the Senior Congressional Staff Seminar. Professor Berger completed her term as APSA Vice President. Professor Berger also, along with Professor Samuels, received a $6 million gift endowment from the Starr Foundation for Asian Studies at MIT. Professor Locke was appointed Associate Director of the MIT Industrial Performance Center. Professor Oye received the MIT Graduate Student Council Teaching Award. He is also a Trustee of the World Peace Foundation. Professor Samuels has been invited to be a Visiting Professor at the University of Tokyo, Spring 2000. Professor Weiner was re-appointed chair of the External Research and Advisory Committee of the United Nations High Commissioner for Refugees, Geneva. Professor Weiner also continued to serve as a delegate of the American Academy of Arts and Sciences to the American Council of Learned Societies.

Joshua Cohen

PROGRAM IN SCIENCE, TECHNOLOGY, AND SOCIETY

The 1997-98 year was one of changes and productivity in many different STS arenas. We graduated one new Ph.D., Ms. Rebecca Herzig, who accepted a job at Bates College. We hired two new junior faculty. In one search we received 113 applications, interviewed five finalists, and selected Dr. Jessica Riskin (Ph.D. Berkeley, formerly assistant professor at Iowa State, and this past year a Dibner Fellow) as Assistant Professor and the first holder of new Leo Marx Career Development Chair in the History and Culture of Science and Technology. In the other search, we received 136 applications, interviewed four finalists, and selected Dr. Joseph Dumit (Ph.D., University of California at Santa Cruz, formerly a postdoctoral fellow at Harvard's Department of Social Medicine and a lecturer in MIT's Anthropology Department, and this past year a Dibner Fellow) as Assistant Professor of Anthropology and Science and Technology Studies. We made two promotions: Associate Professor Evelynn Hammonds to tenure, and Associate Professor Louis L. Bucciarelli to Full Professor (joint with the School of Engineering). We hired a new Director for the Knight Science Journalism Fellowship Program: Mr. Boyce Rensberger from the *Washington Post.* Our new Core Course for graduate students went through its second iteration. Assistant Professor David Mindell, who joined our faculty last year as the Francis and David Dibner Assistant Professor of the History of Manufacturing and Engineering, successfully mounted, together with Professor Charles Leiserson of Course 6, a major new subject, "The Structure of Engineering Revolutions." We had a stellar colloquium series, including the annual Miller Lecture on Science and Ethics, delivered by Professor Hammonds, and student-organized brown bag discussions. Most importantly we pursued a series of new research agendas through a number of ongoing workshops on: risk and high hazard technologies (led by Dr. Constance Perin, Professor Mindell, and Professor Michael M.J. Fischer); race and science (led by Professor Hammonds); deep water archeology (led by Professor Mindell); environmental cleanup (led by Professor Emeritus Charles Weiner and Professor Fischer); and ethical issues in the biosciences and biotechnologies [led by Professor Fischer and Professors Byron and MaryJo Good (Harvard University, Department of Social Medicine)].

DOCTORAL PROGRAM

In its tenth year, the History and Social Study of Science and Technology (HSSST) Doctoral Program (a collaborative venture of STS, the History Faculty, and the Anthropology Program) continued to develop in a satisfactory way. One student completed her Ph.D. and immediately obtained a job; three others passed their General Exams. Present and incoming students received a variety of grants and fellowships, including fellowships from the Dibner Institute, the Spencer Foundation, and the Environmental Protection Agency (EPA).

The HSSST Doctoral Program received 54 applications for the 1998-99 academic year. Three students accepted. This was an odd year, and for idiosyncratic reasons, our initial four top choices did not accept our offer (one choosing to put off graduate school entirely; another choosing between STS, medical school and English, in the end chose English; a third choosing to go where his spouse had an offer; and the fourth after agonizing for weeks chose to go to a place that could offer graduate training in English as well as History of Science). The three students to whom we did offer placements and who accepted our offer, however, are among the original short list and promise a superb and interesting freshman class. One is a minority woman engineer moving towards history of technology; another is a Viennese trained Turkish woman interested in biotechnology in the Muslim world; the third is an Oxford trained Indian biochemist interested in science and development in India.

This was the second year of the Core Course (STS.201/202) proposed at the spring 1996 Faculty Retreat and first taught last year. Built around substantive topics ranging from the scientific revolution of the seventeenth century to the molecular biology revolution, the computer revolution, and environmental issues, the Core Course is an attempt to bring into juxtaposition the different methods and frameworks of the several disciplines that make up the HSSST Program, and thereby to work out, by doing, the distinctive ethos of this interdisciplinary program.

In an on-going plan to stage graduate courses among the Core Course, foundation courses, and electives, next year's required introductory sequence will consist of foundation courses in historiography and anthropology/social theory, along with a one-semester integrative Core Course at the start of the students' second year.

HSSST Graduate Students Ms. Hannah Landecker, Mr. Chris Kelty, and Mr. Ted Metcalfe helped run and participated in the Cultural Studies of Science Seminar Series at the Harvard Center for Literary and Cultural Studies. Professor Fischer was the faculty coordinator from MIT.

PROJECTS, GRANTS, AND INITIATIVES

Professor Bucciarelli received a grant of $47,485 from France-Telecom to consider a comparative study of the development and use of applications related to Telemedicine in France and in the USA. He will be assisted on this project by HSSST doctoral student Mr. Kelty.

Professor Kenneth Keniston received three grants to support his research on cultural aspects of software localization. The NEC Corporation (via the Provost's MIT Research Support Committee) awarded Professor Keniston $60,000; the Provost's HASS Fund awarded $19,688 and Professor Keniston also received a start-up grant of $10,000 from the Mustard Seed Foundation for this work.

Professor Mindell received three grants to support his research on technology, archaeology and the deep sea. The Wade Fund (via the Provost's MIT Research Support Committee) awarded a grant of $50,000; Professor Mindell has also received $25,000 from the Kaplan Foundation and $41,000 from the National Science Foundation (NSF).

Work continued on the history textbook project, "Integrating the American Past: A New Narrative History of the United States," which is funded by the Alfred P. Sloan Foundation (grant total: $1.754 million over eight years). The project is headed by Professor Merritt Roe Smith and includes Professors Pauline Maier (MIT), Daniel Kevles (California Institute of Technology), and Alex Keyssar (Duke University) as primary authors.

EDUCATIONAL ACTIVITIES

The STS Program offered 18 undergraduate subjects and 25 graduate subjects. Undergraduate enrollments totaled 344 (fall 160; spring 184). During the 1997-98 academic year there were 5 majors, 3 minors, and 41 concentrators representing the Classes of 1998-2001.

New undergraduate subjects offered in 1997-98 included "History of Manufacturing" (STS.033/STS.275), taught by Professor Smith; "Analog to Agents: The History of Computing" (STS.035), taught by Professor Mindell; "Down and Dirty: Technical Experts, Citizens, and Cleanup Controversies" (STS.095), taught by Professors Fischer and Weiner. New graduate subjects included "The Structure of Engineering Revolutions" (STS.185J), offered by Professors Mindell and Leiserson; and "Research Seminar in the History of Technology" (STS.930-931), offered by Professor Smith.

SPECIAL EVENTS

The 1997 Siegel Prize for the best work by an MIT student in science, technology, and society was shared by Ms. Diane Greco, a fifth year doctoral student in HSSST for her paper "Unspeakable Practices? On the Communicability of Practical Knowledge During the Rise of the British Magnetic Crusade"; and Rob Martello, a third year doctoral student in HSSST for his paper, "Paul Revere's Last Ride: The Road to Rolling Copper." Both of these papers were published as *STS Working Papers.* The annual Miller Lecture on Science and Ethics was delivered by Professor Hammonds. In May, a retirement dinner was held for Mr. Victor McElheny, Director of the Knight Science Journalism Fellowship Program, whose MIT affiliation will continue next year as a Visiting Scholar in STS.

COLLOQUIA SERIES AND SPECIAL LECTURES

In its eighth year, the STS Colloquia Series, headed this year by Professor Fischer, continued to be a core activity of the HSSST Doctoral Program. The series comprised 27 speakers from such institutions as the Universities of Pennsylvania, Maastricht, Wisconsin, Louisiana State, Johns Hopkins, Texas Medical Branch at Galveston, Chicago, Cornell, Delhi School of Economics, National Railway Museum (York, England), MIT and Harvard, and covered a wide range of topics from "The Three Gorges and the Central Artery Project," "Nuclear Fusion," "Race, Gender, and Medical Biography," "Art as Medicine, Medicine as Art," "Quantum Teleportation," "The Early History of the Electronic Music Synthesizer," and "The Birth of Scientific Expert Testimony." A series of brown bag lunches on graduate student and postdoctoral projects at other universities were organized by students in the cultural studies of science (on the history of prostheses by Mr. Matthew Price of Stanford University, on the history of prostheses and anomalies in medicine and dentistry by Dr. Edward Seldin of MIT and the Massachusetts General Hospital, on the sociology of acoustics research in Denmark by Mr. Mads Borupof the Technical University of Denmark, Lyngby, and on the environmental history of Germany by Ms. Alexandra Schmidt of Christian-Albrechts-Universitaet in Kiel, Germany) and by the students in the history of technology (on the history of prostheses by Mr.

David Serlin of New York University, and on the history of shipbuilding by Professor David McGee of the Dibner Institute).

On-going workshops were a major vehicle for developing new research agendas this year:

The workshop on Control in Contexts: High Hazard Technologies in Operation, for instance, was an effort to think through the changing worlds of safety in such high technology industries as aviation, nuclear power, chemical processing, anesthesiology and surgery, and software design. Presentations were made by Dr. David Gaba (Stanford Medical School), Mr. Robert N. Buck (former senior pilot for TWA), Professor John Hansman (MIT, Aeronautics and Astronautics), Mr. Barry Strauch (Chief of Human Performance Section, Aviation Division of the National Transportation Safety Board), Mr. David Lochbaum (nuclear engineer, Union of Concern Scientists), Dr. Elizabeth Drake (Associate Director of MIT's Energy Lab, member National Stockpile Committee of the NRC), Mr. Bernard Fourest (Chief, Nuclear Safety Department, Electricite de France), and Professor Emeritus Leon Trilling (MIT, STS).

The Race and Science Workshop continued in its second year establishing a bibliography, sorting through the conceptual issues in the literature, and creating a community of scholars on the ways in which racial categories bedevil scientific arguments even where race as an analytic category is disavowed.

The Deep Water Archeology Working Group began monthly meetings this spring on the background, new methodologies and instruments, and future plans for the series of Black Sea Trade Route surveys, land and sea excavations.

Down and Dirty: Technical Experts, Citizens, Cleanup Controversies, designed as a workshop-course, brought together technical experts, community activists, and government regulatory agencies involved particularly at two well-known Massachusetts sites, Woburn (drinking water contamination, childhood leukemia) and Cape Cod [Massachusetts Military Reservation (MMR) Superfund site, breast and prostate cancers]. Participants included five current or recent MIT and Harvard graduate students in environmental engineering (Ms. Nicole Keon, Mr. David Senn, Mr. Winston Yu, Mr. Scott Hassell, Mr. James Hamilton) along with two of their professors (Assistant Professors Bettina Voelker and Charles Harvey), Ms. Gretchen Latowsky [former organizer of For a Cleaner Environment (FACE), the citizens' organization in Woburn, currently with the John Snow, Inc.], Dr. Richard Clapp (Boston University School of Public Health), Mr. James Murphy (EPA Superfund Community Involvement Coordinator); Ms. Maryann Weygan, Ms. Kathy Engel, and Dr. Joel Feigenbaum (members of the Community Advisory Panel, Massachusetts Military Reservation Superfund Site); Mr. Paul Rifkin (Cape Cod filmmaker); Dr. Robin Wagner [Agency for Toxic Substances and Disease Registry (ATSDR) epidemiologist], Dr. Julia Brody (Director, Silent Spring Institute), Dr. Robert Knorr (Massachusetts Department of Public Health epidemiologist), Dr. Louise Ryan and Dr. Marvin Zelen (biostatisticians, Harvard School of Public Health); Dr. Dale Hattis (Center for Environmental Research, Clark University); and Professor David Marks (Director, MIT Center for Environmental Initiatives).

Social and Ethical Issues in the Biosciences and Biotechnologies is also a workshop-course, taught at the Harvard Medical School in the joint MIT-Harvard Health, Science, Technology (HST) Program. Presentations included such topics as the changing political economy of medical science (by Dr. Michael Rosenblatt, Master of the HST track; Dr. Michael Zinner, Chief of Surgery, Brigham and Women's Hospital); the life course of genetics product development (Dr. James Kaye, Genetics Institute); zenotransplantation, its risks and ethical dilemmas (Dr. Fritz Bach, Beth Israel Hospital); Magnetic Resonance Imaging (MRI) guided therapy and craniotomies (Dr. Ferenc Jolesz, Brigham and Women's Hospital); lasers and minimally invasive coronary surgery (Dr. Sari Aranki, Brigham and Women's); thalasemia and the dilemmas of clinical science (Dr. David Nathan, Director, Dana- Farber Cancer Institute); the shaping of molecular biology and genomics by information theory (Dr. Lily Kay, historian of biology); the use of molecular biology for targeting mental illness (Dr. Bruce Cohen, Director, McLean Hospital); art as medicine, medicine as art (Dr. Eric Avery, psychiatrist and artist, University of Texas Medical Branch, Galveston); and nanotechnology and biomedicine (Professor Ian Hunter, MIT).

The India/South Asia Forum, convened by Dr. Abha Sur, a Visiting Scholar in STS, is a nascent working group on science and technology in India and South Asia. Initial meetings focused on flaws in economic development

assumptions (led by Professor Abhijit Banerjee, Economics, MIT), computer software localization (led by Professor Keniston, STS, MIT), and nuclear tests in India and Pakistan (led by Visiting Professor Parviz Hoodbhoy, University of Maryland).

OTHER ACTIVITIES

The *STS Newsletter's* fall issue focused on issues of science journalism and the public intellectual; and a report on the Dibner Institute workshops on "scientific entities." The spring issue focused on the new course "The Structure of Engineering Revolutions" and the on-going STS workshops. Two new *STS Working Papers* appeared by Siegel Prize winners Ms. Greco and Mr. Martello.

KNIGHT SCIENCE JOURNALISM FELLOWSHIP PROGRAM

Now entering their sixteenth year, the Knight Fellowships continue to attract science journalists from around the world to MIT to learn more about the research and innovation they cover. The sixteenth class of Fellows includes six journalists from the United States, one from Germany and one from India. During their nine months on campus, Fellows attend over 60 seminars with faculty, which are specially organized for them, as well as other seminars and workshops devoted to science and technology and their wider impacts. The Fellowships are supported by an endowment contributed by the John S. and James L. Knight Foundation of Miami and by alumni and foundation gifts. Mr. Rensberger, formerly of the *Washington Post*, begins his duties as new director on July 1, following the retirement of founding director Mr. McElheny. Rensberger's most recent book, *Life Itself: Exploring the Realm of the Living Cell*, was published by Oxford University Press in 1997. More information about the Knight Science Journalism Fellowships can be found at the following URL: http://web.mit.edu/ksjf/www/

FACULTY ACTIVITIES

Professor Jed Buchwald taught one course and supervised two graduate students. He edited and wrote an introduction for volume 33 of the journal *Physics*, wrote an article on Hertz, co-authored an article on Thomas Kuhn, and wrote an article for the MacMillan Encyclopedia of Physics on the "Origins of the Wave Theory of Light." He served as a Housemaster, and member of the MIT Museum Board. He became a member of the Einstein Papers Board of Trustees. For the Dibner Institute, he organized a symposium on Thomas Kuhn, and a reunion seminar of talks at Endicott House. He gave talks at a Sloan conference in Toronto, the American Physical Society, the Seven Pines Symposium, on the Ira Flato show on National Public Radio, and at the Dibner conference on Thomas Kuhn.

Professor Fischer co-taught five subjects, coordinated the Core Course for the graduate program, coordinated the Colloquium series, took an active editorial board role in three journals [*Late Editions*, *Public Culture*, *International Journal of Middle East Studies* (*IJMES*)], was a wrap up commentator at two day-long or multiple-day conferences (at Stanford, at the American Anthropological Association meetings in Washington, DC), gave colloquia at Witwaterstrand and Cape Town Universities, published five encyclopedia essays ("Functionalism," "Structuralism," "Interpretive Anthropology," "Critical Anthropology," "Postmodern Anthropology"), a film review essay (on Jean Rouch and Manthia Diawara), and two book review essays (on anthropological theory; on science studies); wrote two articles ("Worlding Cyberspace," "Before Going Digital/Double Digit/Y2000, A Retrospective of Late Editions,") and was the primary drafter of a co-authored introduction for the second edition of *Anthropology as Cultural Critique*. Last August, he also co-taught both undergraduate and graduate courses for two weeks at the Department of Social Anthropology, University of Cape Town. He chaired a search committee and an inter-school promotion committee, oversaw a second search committee, and served on a third search committee.

Associate Professor Deborah Fitzgerald taught three subjects, helped coordinate the fall Core Course for the HSSST graduate students, served as Director of Graduate Studies, served on four dissertation committees; lectured at the Swedish Royal Institute of Technology (Stockholm), Linkoeping University, and Trondheim University; participated in an NSF History of Science conference in Kiev, Ukraine; served on the Dexter Prize Committee (best book in the History of Technology). She served on five MIT Institute committees (Discipline, Writing Requirement, MIT Press, HASS-Equal Opportunity Committee, Women and Minority Faculty Initiative).

Professor Loren Graham, on leave during 1997-98, continued to supervise two doctoral students, served on a search committee, chaired a promotion committee, and gave an STS Colloquium. He published one book in English, *What Have We Learned About Science and Technology from the Russian Experience* (Stanford), an article ("Russia,

Science and Social Constructivism") and a book in Russian (*Outline of the History of Russian and Soviet Science*), and his *A Face in the Rock; The Tale of a Grand Island Chippewa* came out in paperback. A book in English (*Moscow Stories*) is under contract, as is a 12,000 word essay for the Cambridge History of Science, and a Chinese translation of *Science in Russia and the Soviet Union: A Short History*. He administers grants from the Sloan Foundation, MacArthur Foundation, and NEH; is a member of the advisory committee of the MacArthur Project on Joint Foundation Support for Russian Science and Higher Education; chairs the Selection Committee, Individual Grants in the Former Soviet Union for the MacArthur Foundation, and is a member of the selection committee of the James S. McDonnell Centennial Fellowships. He gave four conference presentations and served on the advisory boards of three professional societies. He conducted a historical tour of local sites and gave a book reading to 80 sixth graders and fifteen adults in Munising, Michigan; and a second book reading at the Munising Public Library. He gave an address to the annual meeting of the Great Lakes Lighthouse Keepers Association, Munising, Michigan.

Associate Professor Hugh Gusterson was on leave during 1997-98. He spent the year at Stanford University drafting a new book. In the fall, he set up a web-page debate forum on the nuclear stockpile policies of the United States, a project technically designed and run by HSSST graduate student, Dr. Babak Ashrafi.

Professor Hammonds was promoted to tenure effective February 1998. She taught four subjects, helped coordinate the fall and spring Core Course for the HSSST graduate students, ran the monthly Workshop on Race in Science, Medicine and Technology, delivered the Arthur Miller Lecture in Ethics and Science at MIT, delivered the William Snow Miller Memorial Lecture at the Department of the History of Medicine, University of Wisconsin, gave a keynote address at Spellman College, was part of a keynote panel at the National Women's Studies Association Meetings, lectured or delivered papers at the University of Illinois-Chicago, UCLA, Northeastern University, the Massachusetts Department of Public Health AIDS Bureau, and the MIT Biology Department. She wrote an article, two reviews, and drafted an introduction for a new book. She served on four MIT committees (Search Committee for new Undergraduate Dean of Admissions; Women's Studies Steering Committee; HSSST Steering Committee, STS; Radcliffe Graduate Consortium in Women's Studies Board and Admissions Committee). She also served as a consultant to NSF, the American Association of Colleges and Universities, and the Women and Scientific Literacy Project.

Professor Evelyn Fox Keller was on leave spring term 1998. In the fall, she taught two courses, as well as one three week module of the HSSST Core Course on modern biology. She serves on two dissertation committees, and supervised a UROP student. She served on a search committee, the Siegel Prize Committee, and the Women's Studies Steering Committee. She organized three workshops and spoke at five conferences. She published two articles ("Developmental Biology as a Feminist Cause," "Explanation in Developmental Biology"), co-authored a third ("Writing and Reading about Dolly"), and wrote five more articles currently in press. A German edition of her book, *Refiguring Life*, was published.

Professor Keniston published an article on "Politics, Culture and Software" in the *Economic and Political Weekly* (Bombay), and in the *Himal Magazine* (Kathmandu), and "Legere, Contare e Consocere il Mondo" in the Italian edition of *Technology Review*. He received grants from the NEC Fund (MIT), the Provost Fund (MIT), and the Mustard Seed Foundation. He coordinates the India Student Project in Pune, India, a project for MIT students to help with computer connections and literacy in an Indian high school. He participated in site visits at King Fahd University (Saudi Arabia) and the Malaysian University of Science and Technology. He spoke in Bangalore ("Why Indians Can't Compute"), Delhi (on vernacular computing), Kathmandu ("The Forgotten 95% in South Asia"), Torino ("Crisis in Engineering Education"), and Tokyo ("The Information Age").

Professor Mindell completed a book manuscript, *Deadly Gripe of Science: Technology, War and Experience aboard the USS Monitor* (in press, Johns Hopkins), an article ("Beasts and Systems: Taming and Stability in the History of Control"), two co-authored articles, and a review. He is currently working on a book, *A History of Control Systems* (also under contract at Johns Hopkins). He was co-principal investigator on two underwater archeology expeditions (Skerki Bank, in the Mediterranean; Midway Expedition to locate and film the wreck of the USS Yorktown). He presented talks at the Rochester Museum and Science Center, the Boston University Conference on Remote Sensing in Archeology, and the Society for Historical Archeology. He won three major grants from the MIT Wade fund, the J. M. Kaplan Fund, and the NSF. He organized and co-taught an innovative new subject in Course 6 and STS, "The Structure of Engineering Revolutions"; as well as a new subject on the history of computing. He also taught a

freshman seminar, and co-taught a module on computing in the HSSST Core Course. He serves as Book Review Editor, *IEEE Technology and Society Magazine*; as a Visiting Scientist at Woods Hole Oceanographic Institution, Deep Submergence Laboratory, and Adjunct Researcher at the Institute for Exploration (Mystic, CT). He is the convener of the Deep Water Archeology Working Group. He served on the HSSST Doctoral Program Admissions committee, the STS Committee on Undergraduate Education, as advisor to one STS undergraduate, and two HSSST graduate students.

Professor Theodore A. Postol co-authored five articles and taught three subjects on technology and policy of weapons systems. He serves as co-organizer of the Security Studies Program's Technology, Defense and Arms Control Seminar Series; and is a member of the Lincoln Laboratory/Campus Interaction Committee. He serves on the editorial boards of International Security, and Science and Global Security. He is a consultant to the Department of Energy's Office of Nonproliferation and National Security, and a member of the Scientific Review Board of Brookhaven National Laboratory. He spoke at workshops on missile defense at Stanford, at the Royal United Services Institute for Defense in London, and at a conference on Start III in Cambridge, MA.

Professor Smith was on leave spring term 1998. In the fall he taught two STS courses. He was the primary thesis advisor for six HSSST doctoral students and a second reader for two HSSST doctoral students. With HSSST doctoral student Mr. Gregory Clancey, he edited *Major Problems in the History of American Technology* (Houghton Mifflin). He serves on the MIT Museum Board, the MIT Museum Director Search Committee, and the STS faculty search committee for the history of science and technology position. He chaired a panel at the annual meeting of the Society for the History of Technology (SHOT) and delivered the keynote speech at the Industrial Technology and History Symposium organized by the Japan Research Industries Association, Yokohama, Japan. He serves on the Board of Trustees of the Hagley Museum and Library, and the American Museum of Textile History; the Editorial Advisory Boards for Edison Papers, Rutgers University, and the National Park Service; is a book series editor for the Johns Hopkins University Press; and consultant for Unicorn Films.

Professor Sherry Turkle was profiled in the *Scientific American* (4/98), was named one of the top 50 Cyber Elite by *Time Digital Magazine*, and one of Boston's Top Wired Women by *Boston Webgrrls*. Her book, *Life on the Screen*, came out in paperback and has been translated into eight languages. She published five chapters in books with three more in press; and a journal article. She delivered seventeen invited lectures or conference papers, including keynote addresses to the New England Association of Schools and Colleges Annual Meeting, the National School Boards Association's 11th Annual Technology and Learning Conference, the EDUCOM '97 Annual Meeting, the Nicholas Mullins Memorial Lecture at Virginia Polytechnic Institute; addresses to the New York Psychoanalytic Institute, the Boston Psychoanalytic Institute, Cambridge Hospital's Department of Psychiatry, the CSC Index Senior Management Interchange, the School of the Art Institute of Chicago, and the Canadian Business Telecommunications Alliance Annual Conference. She co-taught a popular subject in the Media Lab, helped with the Core Course for HSSST doctoral students, offered a new subject, "Thinking with Objects," as well as her course on computers, gender and identity. She supervised seven student projects, and is a primary advisor or dissertation committee member for three HSSST graduate students. She served on the search committee for the new STS faculty member in cultural studies of science, and serves on the MIT Committee on Privacy.

FUTURE PLANS

STS hopes to fill a junior tenure-track position. A search will be run during 1998-99 with the hope of finding someone who has expertise in areas beyond North America and Western Europe. The search process is designed to consciously and proactively pursue affirmative action to diversify our faculty. The task of reviewing the graduate program basic courses in the wake of initiatives begun during 1996-97 and 1997-98 will continue during 1998-99 particularly after completing the current series of new hires. We have also begun a serious review of the undergraduate offerings, and will continue to put into place a more coherent set and diverse range of subjects. We will also continue our efforts to teach and interact with units across the Institute.

More information about the STS Program can be found on the World Wide Web at the following URL: http://web.mit.edu/sts/www/

Michael M.J. Fischer

CENTER FOR INTERNATIONAL STUDIES

The Center for International Studies promotes theoretical and applied international studies at MIT. Major research and training units within CIS include the Security Studies Program (SSP), the Development Studies Program, the MIT Japan Program, and the MIT International Science and Technology Initiative (MISTI). These established programs provide a rigorous base for work on emerging issues. Traditional strengths in security strategies, development studies and political economy anchor major initiatives on democratization and ethnic conflict, migration and refugees, international economic and social performance, regulatory and trade policy, technology policy and environmental issues.

CIS research is conducted by established formal programs and through less formal crosscutting projects. Work by institutionalized CIS Programs, described more fully below, includes:

- Security Studies Program research on war and war prevention, ethnic conflict, peacekeeping, nuclear proliferation, ballistic missile defense, defense industrial policy, and arms trade;
- Japan Program and MISTI research on political economy and technology transfer issues, with studies on national systems of innovation, sectoral studies on aircraft and semiconductor production and a major MISTI-IPC study on the political economy of Hong Kong;
- Development Studies Program research on democratization, the origins of ethnic identity, decentralization and the effective governance of reforming economies.

Many pressing international issues do not fit neatly within functionally or regionally defined programs. Current crosscutting CIS working groups link CIS programs to each other and link CIS to other groups at MIT. These include:

- The MacArthur Foundation Transnational Security Project, with two working groups, one on ethnic conflict and secession and the other on economic security issues associated with increasing transborder flows of goods, technology and capital;
- The Mellon Foundation Migration Group, a Boston area inter-university consortium, with work on the domestic sources and international security implications of movements of migrants and refugees;
- The Energy Security Working Group, with research on military, political and economic implications of Asian energy demand;
- The Risk and Regulation Working Group, with research on how scientific and technical information is incorporated into regulatory decisionmaking in Europe, Japan and the US; and
- The China Environment Working Group, with research on the fit between international programs directed at regional and global environmental externalities and local conditions defined in technical as well as political and economic terms.

CIS operates major training, internship and outreach programs and provides substantial support for graduate and undergraduate scholarship. Last year, CIS programs and projects provided full or partial support to approximately 40 graduate students in the social sciences. In addition, CIS provides educational opportunities for MIT scientists and engineers and for national decisionmakers. The Japan Program and MISTI train and place approximately 110 interns per year in Japan, China, and Germany. CIS educates public and private decisionmakers through two Washington based executive education programs, the Seminar XXI Program and the Kalker Workshops at the Foreign Service Institute, and through the Senior Congressional Staff Seminar at MIT. Finally, CIS also sponsors a broad array of seminars, colloquia, and lectures on campus, offering the MIT community diverse perspectives on important international issues.

SECURITY STUDIES PROGRAM

The MIT Security Studies Program (SSP), formerly the Defense and Arms Control Studies Program, analyzes security alternatives available to the United States and other major and regional powers. Of great interest to the program is the role the United States will play in the world scene no longer dominated by the Cold War confrontation. The program also is examining the extent to which perceived economic and environmental problems are likely to affect international security arrangements, military options, and the resources made available for armed forces.

SSP sponsors a number of working groups - research collaborations of faculty, staff and students - with each group adopting a distinctive format and topic. One, led by Professor Harvey Sapolsky and Dr. Owen Cote, examines

American defense policies and has been especially concerned with the effect casualties have on the conduct and political acceptability of war. A second, led by Professor Barry Posen, has concentrated on conventional warfare with special emphasis on ethnic conflicts. A third, led by Professor Sapolsky, has been concerned with the impact the end of the Cold War will have on aerospace, shipbuilding, and research and development. A fourth, directed by Professor Theodore Postol and Dr. George Lewis, explores defense technology issues, most recently on the future of the ABM Treaty. A fifth, also led by Professor Sapolsky, has been examining the environmental legacies of the Cold War. A sixth, jointly directed by Professors George Rathjens, Carl Kaysen and Jack Ruina, has been exploring American national strategy and force requirements in a world filled with ethnic turmoil and failed states. A seventh, led by Professor Richard Samuels and offered in conjunction with the MIT Japan Program, looks at security issues in Asia. An eighth, led by Dr. Marvin Miller, studies proliferation problems. In addition, the program sponsors several seminar series including the SSP seminars, the Future of War seminars (joint with three programs at Harvard), the Star Series and the Weapon Seminars Series. Four major conferences were held: Privatization and Outsourcing (our third annual defense environmental conference); The Future of the US and European Defense Industries (joint with the London based Centre for European Reform); The Second Admiral Levering Smith conference (a nuclear weapons series); the Fifth Annual James H. Doolittle conference (this year's topic was Defense Research); and Urban Warfare, our invitational conference.

The director of the program is Professor Sapolsky, who has sought to encourage the initiatives mentioned above and to increase the program's research and public education activities. Among the Program publications are *Breakthroughs*, a research journal now in its seventh year; *Early Warning*, the program's newsletter; Security Studies Seminars, reports on current topics; a working paper series; and the newly established MIT Security Studies Conference series. Major sponsors have been the Carnegie, Ford, MacArthur, and the Alton Jones Foundations. In addition to twelve faculty members, thirty-five graduate students, twelve post-doctoral visitors and scholars, four military fellows were affiliated with the program this year.

PROGRAM IN DEVELOPMENT STUDIES

Research and training in development studies within the Center focused on questions of citizenship, ethnicity and nationalism, international migration and refugee movements, non-governmental organizations, transnational linkages between developed and developing countries, environmental policies, economic liberalization, and trade reform.

The CIS based Inter-University Committee on International Migration, chaired by Professor Myron Weiner, continued its guest lecture series on new approaches to the study of migration and refugee flows. In 1997-98 the seminar focused on two themes: policy issues that have arisen over the prevention, management, and resolution of refugee movements, and emerging trends in international labor flows. With support from the Mellon Foundation, the Committee initiated a new program on Non-Governmental Organizations and Forced Migration. The program awarded small grants to graduate students and research scholars at MIT and other member institutions of the Committee, including Harvard, Boston University and Regis College. Sharon S. Russell (CIS) is program director. The Committee completed its comparative study of US and Japanese migration, citizenship and refugee policies, funded by the Center for Global Partnership, with the publication by Macmillan and NYU Press of a volume entitled *Temporary Workers or Future Citizens? Japanese and US Migration Policies*, edited by Professor Weiner and Professor Tadashi Hanami (Sophia University). A related project by the American Academy of Arts and Sciences on German-American Migration and Refugee Policies in which several members of the committee participated was also completed with the publication of a five volume series by Berghahn Press edited by Professor Weiner. Under an arrangement with the Office of the United Nations High Commissioner for Refugees (UNHCR) each year one of their staff members participates in the work of the Inter-University Committee on International Migration. The end of empire was the topic of the MIT-Harvard Joint Seminar on Political Development (JOSPOD), co-organized by Professor Weiner (Political Science).

With support from the Smith Richardson Foundation, Professor Weiner initiated a project on demography and security. Ten studies have been commissioned on the political consequences of demographic changes and on the security implications of state policies to change demographic variables for a workshop that will be held at the Center in late 1998. A project on race, ethnicity and censuses conducted by Assistant Professor Melissa Nobles (Political Science), drawing in part from a conference at the Center funded by the Sloan Foundation, was also completed. It

will be published by Stanford University Press under the title *Shades of Citizenship: Race and Censuses in Modern Politics.*

CIS supported four series on development issues.

- The Seminar on Peoples and States: Ethnic Identity and Conflict, chaired by Professor Jean Jackson (Anthropology) continued its examination of issues of ethnic and nationalist identities in relation to the state.
- The Emile Bustani Middle East Seminar, organized by Dean Philip Khoury (History and CIS), continued its exploration of the issues of peace, conflict and democratization in the Middle East.
- The Ford Methodology seminar, a workshop funded by the Ford Foundation, focused on methodological issues in field research with presentations by faculty, guest lecturers and dissertation candidates. The 1997-98 Ford seminar was organized by Assistant Professor Fred Schaffer (Political Science and CIS) and focused on problems of democratization.
- The program in Transnational Security, run jointly with the Harvard Weatherhead Center for International Affairs and supported by the John D. and Catherine T. MacArthur Foundation sponsored a series of workshops on the causes and consequences of secession, co-chaired by Professor Stephen Van Evera (MIT) and Professor Bryan Hehir (Harvard).

MIT JAPAN PROGRAM

In 1991, the MIT Japan Program was named by the Air Force Office of Scientific Research as one of the first four United States-Japan Industry and Technology Management Training (JITMT) Centers in the nation. This grant was renewed two years later and again in 1995, reflecting the high level of the Program's accomplishments. With funding from this award as well as from MIT's Ayukawa Fund, the Starr Foundation, and its Corporate Consortium, the Program continues to be the largest, most comprehensive, and most widely copied center of applied Japanese studies in the world. Dissemination of the Program's accumulated knowledge and experience is pursued through three sets of coordinated activities: education, research, and outreach.

Education is central, with placement of MIT science, engineering, and management students as interns in Japan at the core. Educational activities during the period under review were as follows:

- The Program placed 35 interns.
- The Program is also active in curriculum development and training. The Executive Seminar course on Japan and East Asia will be offered for the sixth consecutive year; 24 Target Seminars were given during the period under review; and the Program's Video Series currently contains 57 titles and are an important tool for dissemination of information to individuals with time and/or budget constraints.
- The Program has been active in developing training materials on Japan including two CD ROMs, a workbook, and a case study book on building trust and negotiating with the Japanese.
- Japan East Asia Network. Created through dialogue with Program sponsors, the Japan East Asia Network brings sponsor companies together to discuss specific issues of concern and to share experiences for mutual benefit. Sessions are chaired by Program Director Richard Samuels, Associate Director D. Eleanor Westney, and industry experts in their field. Topics for the period under review have included: Supporting Technical Support, Linking R&D Organizations across the Pacific, and Technology Transfer and Corporate Strategy in Asia.

In research, the Program undertook the following projects during this period:

- The Theater Missile Defense Project - under the supervision of Program Director Richard Samuels
- Energy and Security in Asia Project - under the supervision of Michael C. Lynch, visiting scholar at the Center for International Studies
- The Future of US-Japan Defense Technology Collaboration - under the supervision of Program Director Richard Samuels.

Japan-related research findings are also disseminated through the Program's Working Paper Series. During the period under review, 15 working papers were published.

Significant outreach activities this year have included:

- MIT Japan Program Distance Education Series, including seminars on Japan/China issues; on Understanding Business Infrastructure in Japan and the Pacific Rim; and on Creating Effective Regional Strategies, Building Human Capital in Japan and the Pacific Rim.

- Continued publication of the MIT Japan Program Science, Technology & Management Report.
- Symposium entitled "Securing Asian Energy Investments: Geopolitics and Implications for Business Strategy"
- Japan Science and Technology Databases.
- Continued cooperation with the Institute's Department of Foreign Languages and Literatures on the JPNET (Japanese Network) Project to build a virtual community for Japanese specialists.
- Continued cooperation with the MIT Libraries on the Japanese Scientific and Technical Information Project to create a national resource for Japanese scientific and technical information.
- Continuation of the Program's dinner series, technology forum lectures, informal talks, IAP events, weekly Japanese lunch table with Japanese cultural activities, and Japanese film showings.
- Development of web-based course on Japan and Japanese negotiation practices.

The Program's Corporate Consortium has 17 members, all of them large American multinationals, and the list of Japanese host organizations continues to grow.

MIT INTERNATIONAL SCIENCE AND TECHNOLOGY INITIATIVE

The MIT International Science and Technology Initiative (MISTI) creates and supports programs for the internationalization of education and research at the Institute. MISTI's objectives are to expand core resources for studying foreign societies on campus and to share a growing MIT base of knowledge about foreign science, technology, and industry through outreach programs in the US.

MISTI/CHINA has been the first focus of the project offering internships in mainland China, Taiwan and Hong Kong to students who wish to have the experience of working in a multinational company, laboratory or public service organization. MISTI/China also facilitates collaborations between MIT faculty and researchers in outstanding universities and laboratories in China.

- This year MISTI funded 10 faculty members to go to China to conduct collaborative research in a variety of disciplines. Included in this group were faculty participating in the MIT-Tsinghua Conference in January 1998 in Beijing. The conference focused on recent and future research on management and innovation in high-technology industries in Hong Kong and mainland China and was jointly sponsored by MISTI, the Industrial Performance Center and Tsinghua University.
- MISTI sent 56 student interns to China in 1998 through either the traditional China internship program or the MIT-China Education Technology Initiative (MIT-CETI). MIT-CETI provides opportunities for MIT students to go to China to help high schools to set up and maintain web servers, and create home pages using HTML. This year the MIT-CETI program doubled with 25 students and 9 Chinese high schools participating. (In 1997, 13 students and 5 high schools took part in the project.)
- MISTI hosted 6 visiting scholars this year including the well-known Chinese economist, Angang Hu. Dr. Hu is a Research Fellow with the Research Centre for Eco-Environmental Sciences, Chinese Academy of Sciences. Dr. Hu advises the Chinese government on public policy and economic issues.
- This year MISTI sponsored 14 China Forum lectures and 6 films. A wide range of topics was covered including China's impact on East Asian security and the development of high-tech industry in Hong Kong and China.

MIT Germany Program was launched in 1996 to provide opportunities for undergraduate and graduate students to combine their knowledge of German language and culture with their expertise in the fields of engineering, science, and management by working in German companies or research institutions.

- In June of 1997, a first group of 23 undergraduate and graduate students went to Germany and worked as interns in German companies and research institutions. The duration of these internships ranged from three to twelve months. Students were placed in major German companies such as Bayer, Daimler Benz, Dresdner Bank, Forschungszentrum Karlsruhe, IBM Deutschland, and Thyssen Industrie. For 1998, a group of 38 students is expected to participate in the internship program.
- Through the MIT Germany Forum, the program ran a year-long movie series on the city of Berlin. It also sponsored lectures by renowned dramatist Holger Teschke and by the Distinguished Max Kade Visitor in the German section of the Department of Foreign Languages, writer Katja Lange-Mueller. It co-sponsored the Lufthansa-Award for Excellence in German Studies at MIT.

- The program is funded by a start-up fund from the German Federal Ministry of Research, Education, and Technology. In the next years, it plans to further its cultural outreach efforts, expand research projects with Germany, and serve as a clearinghouse for German scientists, scholars, and students who would like to pursue research at MIT.

ACTIVITIES IN POLITICAL ECONOMY

Research and training activities in political economy continued to expand dramatically, with work clustering in two overlapping areas. One set of projects centers on national adaptations to an increasingly global economy. Projects in that area examine the economic and political consequences of increasing integration of markets for goods, technology, and capital. A second set of projects centers on how economic, security and environmental externalities might be addressed efficiently and effectively.

The Harvard-MIT Joint Working Group on Transnational Economic Security examined the effects of globalization on the demand for private and public adjustment initiatives and on the financial capacity of firms and governments to facilitate adjustment; and on firm and governmental incentives to alter taxation, environmental regulations, and labor standards. This group was co-chaired by Associate Professor Kenneth Oye and Dr. William Keller (MIT) and Professors Dani Rodrik and Raymond Vernon (Harvard) and was supported by the John D. and Catherine T. MacArthur Foundation.

Environmental issues were the focus of three sets of activities.
(1) China Environment: Two teams are examining local and international implications of coal combustion in China. Professor Karen Polenske of DUSP is examining the human health effects of household coal combustion in China. International aid and industrial coal combustion is the focus of a CIS joint project with Tsinghua University, Tokyo University and the Swiss Federal Institutes of Technology (ETH). The MIT members of the team include Professors Janos Beer and Adel Sarofim of Chemical Engineering and Assistant Professor Zhiyuan Cui and Professor Oye of Political Science. The project has been supported by diverse sources including the Japan Foundation, ABB, NEDO, the Alliance for Global Sustainability and the MISTI program.
(2) Sustainable Development: Professor Nazli Choucri organizes the Global Forum on Sustainable Development which focuses on technology, policy, and strategy dimensions of evolving global accords on environment and sustainable development. This UN supported initiative includes international institutions, business and industry. Professor Choucri has also been working with China's Agenda 21 to develop Chinese language electronic networking facilities on problems of sustainable development.
(3) Regulation and Trade: Professors Sapolsky and Oye have formed a new working group examining environmental regulations and trade. The group is examining how scientific and technical information on environmental and health risks is incorporated into regulatory decisionmaking in the US, Europe and Japan, and is evaluating the implications of international variation in regulations on trade and investment. The project is supported by the Consortium on Environmental Challenges and by the Alliance for Global Sustainability.

WASHINGTON OUTREACH ACTIVITIES

Seminar XXI is held in Washington DC for senior military officers, government officials and industry executives in the national security and economic policy communities. The main objective of Seminar XXI is to develop among the program Fellows new analytic skills for understanding foreign societies, including the instincts to ask different questions about the facts they receive on the job, and in turn, to search out alternative interpretations of that data. Seminar XXI meets nine times over the course of the year, with each session focusing on a different foreign country or policy issue. By considering countries and issues through different frameworks of analysis, the range of possible explanations for these countries' behaviors is widened, as is the range of US policy options that can be considered systematically. In 1997-98, Professors Oye, Posen, and Weiner (Political Science) served as Co-Directors, while founders Professor Suzanne Berger, Jake Stewart, and Mitzi Wertheim served as members of the Executive Committee.

CIS runs a parallel program of "Kalker Workshops" at the State Department's Foreign Service Institute in Washington in which American diplomatic trainees of varying rank participate in a series of workshops dealing with salient issues in global affairs. The workshops are led by Professor Emeritus Lincoln P. Bloomfield (Political Science) and Fred Hill of the Department of State and are funded by a generous contribution of alumnus Harry Kalker.

Professor Eugene Skolnikoff leads an annual seminar that provides intensive briefings on a selected issue in science and technology policy for senior members of congressional staff. In 1998, the seminar offered a full range of views on the science and policy of climate change. The series has been supported by the Sloan Foundation.

FELLOWSHIPS

Five fellowship programs provide funding for doctoral students and faculty seed research. The Program in Transnational Security, supported by the MacArthur Foundation, provides support for research on transnational economic security and on intergroup conflicts, human rights and refugees. Funding is available to doctoral students for academic year and summer support and to faculty for seed research support. The National Science Foundation Traineeship in Democratization provides five fellowships annually for five years to support doctoral student training. Doctoral students from all social science departments at MIT are eligible to apply. The International Energy Policy Research Grant competition continues to provide funding to faculty, researchers, and advanced doctoral students working on any aspect of international energy, environment and related technology policy. The Ford Foundation-sponsored methodology program provides support to students working on development issues. The new Mellon Foundation program on Non-Governmental Organizations and Forced Migration awards small grants to graduate students and research scholars at MIT and other member institutions of the Committee. In addition to these four fellowship programs, CIS research and outreach activities provide substantial support for graduate education.

OTHER ACTIVITIES

During 1997-98 CIS was host to visiting scholars from China, Israel, India, Japan, Korea and Russia. In addition to the publications of the Security Studies, Japan and MISTI Programs, the Center publishes a bi-annual newsletter, PreCIS, and four working paper series. They are CIS Working Papers and Findings, a series of article-length summaries of recently completed social science dissertations in comparative and international studies. The latter is funded by a grant from an MIT alumnus. In addition the Center publishes the Migration Working Paper Series and the MacArthur Transnational Security Working Papers.

PERSONNEL

CIS Director Kenneth Oye, Security Studies Director Harvey Sapolsky, Japan Program Director Richard Samuels, MISTI Director Suzanne Berger, and Development Studies Director Myron Weiner continued to serve in these roles. Dr. William Keller joined CIS as the new Executive Director. Prior to coming to MIT, Dr. Keller served as Deputy Director and Associate Professor at the Center for Trade and Commercial Diplomacy of the Monterey Institute of International Studies and as Project Director and Senior Analyst at the Office of Technology Assessment. Ms. Deborah Grupp joined CIS this summer as our new Administrative Officer. CIS draws personnel from the MIT faculty and student body and recruits through the MIT Personnel Department. Our personnel reflect the general commitment of MIT to affirmative action goals. In the nine most senior CIS management positions, CIS currently utilizes one Asian American male and four women.

More information about this center can be found on the World Wide Web at the following URL:
http://cis-server.mit.edu/cis/index.htm

Kenneth Oye

WOMEN'S STUDIES PROGRAM

Women's Studies redresses the invisibility of women and gender in the construction of knowledge and reminds us to include women's as well as men's contributions, experiences and perceptions in understanding the world. The inclusion of Women's Studies subjects in the curriculum of an MIT student helps to produce an engineer, scientist, or business executive who is better-equipped to contribute fully and participate effectively in teams made up of men and women.

PROGRAM ADMINISTRATION

The program is directed by Professor Ruth Perry, Professor of Literature, and Founder of MIT Program in Women's Studies. During academic year 1997-98, the Women's Studies Steering Committee consists of Assistant Professor Brenda Cotto-Escalera (Theater Arts), Professor Isabelle de Courtivron (FL&L), Associate Professor Evelynn Hammonds(STS), Professor Jean Jackson(Anthropology), Professor Henry Jenkins(Literature and Film & Media Studies), Professor Evelyn Fox Keller(STS), Women's Studies Research Librarian Marlene Manoff(Humanities Library), Coordinator Michèle Oshima, (Women's Studies), Professor Perry(Literature), Associate Professor Margery Resnick(FL&L), Professor Susan Slyomovics (Anthropology), and Associate Professor Elizabeth Wood(History).

CURRICULUM

The Program in Women's Studies offers an undergraduate curriculum consisting of core classes and crosslisted subjects from cooperative departments. Students may concentrate, minor and petition for a major departure in Women's Studies. The Program in Women's Studies offered twenty-one subjects during the academic year 1997-98, with approximately 300 students enrolled. Professor Resnick conducted an independent study with one student and Professor Hammonds advised one student on her Women's Studies Pre-thesis research. In addition, Professor Hammonds was the representative for the program to the Graduate Consortium in Women's Studies (GCWS), a pioneering effort by faculty at six degree-granting institutions in the Boston area and Radcliffe College to advance women's studies scholarship in a series of team-taught interdisciplinary graduate seminars. This year, the GCWS cosponsored four graduate level courses, in which one MIT graduate student enrolled.

HONORS AND AWARDS

Rita Leung '99 was the third recipient of the joint writing prize offered jointly by The Program in Writing and Humanistic Studies and the Program in Women's Studies. The Louis Kampf Writing Prize in Women's and Gender Studies honors both Professor Emeritus Louis Kampf's contributions to Women's Studies at MIT and rewards high quality undergraduate writing in women's and gender studies. The Prize is sponsored by Women's Studies and included among the annual writing prizes given by the Program in Writing and Humanistic Studies. The Prize is judged by faculty from Writing and Humanistic Studies and Women's Studies.

PROGRAM HIGHLIGHTS

- "Gender and Technoscience" a faculty roundtable featuring MIT Professors Hammonds, Lynn Stein, and Sherry Turkle, Luleå Professor Lena Trojer, Luleå President Ingegerd Palmer and Swedish government official Arne Jernelöv was moderated by Professor Keller, and "Comparative Perspectives on Women and Engineering," a roundtable of graduate students, were coordinated by Women's Studies and sponsored by Science, Technology and Society, Women's Studies and Luleå University (Luleå, Sweden).

- The talk "Nikita and Point of No Return: the Remaking of French Femininity" was given by Ginette Vincendeau and cosponsored by Foreign Languages & Literatures, Women's Studies and Film and Media Studies.

- The talk "Invisible Men and Unsuspecting Women: The Politics of AIDS in Black Communities" was given by Cathy Cohen and cosponsored by Political Science and Women's Studies.

- The panel "Coordinating Academic and Biological Clocks: Parenting and Tenure" featuring Anne E. Preston, Shirley Malcom, and Virginia Valian was moderated by Professor Lotte Bailyn and coordinated by Women's Studies.

- A two-session IAP seminar on "Women and Medicine" featuring local doctors and medical students was organized by Professor Resnick.

- A panel "Faiths and Feminisms" of MIT students moderated by Lecturer Jorunn Buckley was coordinated by Women's Studies. The Faiths and Feminisms speaker series featured Paula Fredriksen and Wafaa' Salman and was curated by Lecturer Buckley in connection with her subject, "Women and Monotheism: Judaism, Christianity and Islam."

- A brown bag lunch talk by author Helen Epstein (*Where She Came From: A Daughter's Search for Her Mother's History*) was coordinated by Women's Studies and Hillel.

- The series of science fiction readings by Ellen Kushner, Octavia Butler, Samuel Delany, and Nancy Kress, was cosponsored by the Media-In-Transition Project, Film & Media Studies, LSC and Women's Studies.

- Under the coordination of Women's Studies, Anne Fausto-Sterling gave the talk, "The Problem with Nature/Nurture."

- A series of films offered in connection to Women's Studies subject SP406 "Violence Against Women" was sponsored by Women's Studies during the fall.

- Women's Studies coordinated the Graduate Women's Brown Bag Lunch Series featuring: "Sculpted Bits" (Maggie Orth/Media Arts and Sciences), "Defining Women's Political Interests in Japan" (Miriam Murase/Political Science),."What is Social Knowledge?" (Jennifer McKitrick/Philosophy), and "Suffering Science: U.S. Polar Exploration and Cultures of Manly Sacrifice" (Rebecca Herzig/STS).

- Whitney Chadwick presented a slide lecture on Surrealist photographers Lee Miller and Claude Cahun for Women's Studies in connection to the exhibit "Mirror Images: Women, Surrealism and Self-Representation" at the List Visual Arts Center.

- Women's Studies promoted the following Gender and Middle East series in collaboration with the McMillan-Stewart Lecture on Women in the Developing World, Foreign Languages and Literatures, the Bustani Middle East Seminar, the Peoples and States Lecture Series: Assia Djebar ("Algeria: Culture Under Siege," "The Women of Mount Chenoua: Filming the Unfilmable," and "Ecrire l'Algérie violente"); Professor Slyomovics"Algerian Women's Prison Poetry;" and Fatima Mernissi "How to Tap Social Capital in the Arab World."

- Women's Studies cosponsored the Race and Cyberspace Symposium with the Media-in-Transition project, Film and Media Studies, the Dean of Engineering, and the Dean of Humanities and Social Science, featuring Tara McPherson, Erika Muhammad and Glenn Kaino and moderated by Professor Cotto-Escalera.

- Women's Studies cosponsored a screening of "A Midwife's Tale," with the Boston Women's Health Collective, the Cambridge Commission on the Status of Women, the Somerville Women's Commission and Massachusetts Friends of Midwives, featuring the producer Laurie Kahn-Leavitt and the author of the Pulitzer prize-winning book, Laurel Thatcher Ulrich.

- Women's Studies cosponsored Shree Mulay's lecture-discussion "Sex, Lies and Population Lullabies: Unethical Clinical Trials for Contraceptive Research" with STS and the Alliance for a Secular and Democratic South Asia.

RESEARCH, PUBLICATIONS, AND SERVICE

The Women's Studies Faculty continued their active contributions to their individual fields. Most of these accomplishments are listed in the reports of their home departments, so special attention is given here to achievements relating to work on gender.

Professor Perry served the Graduate Consortium in Women's Studies as a panelist on interdisciplinary teaching panel for a Chinese delegation, and on the search committee for the coordinator. She gave the following lectures:

"Current Issues in the World of Women's Studies" at University of Nevada, Las Vegas; "Mary Astell: A Seventeenth-Century Philosopher" at the University of Massachusetts, Amherst; "Everything You Wanted to Know About Women's Studies, But Were Afraid to Ask" for MIT Matrons, and "Incest as the Meaning of the Gothic" for the University of Oregon, Eugene and for Arizona State University. In addition, she reviewed The Works of Aphra Behn, ed. Janet Todd for The Women's Review of Books. She published the following articles: "Women in Families: The Great Disinheritance" for Women in the Eighteenth Century, "Incest as the Meaning of the Gothic" for The Eighteenth-Century: Theory and Interpretation and "Austen and Empire" for Monstruous Dreams of Reason: Writing the Body, Self, and Other in the Enlightenment, ed. Laura J. Rosenthal and Mita Choudhury. During the fall, Associate Professor Diana Henderson was an Honorary Visiting Fellow in The Gender in Writing and Performance Research Group at The Open University (United Kingdom). She published the following articles: "A Shrew for the Times." *Shakespeare: The Movie. Popularizing the plays on film, TV, and video*. Eds. Lynda E. Boose and Richard Burt. New York: Routledge, 1997: 148-168; "Female Power and the Devaluation of Renaissance Love Lyrics." *Dwelling in Possibility: Women Poets and Critics on Poetry*. "Reading Women's Writing" series. Eds. Johanna Prins and Maeera Shreiber. Ithaca: Cornell University Press, 1997: 38-59; "The Theater and Domestic Culture." *A New History of Early English Drama*. Eds. John D. Cox and David Scott Kastan. New York: Columbia University Press, 1997: 173-194, and review: *Shakespearean Tragedy and Gender* by Shirley Nelson Garner and Madelon Sprengnether, eds. *Renaissance Quarterly* 50.3 (Autumn 1997): 13-15. The following articles were written and are in press or under press review: "Shakespeare's Reading: Reading Vernacular Literature" (in collaboration with James Siemon). *A Companion to Shakespeare*. Ed. David Scott Kastan. Basil Blackwell. Forthcoming 1998-99; "Enter Queen Isabel: The Difference It Makes." Solicited for inclusion in the "Critical Study" section of William Shakespeare's *Henry V*. Ed. John Russell Brown. New York: Signet Classic. Forthcoming 1998-99; "Teaching Sidney's Astrophil and Stella." Solicited for inclusion in *Approaches to Teaching Shorter Elizabethan Poetry*. Eds. Patrick Cheney and Anne Lake Prescott. Under review by MLA Publications. Tentative publication date, 1999; "Rewriting Family Ties: Woolf's Renaissance Romance." Accepted by the editor for inclusion in *Virginia Woolf: Reading the Renaissance*. Ed. Sally Greene. Forthcoming from Ohio State Press, spring 1999; and "Rend(er)ing Bodies in The Changeling and The Piano." Accepted by the editors for inclusion in *Disturbing Bodies: Corporeal Knowledge and Reading Practices in Early Modern Culture*. Eds. Lowell Gallagher and Arthur L. Little, Jr. Volume under consideration by Routledge. She delivered the following conference papers and invited lectures: "The Return of the Shrew: Why Now? Why Not? But How?" for the Honors College of Stonehill College, MA, April 1, 1998; "The Disappearing Queen: Looking for Isabel in Henry V." -Seminar paper, circulated and discussed at SCAENA: Shakespeare and His Contemporaries in Performance, St. John's College, Cambridge University, U.K., August 13-15, 1997; "Re-viewing Queen Isabel in Henry V." -Seminar on Writing about Performances. Shakespeare Association of America, Washington, D.C., March 27-30, 1997; "The Disappearing Queen: Looking for Isabel in Henry V." -The Gender in Writing and Performance Research Group, The Open University, Milton Keynes, U.K., September 8, 1997. -Rocky Mountain Medieval and Renaissance Association, Banff, Alberta, Canada. May 15-18, 1997. She served on the Organizing Committee for the Annual Conference of the BBC/Open University Research Group on Gender and Performance at the University of London, July 1998 and was a Seminar Organizer and Leader for "Shakespeare on Film: Issues of Gender" at the Shakespeare Association of America in Cleveland, Ohio, March 1998.

Professor Keller published the following article: "Developmental Biology as a Feminist Cause?" in *Osiris*. Professor Turkle published the following articles: "Cyborg Babies and Cy-Dough Plasm: Ideas about Life in the Culture of Simulation" forthcoming in *Cyborg Babies: From Technosex to TechnoTots*, and "Tinysex and Gender Trouble" in *Feminisms*. Additionally, she was named one of Boston's Top Wired Women by Boston Webgrrls. Professor Hammonds did the following reviews: Donna Haraway's *Modest Witness* in the *Journal of the History of Biology*, and Susan Smith's *Sick and Tired of Being Sick and Tired: Black Women's Health Activism in American, 1890-1950* in the *Bulletin of the History of Medicine*. She has the following piece forthcoming: "Whither black Women's Studies, An Interview with Beverly Guy-Sheftall" in *Differences: A Journal of Feminist Cultural Studies*. Professor Hammonds was a consultant to the Women and Scientific Literacy Project: Building Two-Way Streets for the NSF and American Association of Colleges and Universities. She gave the following talks: the Miller Lecture on Science and Ethics: "Women and AIDS: Reconstructing A History of An Epidemic;" "When the Margin is the Center: Black Feminism(s) and Difference" for the conference on "Feminism's Race Question;" and for the NWSA annual conference plenary: "Women, Race and Science." Professor Cotto-Escalera directed another staging of her play *Motherlands* in December at the Boston Center for the Arts. Additionally she served on the panel "Theater by Queer Women of Color" for the OutWrite Conference held in February. Associate Professor Anne McCants has the article

"The Not-So-Merry Widows of Amsterdam, 1740-1782" forthcoming in the *Journal of Family History*. Professor Wood published the following review: Barbara Alpern Engel and Anastasia Posadskaya-Vanderbeck, eds. *A Revolution of Their Own: Voices of Women in Soviet History* for *Slavic Review*. She gave the lecture "Gender and Gerontocracy: the Brezhnev Years" at Boston University. Professor de Courtivron has been working as a guest editor of a special edition *of SITES: the journal of 20th Century/Contemporary Women Writers*. She has published book reviews in *The New York Times* and *The Women's Review of Books*. Professor Resnick published the article "The Destruction of the Myth of Spanish Homogeneity: Marginal Characters in Carme Riera's *Palabra de Mujer*" in *Proyecciones Sobre la Novela*. She arranged a talk by the Cuban author Excilia Saldaña, and gave the MIT Technology Day talk "Roofwalkers: MIT Women and the American Dream." Professor Slymovics is co-editing a volume of essays on gender and the Middle East with Suad Joseph, entitled: Gender and Transformation in the Middle East. She is on the advisory board of *Women and Performance: A Journal of Feminist Theory.*

Women's Studies has been quite fortunate with numerous faculty appointments relevant to our program. Susan Slyomovics has been appointed professor of Anthropology and first chair holder of the McMillan-Stewart Chair on the study of women in the developing world. Sally Haslanger has been appointed to associate professor with tenure of Philosophy. Lecturer J. Emma Teng has been appointed to assistant professor of FL&L. Lora Wildenthal has been appointed to assistant professor of History.

FUTURE PLANS

Professor Perry will go on sabbatical after this year. Associate Professor Resnick will become the director on July 1, 1998 for a two-year period.

Ruth Perry

SLOAN SCHOOL OF MANAGEMENT

The 1997-98 year marked the completion of Glen Urban's term as dean of the MIT Sloan School of Management and the culmination of Sloan's five-year plan for preeminence initiated in 1994. This report highlights the achievements of that five-year term and, more specifically, the accomplishments of the past year.

During the past five years, the MIT Sloan School:

- Implemented a new MBA core curriculum, which was met with high acceptance from faculty and students.
- Increased the size of the MBA class by 150 percent and doubled the number of undergraduate students taking management courses at Sloan.
- Pioneered a joint degree program with the School of Engineering called System Design and Management. The program takes advantage of distance-learning technology.
- Established and expanded the MIT Entrepreneurship Center, housed at the Sloan School.

More specifically in the past year, Sloan:

- Boosted the size of the faculty from 74 to 89, including the hire of two senior faculty members in finance, Stephen Ross and Kenneth French.
- Launched two international MBA programs in collaboration with China's most prestigious universities: Fudan and Tsinghua. Sloan also signed an agreement to add Lingnan University to that collaboration. As part of this effort, Sloan hosts Chinese faculty at Sloan to help them absorb and apply Sloan's approach to management education.
- Added the New Product and Venture Development management track which today is Sloan's largest and fastest growing track.
- Held a design concours in the spring of 1998. Six top architectural firms were invited to develop innovative ways to leverage Sloan's current Charles River location at 70 Memorial Drive within the MIT Campus. Sloan continues to work with MIT in developing plans for improving and enhancing facilities for the school.
- Continued efforts to increase the diversity of the student body. Sloan boasts nearly 40 percent population of international students, among the highest of top business schools. The percentage of under-represented minorities went up to 8 percent this year, up 2 percentage points over last year.
- Worked with the School of Engineering to develop a major new initiative in Singapore.

The progress on the international front is providing new resources for both curriculum development and research. Sloan is responding to a shift in the structure of the executive education market by designing new executive programs based on both traditional in-class and remote learning approaches. Initiatives in pharmaceuticals, the Center for Innovation in Product Development (CIPD) and efforts with engineering in lean autos, aircraft and ships highlighted research in 1997-98.

Sloan restructured with a minimal increase in head count to generate the resources necessary for these programs. A new matrix organization enables Sloan to be more flexible in the face of changing demand and to increase efficiency through the sharing of resources across programs. Staff productivity has increased by more than 25 percent after projected staff growth. In addition, faculty members are using a point-based load measurement system. This new system, along with the increased number of students, has boosted teaching productivity 25 percent after projected faculty growth.

The volume of research directly accounted on Sloan books is projected to decline by $3 million in FY98, due to the phase-out of the Organizational Learning Center plus a drop in income for Center for Information Systems Research, Center for Coordination Science and the 21st Century Organizations program. However, the level of research at Sloan supported by the close ties with other MIT schools, including Lean Aerospace, Lean Sustainment, International Motor Vehicle Program and CIPD, is increasing substantially. Sloan estimates the combined research volume to be at an all-time high.

Sloan's budget remains healthy, given the proposed revisions to the five-year plan. The School has been able to contribute resources to the Institute substantially above the level of the original plan. The five-year profit-sharing experiment has been successful. Sloan has contributed more than $9 million in incremental funds over the FY94-FY98 period through reduction in general funds, profit sharing and new overhead taxes versus $6.9 million in the

original plan. Sloan forecasts it will contribute more than $18 million in the plan period FY99-FY2003. These results are expected even after new programs — executive education and international — are implemented to respond to increasing business school competition and to meet the attack on faculty from other top schools.

Overall, it has been a very productive year resulting in the implementation of many of the programs proposed in the 1994 five-year plan. In closing the fifth year of my term as dean, I want to thank the Institute leadership for its support, as well as faculty colleagues and staff for contributing to Sloan's success. I now pass the baton to the new dean Richard Schmalensee. Dick worked very closely with me as Deputy Dean, and I know he will provide outstanding leadership for Sloan.

Glen L. Urban

EDUCATION

MBA PROGRAM

Our mission is to create and deliver a small MBA program based upon collegiality and teamwork, an international focus, and a diversity of cultures and interests. The innovative and integrative curriculum provides a strong analytical foundation to management, encourages the interplay of ideas and their practical application, and allows students to design an individualized educational program exposing them to leading-edge research and practice.

In 1997-98, student enrollment for the MBA program and Leaders for Manufacturing was 717, the largest in Sloan School history. The first-year MBA class had 308 students and included 28 percent female, 8 percent U.S. minority, and 38 percent international, average age of 27.5 years, and average work experience of 4.6 years. Of the students' undergraduate degrees, 48 percent were in engineering, 24 percent in social sciences/humanities, 20 percent in business, and 8 percent in math/science.

The fall of 1997 was the fifth year of the revamped MBA curriculum. Students complete a fall core of six subjects and then choose a specific management or self-managed Track. The newest track, Operations and Manufacturing, awarded its first certificates this year. Additionally, the New Product and Venture Development Track enjoyed skyrocketing enrollment of students interested in entrepreneurship and product marketing. More than two-thirds of graduating MBA students completed a management track. The balance opted for the self-managed track, which provides them with maximum flexibility in course selection and the ability to customize their program following completion of the fall core.

Overall student satisfaction with the MBA Program remained high in 1997: 91 percent of MBA students rated their Sloan experience 7 or higher on a 10-point scale. Some 89.1 percent stated that they would recommend the Sloan MBA Program to potential business school students, up from 85.1 percent last year.

Twenty-seven members, or 8 percent, of the first-year MBA class were from under-represented minority groups. The Class of 1999 includes 13 African-Americans, seven Mexican-Americans, five Puerto-Ricans, and two Native American. They joined 46 second-year minority students. On average the Sloan School provided $10,000 in scholarship support for first year students from underrepresented minority groups.

The Minority Business Club and Minority Student Support Group met regularly during the academic year to discuss minority student issues. Representatives from the MBA Program and Master's Admissions Offices also attended school Diversity Committee meetings and participated in a diversity training day in the fall term.

The MBA Program again subsidized the membership of minority students in the National Black MBA and National Hispanic MBA associations, allowing students to attend national conferences. RÈsumÈ books were developed for both groups and were used at career fairs for these events.

U.S. News and World Report ranked the Sloan MBA Program #3 in the nation in its 1998 annual survey of graduate business schools published in March, up from #4 in 1997. The program's continued high rankings (#2 in 1996, #1 in 1995, and #2 in 1994) are recognition of student selectivity, high graduation rate, career placement success, and academic reputation.

MBA students and faculty participated in five international trips this year. The international trips continue to be an important part of the MBA Program student experience. The trips are initiated by students (itineraries, logistics, and fundraising) and are supported by the MBA Program Office and International Management faculty. Each trip is preceded by a regional academic seminar that examines the relevant management, social, and cultural issues of the countries visited. The trip destinations this year were China, Japan and Korea; Venezuela and Columbia; Australia and New Zealand; and Vietnam and Thailand. Some 250 MBA students participated.

Lawrence Abeln

LEADERS FOR MANUFACTURING

The Leaders for Manufacturing Program (LFM) is a partnership between MIT and 20 U.S. manufacturing firms to discover and translate into teaching and practice principles that produce world-class manufacturing and manufacturing leaders. LFM supports students both as fellows in the program and as research assistants throughout the Institute. Both groups of students participate in a research program that is directed by a joint faculty-industry committee.

The largest component of the educational efforts is the Fellows Program, a 24-month dual-masters degree (engineering and management) program involving a single integrative research project carried out on site in partner firms. Of the 48 students who graduated in 1998, 90 percent took positions in manufacturing firms, and 30 students accepted positions with LFM sponsors. AlliedSignal, Qualcomm, and Dell were notable for a large number of hires. Industry continues to show strong support for hiring LFM graduates. The class of 1999 is comprised of 42 students; the class of 2000 had 48. This year marks the 10th year of operation for LFM.

Each of the 48 graduates completed a six-month internship at a partner company. These internships have provided significant economic benefit to partner companies. They also have increased faculty involvement in current industrial problems and have had an impact on both MIT on-campus research and classroom teaching.

LFM has worked with the Deans of the Management and Engineering schools to create a position of Director of Leadership for the Sloan School and LFM. A search process to fill the position is under way. This person will integrate and coordinate the various aspects of LFM's leadership curriculum, and will work to expand the leadership offerings for the Sloan School as a whole.

Research has been conducted with seed funding from LFM in diverse areas. The Organizational Change group, for example, has focused on the real value of LFM to companies and how LFM helps its partners to change.

Another initiative, the Next Generation Manufacturing (NGM) project, has sought to address LFM's mission of discovering the principles for world-class manufacturing in the future. This past year LFM partner companies committed funds to continue the project and have adopted NGM's framework as the guide against which the curriculum and research of LFM be mapped.

LFM is collaborating with Stanford's SIMA program on a project on remote diagnostics. Partner companies have strongly supported such joint research.

LFM has added Celestica as an internship partner of the program. Chrysler Corporation will not continue as an active partner this coming year. Students this year also took a number of internships in foreign countries as part of LFM's efforts to reflect the global nature of its member companies.

LFM continues its efforts to extend the educational experience to other audiences in our partner companies beyond the Fellows. A six-day Industry Leaders Course on Product Development was held at MIT for 40 partner company personnel with sessions spread over a two-month period.

The National Coalition for Manufacturing Leadership (NCML), a partnership of 14 universities with joint management and engineering programs founded by LFM, hosted a joint recruiting forum at the University of Michigan.

LFM is collaborating more with other groups at MIT with similar missions. LFM now reports with six other programs to a Dean of Engineering Systems. LFM is working closely with the Systems Design and Management Program, sharing class offerings and support staff with them.

LFM'S goals for the coming year include:

- Enhancing the internship experience by building explicit plans for disseminating the learning of internships into the definition of the projects.
- Working with its industry to better define those learnings which are gained through real-life, on-the-job experiences and are critical to successful manufacturing leaders, and then bringing these learnings in an accelerated fashion to those people the companies look to as future leaders.
- Bringing the Director of Leadership into LFM to integrate the leadership curriculum into a more continuous, reinforcing set of experiences.
- Continuing the research activities, including the Next Generation Manufacturing (NGM) project, the Stanford collaboration, and the study of graduate utilization.
- Expanding outreach by involving a non-US company in the program, with Siemens being a likely candidate.
- Repeating and enlarging the course for Industry Leaders on product development.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/lfm/www/

Stephen C. Graves, William C. Hanson, David E. Hardt

EXECUTIVE EDUCATION

Sloan's Office of Executive Education has continued its efforts to provide superior programs to key partner companies and alumni of executive education, drawing on Sloan's research depth and expertise to help managers and executives solve important business problems. The office achieved the following results in 1997-98:

Both the Management of Technology and Sloan Fellows Programs — which fall under the purview of Executive Education — successfully recruited large classes for 1998-99, indicating continuing strong demand for these mid-career management degrees. (See separate reports that follow.)

Six executive short courses were successfully presented in May and June — The Chief Network Officer: Managing the IT Infrastructure; Negotiation: Theory & Practice; Management of Change in Complex Organizations; Corporate Strategy; System Dynamics: Modeling for Organizational Learning; and Product Design, Development and Management.

Responding to market demand for more customized programs, Sloan increased its offerings of executive education programs for individual companies. For the third time, the School offered an innovative "change agent" program to Siemens Nixdorf.

We have reaffirmed our commitment to maintaining and expanding our research base as a means of adding value to our educational programs.

More information about this program can be found on the World Wide Web at the following URL: http://web.mit.edu/sloan/www/academics/

Susan C. Lowance

MANAGEMENT OF TECHNOLOGY PROGRAM

The MIT Management of Technology (MOT) Program, the first joint program between the Sloan School and the School of Engineering, was established in 1981 to develop leaders who will create the linkages between their organization's underlying technology and its overall strategy. The program grants the special degree SM in Management of Technology.

The MOT Class of 1998, with 56 participants, was the largest to date. As in previous years, the average age was 35, and average post-university work experience was 10 years. Some 55 percent of the participants were international, representing 21 countries, and 85 percent were sponsored by their organizations. Before entering the MOT Program, 30 percent had earned master's degrees, and 16 percent PhD's.

For the annual MOT international trip, the class of 1998 met with government and industry leaders in Latin America, including Chile, Argentina and Brazil. In Argentina, the parents of one of the MOT's hosted the entire class at their ranch for a wonderful day's respite.

The MOT Program has begun to attract greater attention in the outside world. It has achieved and maintained its target enrollment of 50-55 students. In addition, our Web site continues to provide good marketing for the program, now having received more than 55,000 visitors.

Our primary goal for the coming year is to strengthen our relationships with U.S. sponsoring organizations in order to expand our already-strong applicant pool.

More information about this program can be found on the World Wide Web at the following URL: http://web.mit.edu/mot/

Rochelle Weichman

SLOAN FELLOWS

The MIT Sloan Fellows Program entered the 1997-98 academic year again with one of the largest classes over the 67 year life of the program.

The program strives to provide a learning community that reflects the international character of organizations today and to select participants with the highest potential for leadership roles. The 1998 class comprised 57 participants, all sponsored by their employers, of which 50 percent were U.S.-based organizations and 50 percent were international. This balance was achieved in the face of increased demand for places by Latin American companies, continued demand by Asian companies, and strengthening demand by U.S. companies. Participation by women and U.S. minorities, however, remained low, at 15 percent.

The teaching quality, as ranked by the participants, received the highest praise. Graduates were offered the option of choosing between the degree designations MBA or MS in Management. The majority elected the MBA. The thesis remains a degree requirement for Sloan Fellows.

The program will continue to cultivate a dynamic and balanced U.S./international learning community that cultivates effective leadership to meet the fast-changing demands of today's economic environment. Efforts will continue to increase participation by women and minorities.

Susan C. Lowance

DOCTORAL PROGRAM

Sloan's Doctoral Program aims to provide institutions in the United States and abroad with outstanding management faculty and researchers.

On the input side, we experienced another record year. We received 479 applications from 48 countries, fully a quarter of them from China. We made 24 offers and got 15 acceptances (a yield of 63 percent, better than in past years). Total enrollment now stands at 87. The number of women in the Doctoral Program remains at 24.

On the output side, our total number of graduates for the past academic year was 21. Job successes and placements have been quite good in all 10 of our management fields. Recent graduates have found positions at Columbia, Northwestern, Cornell, the Univ. of Michigan, INSEAD, Kobe University, the National University of Singapore, INCAE-Costa Rica and the London School of Economics. Compared to last year, no graduates chose industrial careers this season.

While the number of under-represented minority students (and applicants) remains small, currently three active students. However, we take quiet pride in graduating a Ph.D. student of Hispanic American heritage who was placed in one of the top schools of the country. We also brought into the program a new student from Puerto Rico (supported in part by the General Electric Faculty for the Future project). To increase the participation of minority students in Ph.D. studies, we have continued initiatives begun last year to increase our diversity including participating in the KPMG Peat Marwick PhD Project (an annual recruitment event).

SLOAN VISITING FELLOWS PROGRAM

The MIT Sloan Visiting Fellows Program provides the opportunity to pursue full-time, non-degree studies tailored to individual goals and interests. Each Visiting Fellow's program of study, usually for one or two semesters, is designed in consultation with a faculty adviser to meet individual professional needs and interests.

Originally a small program with about four to six participants a semester, the program has steadily increased to more than double that number. Thirteen participants were enrolled for fall 1997 and 12 for spring 1998.

The 1997-98 academic year included self-sponsored and company-sponsored participants as well as Fulbright Scholars and visiting students from Linkoping University and the Norwegian Technological University. Graduates of the Management of Technology (MOT) Program continue regular participation in the Visiting Fellows Program as a second semester or year of sponsored study.

Regular sponsors of participants included Schlumberger and Sanwa Bank. Sinclair S.A. and McKinsey & Co. each sponsored participants as well.

More information about this program can be found on the World Wide Web at the following URL:
http://web.mit.edu/

Jennifer Mapes

SYSTEM DESIGN AND MANAGEMENT PROGRAM

See the listing under School of Engineering

TEACHING PROGRAMS

UNDERGRADUATE PROGRAM IN MANAGEMENT SCIENCE

During the 1997-98 school year, the recent rapid growth of the undergraduate program began to level off. We began a series of curricular and extra-curricular enhancements to the program. Seventy-six seniors majoring in management science graduated, our highest number of graduates in several decades. Of those 76 seniors, 38 chose an option in finance, 24 selected information technologies, 14 chose marketing research, four went into operations research, and two went into behavioral science. Two had double options in finance and information technologies, one had a double option in finance and marketing, and one in information technologies and marketing.

Fourteen of our graduates received simultaneous SB degrees. Six also received SB degrees from the Department of Electrical Engineering and Computer Science and one each from the Departments of Economics, Chemical Engineering, and Mathematics. One received additional SB degrees from both the Department of Economics and the Department of Electrical Engineering and Computer Science.

At a post commencement reception, the School recognized Nori Nadzri and Jamie Buller, June 1998 graduates, with the Sloan School of Management Senior Prize. Awarded to outstanding seniors majoring in Management Science, this annual prize honors students who achieved high scholastic standing and demonstrated leadership and professional promise.

As of the Registrar's fifth week count this spring, 167 students were enrolled in the Management Science SB Program. Four additional students joined the program after the fifth week. Some 42 students were enrolled in Management Science as their second SB degree program at MIT. The total spring undergraduate enrollment was 213, up only one from spring 1997.

Enrollment in the undergraduate program has almost doubled since spring 1994, when total enrollment was 110. The program is now the fifth largest undergraduate program at MIT, larger than most of the departments in the School of Engineering, and larger than all but the biology department in the School of Science.

A large number of students from other MIT degree programs continue to enroll in management subjects. In the 1997-98 academic year, there were 804 undergraduate enrollments in Sloan School subjects (the same number as the year before). This represents the equivalent of 101 full-time students. The number of Spring enrollments was 473, which represents 193 virtual Sloan undergraduates in addition to our 213 actual undergraduates. We are computing "virtual" undergraduates by dividing the number of Full-time Equivalents by 60 percent, the approximate portion of an MIT upperclass consisting of departmental subjects.

New Initiatives

A new curricular initiative planned for 1998-99, and piloted in February 1998, includes two significant changes to the subject 15.279 "Management Communications for Undergraduates." The subject is now a requirement, making Sloan the first MIT undergraduate department to require oral as well as written communication skills in its curriculum. This subject will also include a front-end orientation to the Sloan School and to managerial pedagogy. Extra-curricular enhancements planned for next year also include a speaker series for undergraduates.

Increased Student Satisfaction

The '97-'98 Undergraduate Program satisfaction survey showed increases in overall satisfaction to 7.8, up from 7.1 on a scale from 0 to 10. Students rated faculty advisers 6.2, up from 5.8; the Undergraduate Program Office 7.8, up from 7.4; Educational Services 6.5, up from 6.3; and the bidding system 6.3, up from 6.1. Some 93 percent of the students — up from 71 percent last year — rated their overall satisfaction as 7 or higher. The question, "Would you recommend Course 15 to freshman?" also received a higher positive response this year (8.9) than it did last year (8.1). Satisfaction with teaching, faculty expertise, relevance, innovativeness, and facilities decreased slightly.

IAP

During January 1998 Sloan offered a number of IAP activities: The Foreign Currency Exchange Bourse Game, given for the eleventh year in conjunction with Citibank, was coordinated by Professor Jiang Wang and the Educational Services Office. Three entrepreneurial subjects were offered. Senior Lecturer Russell Olive offered "Personal Entrepreneurial Career Strategy and Preliminary Venture Analysis." Visiting Lecturer Barry Unger offered "Starting and Running a High-Tech Company." Visiting Lecturer Joseph Hadzima presented "The Nuts and Bolts of Business Plans." Professors John Little and Dimitris Bertsimas presented a series on "What is Management Science? What is Operations Research?" Professor Charlie Fine coordinated a lecture on "Business Ethics in the Talmud," and Professor John Sterman led a series of sessions on "System Dynamics and the Future."

Sloan Undergraduate Advising and Committee Assignments

Faculty who served as undergraduate advisers included Professors Thomas J. Allen, Dimitris J. Bertsimas, John S. Carroll, Chyrsanthos Dellarocas, Stephen C. Graves, Denis Gromb, Leigh Hafrey, Neal Hartman, John D. C. Little, Stuart E. Madnick, Michael Mikhail, J.D. Nyhart, Jim Orlin, William J. Qualls, Maureen A. Scully, Scott Stern, Marcie Tyre, John Van Maanen, and Roy E. Welsch. Advisers also included Sloan Administrators Jeffrey A. Meldman, Director of Undergraduate Programs; Heather M. Madnick, Assistant Director Undergraduate Programs and Assistant Director of Educational Services; and Debbie H. Shoap, Associate Director, Sloan Educational Services Department. Professor Carroll continued as departmental coordinator of MIT's Undergraduate Research Opportunities Program (UROP) and Professor Hartman as departmental writing coordinator for Phase Two of the Institute Writing Requirement. Meldman served as chair of the Undergraduate Advisors Committee. He and Ms. Madnick were IAP Co-Coordinators. Ms. Madnick currently serves on the IAP Automatic Registration Committee and was elected Co-Chair of the MIT Undergraduate Administrators Round Table.

Faculty serving on the Undergraduate and Interdepartmental Policy Committee included Professors T. Allen, S. Graves, D. Gromb, S. Madnick, together with Dean Jeffrey A. Barks, Meldman, and Heather Madnick. Professor J. Carroll served ex officio and Professor J. Little chaired the committee.

MIT Undergraduate Advising
Lori Breslow, Neal Hartman, Steve Graves, and JoAnne Yates contributed to undergraduate education at the Institute by advising freshmen and conducting Freshman Advisor Seminars.

Heather Madnick, Jeff Meldman

RESEARCH CENTERS AND GROUPS

CENTER FOR COORDINATION SCIENCE

The MIT Center for Coordination Science conducts multidisciplinary research to help understand how information technology can provide new ways of organizing human activity and help people work together better. Primary funding comes from a variety of government sources, including ARPA, NSF, and the Defense Logistics Agency. The center has corporate sponsorship from Fuji Xerox and is open to sponsors from the 21st Century Initiative listed below.

The past year has brought significant progress on the center's main project, the Process Handbook, a set of tools for inventing organizations that joins both coordination theory and coordination technology. The center developed a major reimplementation of the software, more than doubled the number of processes and activities represented in the database (now over 4500), and made a restricted version of the Process Handbook available to the public over the Internet.

Other activities included hosting a sponsor workshop and the publication of several working papers on a range of topics, among them measures of the value of information technology, and software tools to support exception handling. We also hosted a visiting scientist from Fuji Xerox.

In the coming year, we plan to continue developing the Process Handbook software and content. Two specific foci of attention are: (1) exploiting the concepts of coordination and dependencies in the Handbook, and (2) developing software tools for exception handling. We also plan further research and activities in electronic commerce and virtual organizations.

More information about this center can be found on the World Wide Web at the following URL: http://ccs.mit.edu

Thomas W. Malone

CENTER FOR ENERGY AND ENVIRONMENTAL POLICY RESEARCH

The Center for Energy and Environmental Policy Research (CEEPR) has been the locus of research at MIT on energy economics since the mid-1970s and environmental economics since the late 1980s. CEEPR is jointly sponsored at MIT by the Sloan School, the Department of Economics, and the Energy Laboratory. CEEPR receives financial support from corporate sponsors and government agencies in the United States and Norway. In conjunction with MIT's Center for Global Change Science, CEEPR co-sponsors the Joint Program on the Science and Policy of Global Change, which conducts interdisciplinary research to influence global climate policy.

A total of 18 Joint Program Reports were disseminated, and 12 earlier reports were published in various peer-reviewed journals. The most prominent of these, from a policy standpoint, was an article in *Foreign Affairs*, which provided a "report card" on the Kyoto Conference of the Parties. During the same year, CEEPR published a special report, *Emissions Trading under the U.S. Acid Rain Program*, which summarizes the Center's research over the past two years on this innovative approach to environmental policy. At the same time, 12 working papers and seven reprints were added to CEEPR's publications list.

Both CEEPR and the Joint Program convened workshops of sponsors and other interested parties to present and discuss research results. During the year, CEEPR held its usual fall and spring workshops in Cambridge. The Joint Program held one in the fall in Cambridge and another in London in June in collaboration with the Royal Institute of International Affairs.

The Joint Program's distinctive feature is the integration of streamlined but comprehensive economic, climate, and ecological models in one Integrated Global Systems Model. Output from this model forms the basis of the

publications noted above and for frequent informal participation in the supply of analysis and information to the policy process.

CEEPR has become the foremost interpreter of the U.S. Acid Rain Program, a pioneering public policy experiment in the use of tradable emission permits to achieve an environmental goal. An initial two-year funding has been extended for three more years. A major new initiative has just been funded to extend the analysis to CO2 trading.

During the 1997-98 year, CEEPR completed the construction of a comprehensive mine-level data base on U.S. coal output and labor input that will provide new insights into the micro-phenomena underlying aggregate industry productivity improvement. Work has begun, in conjunction with the Norwegian Petroleum Directorate, to extend the analysis to oil production from the North Sea.

A. Denny Ellerman

CENTER FOR INFORMATION SYSTEMS RESEARCH

Established in 1974, the Center for Information Systems Research (CISR) investigates critical issues concerning the management and use of information technology in complex and dynamic organizations. Faculty associated with the center have conducted pioneering research in such areas as decision support systems, critical success factors, database systems, strategic IS planning, end user computing, executive support systems, and coordination technology.

In 1997-98, CISR research was summarized in two new working papers, a column in *Harvard Business Review*, and a white paper. CISR staff also presented research findings at the International Conference on Information Systems (ICIS), the annual meeting of the Society for Information Management (SIM) and three of its chapter meetings, and at seminars at the University of Minnesota, London Business School, and Nomura Management School. Staff are focusing on four key issues in IT management:

- Development of value-adding IT infrastructures
- Strategies for developing performance support systems
- The role and management of corporate intranets and extranets
- Processes for leveraging value from enterprise resource planning systems

In addition to teaching in several Sloan graduate and executive education programs, CISR staff conducted an executive education course, *Managing the IT Infrastructure for Global Competitiveness*, in May for 40 IT professionals. In June, CISR held its annual *Summer Session* for 130 information technology professionals from all over the world. During the year, CISR staff designed and delivered management education programs for IT professionals at Pfizer, TRW, and GE Capital. CISR held one-day workshops on both knowledge management and enterprise resource planning systems for sponsors and research participants.

CISR research staff visited sponsor companies to discuss current research and to learn about their IT management issues. They participated in several IT education initiatives at sponsor firms. CISR research staff joined the editorial board of *MIS Quarterly* and served as reviewers for *Sloan Management Review*, *MIS Quarterly*, *Information Systems Research*, and *ICIS*. In October, a case study developed at CISR with The Travelers Property and Casualty Company was awarded third place in the Society for Information Management's best paper competition. Additional information about CISR is available at its Web site: http://web.mit.edu/cisr/www

INTERNATIONAL CENTER FOR RESEARCH ON THE MANAGEMENT OF TECHNOLOGY

ICRMOT offers a program of research on technology management, and the relationships among technology processes and marketing, production, and global business strategies. The work is supported mainly by large technology-based companies that are facing the demands of complex and dispersed technology management, often on a global scale. Member companies help select projects for funding and participate in Center workshops.

Current research topics include using technology alliances to establish leadership in emerging technologies; knowledge management in cross-functional teams for product development; understanding the management of virtual work in dispersed organizations; metrics for valuing R&D; the role of technology in commoditized markets;

lean transitions from engineering to production; and rapid software development techniques. In 1997-1998, research funds contributed to the support of seven members of the MIT faculty and five Ph.D. students, and also engaged a variety of students in master's programs in related thesis work. In the past year, 14 working papers were issued. Several have appeared in refereed journals including one that has appeared in a management review published by the *Financial Times* of London.

The Center continues to expand its efforts to strengthen the flow of knowledge to member corporations. Members are encouraged to help set research priorities, and serve as sites for MIT research projects to ensure that the research is directly applicable to their concerns. On-campus seminars were made available to member companies, beginning with an April 1998 presentation on the challenges posed by global atmospheric change to public policy and technology development. The presentation by Professor Mario Molina, Nobel Laureate for Chemistry in 1995, was viewed at member sites in the U.S. and Europe. A program of small, interactive workshops at MIT and elsewhere was expanded. In 1998-99, two workshops will be held in Europe, a third event in Japan in December, and two workshops at MIT.

INVENTING THE ORGANIZATIONS OF THE 21ST CENTURY

Inventing the Organizations of the 21st Century is a four-year-old research and education initiative that works with innovative managers, leaders, and academicians to help them invent the organizations that will become common 10 to 20 years from now.

In 1997-98, the initiative held one major meeting with sponsors — a research review meeting that presented sponsors with a broad range of research results. We also completed a significant restructuring of the initiative to provide a more decentralized framework for sponsor participation. In the new structure, corporate sponsors pick from a "menu" of research projects and other activities related to the themes of the initiative.

Other activities included the hosting of scenario workshop for one sponsor (British Telecom) and the publication of several working papers on learning histories, multipoint learning, and workers "guilds."

More information about this program can be found on the World Wide Web at the following URL:
http://ccs.mit.edu/21c/

Thomas W. Malone

LABORATORY FOR FINANCIAL ENGINEERING

The focus of the Laboratory for Financial Engineering is the quantitative analysis of financial markets using mathematical, statistical, and computational models. The LFE's goals are to spur advances in financial engineering and computational finance, and develop better ways to teach students and executives how to apply financial technology in corporate settings.

In the past year, LFE continued making progress on several existing projects and launched additional projects. Existing projects include the Derivatives Project, the Artificial Markets Project, the Risk Management Project, the Trading Technology Project, the Trading Volume Project, and the Financial Visualization Project. These projects and their corresponding preprints and reprints, along with LFE staff and affiliated faculty, are described in more detail at the LFE's web site.

New projects launched this year include the Derivatives SourceBook Project (a searchable web-based taxonomic bibliography of the derivatives literature), the Risk Preferences Project (an attempt to quantify individual and corporate preferences for risk and expected return using original survey data), and the Evolutionary Dynamics Project (computer simulations of the interaction between natural selection, competition, and innovation of economic agents).

The LFE's activities are supported through industry grants and private donations. This past year we matriculated the first two Merrill Lynch Fellows through the Operations Research Center. We continue to make progress towards a major gift from Merrill Lynch to support a variety of activities across the Institute. Lehman Brothers agreed to join the LFE as a sponsor of the Risk Preferences Project.

The Track in Financial Engineering, a part of the Sloan MBA curriculum, continues to be partially supported by the LFE and has been given more resources by the Sloan Dean's Office. Professor Greg Willard, a new assistant professor, has joined the TFE and is responsible for organizing the Proseminar in Financial Engineering.

The LFE continues to struggle with course development for the Trading Lab because of limited resources to fund this activity. Several trading simulations have been developed for the Analytics of Financial Engineering course (15.450). Research projects are also being developed related to the Trading Lab (such as the Artificial Markets Project described above). The Trading Lab has considerably more potential from both research and teaching perspectives if resources can be raised to support it to the same extent that other universities support similar activities.

More information about this program can be found on the World Wide Web at the following URL: http://web.mit.edu/lfe/www/

Andrew Lo

MIT ENTREPRENEURSHIP CENTER

The mission of the MIT Entrepreneurship Center is to train and develop the leaders who will make high-tech ventures successful. To that end, we offer educational programs to inspire, educate, and coach new generations of entrepreneurs from all parts of MIT. To support this mission, MIT's Entrepreneurship professors and staff teach and conduct basic research to enhance our fundamental understanding of the dynamic process of high-tech venture development in the United States and around the world.

The MIT Entrepreneurship Center was launched as an Institute-wide initiative in 1996. At that time, President Vest said, "We must not only be the best, we must serve as a model for others and ensure that, together, we all make a significant global impact in this vital field." To achieve these objectives set out by the President, we established two practical goals: to recruit 10 leading professors and practitioners, and to raise $60 million in endowment to fund teaching and research.

In 1997-98, while making progress toward those two goals, we worked in parallel with our current core team to meet the rapidly rising demand for entrepreneurship courses consistent with our mission. Student enrollment in Entrepreneurship courses increased from 327 to 926:

Course	1995-96	1997-98	Two-year Growth
New Enterprises	70	270	286%
Entrepreneurship Lab	20	138	590%
Independent Activities Period	128	283	121%
All Others	70	235	236%
Total	288	926	221%

We recruited a new tenure-track faculty member, Professor Simon Johnson, who teaches "Entrepreneurship Without Borders," a class focusing on global entrepreneurship and the international issues facing high-tech ventures. We also hired Matthew Utterback as our first full-time Program Manager. A Research Committee was established to evaluate proposals and support entrepreneurship research. We launched a joint project with the Harvard Business School to study systems supporting new venture creation and success in the United States. The Center received several accolades from the Press: *Mass High Tech* magazine awarded us the distinction of the Commonwealth's "Education All Star" and *Inc. Magazine* judged the MIT $50K Entrepreneurship Competition to be "more equal than the others" among university business plan competitions.

On the financial side, endowment pledges from entrepreneurial alumni increased to $16 million toward our goal of $60 million. A corporate sponsors program was established to add to the intellectual life of the School and to support our annual operating budget.

In the coming year, our faculty will develop and teach two new courses — "Entrepreneurial Marketing" and "Technology Entrepreneurship." The latter is a joint course between Sloan and Mechanical Engineering. Our growth plans include recruiting another senior faculty member in Entrepreneurship and two new practitioners.

Kenneth P. Morse

MIT PROGRAM ON THE PHARMACEUTICAL INDUSTRY

The MIT Program on the Pharmaceutical Industry (POPI) was founded in 1991 as a research and education program for understanding the structure and dynamics of the global pharmaceutical industry — the firms and their suppliers, customers, and regulators. POPI seeks to improve the industry's performance and reduce the cost of health care by lowering product costs and decreasing the time required to bring new products to patients.

In 1997-98, faculty associated with POPI continued research on case histories of important drugs, the cost of new drug development, the use of combinatorial chemistry to systematize key aspects of drug discovery, and many other topics. A large symposium held in Cambridge in December 1997 examined many of these issues.

Among new collaborations, POPI has entered into a research study with colleagues at the Rand Corporation to examine the future economic impact of patenting biomedical research tools. The new research seeks participation from a number of pharmaceutical and biotechnology firms as well as governmental agencies.

Stan N. Finkelstein

SYSTEM DYNAMICS GROUP

The System Dynamics Group, founded in the early 1960s by Professor Jay W. Forrester, studies complex systems — often with the aid of computer simulation models — to learn how their structure influences their behavior. The Group is composed of Sloan School of Management faculty plus graduate students and MIT undergraduates. Inquiries should be directed to Nan Lux, the Program Manager, at <nlux@mit.edu>.

The System Dynamics Group has three main areas of research. The National Model Project continues research, under the supervision of Professor Jay W. Forrester, on how the U.S. economy works. The project strives to understand how the U.S. economy works, and analyzes the effects of proposed economic policies.

The second project is "The Improvement Paradox: Designing Sustainable Quality Improvement Programs" directed by Professor John Sterman. This research involves detailed field study with four partner organizations to ground computer models in intensive longitudinal study of quality improvement programs. Designing sustainable quality programs has proven to be difficult, and the evidence linking quality improvement to financial benefits is mixed. Even highly successful quality programs under certain conditions can lead to significant short-run deterioration in financial results and subsequent loss of commitment to the quality program.

Participants in the System Dynamics in Education Project continued writing *Road Maps*, a series of self-study guides that use modeling exercises and selected literature to teach the methods and principles of system dynamics. The initial nine chapters of *Road Maps* are now available free on the World Wide Web at http://sysdyn.mit.edu

More information about this organization can be found on the World Wide Web at the following URL: http://web.mit.edu/sdg/www/

Nan S. Lux and John D. Sterman

ADMINISTRATION AND SERVICES

ADMISSIONS OFFICE

This has been another highly successful year for Sloan Admissions. The new class was made up of 358 students, including the Leaders for Manufacturing joint Sloan/Engineering candidates. Continuing the trend of the past several years, the class is an experienced one, having an average of 4.5 years of employment before matriculating. The average age was 27.3 years. Average GMAT score rose to 690.

The number of applications to Sloan again rose, to 3,452, reflecting a continued strong interest in the MBA professional degree, bolstered by a strong economy and job market. As business becomes more complex and reaches into sectors that were previously less business-oriented — such as health care — we have seen a diversification of applicants to include doctors, lawyers, architects, and other professionals who find themselves in need of sophisticated management skills to complement their professional expertise.

Sloan continues to be a diverse population on all dimensions. The incoming class is 38 percent international, 27 percent women, and 9 percent under-represented minority students. In addition, students have come from all over the United States, from backgrounds in engineering, mathematics, and the sciences, as well as from history, journalism, social science, economics, and business.

Plans for the coming recruitment season include renewed recruiting efforts in Europe as well as a continuation of our presence in Asia, South America, and across the U.S. and Canada. The voluntary participation of current students and alumni/ae in these efforts gives evidence of the satisfaction with our program.

Meg Manderson

ALUMNI RELATIONS OFFICE

The Sloan Alumni Relations Office's mission is to keep its 16,000 alumni worldwide connected with each other and the School, and to foster goodwill towards Sloan. Specific challenges for FY98 were to expand visibility of the programs and services available; determine alumni perceptions regarding their Sloan education; and implement a new online alumni directory. The alumni relations staff remained at 3, which is 30 percent the size of similar institutions.

In FY98, overall alumni activity and involvement were high. Highlights included nearly 100 alumni events held around the world, involving more than 2,000 alumni. Some 2,000 alumni volunteered to assist Sloan in recruiting, student mentoring, and admissions. Nearly 300 alumni took advantage of the personalized career counseling services. Reunion '98 had nearly 400 participants, a record high, that included a 40th year reunion class. The Sloan Alumni Interactive website continues to be a major conduit for alumni with more than 27,000 visitors to date.

A key issue for Sloan alumni is the availability of an online directory. Since networking is critical to business school alumni, the online directory and other networking services offered through MIT's Alumni Network Services (ANS) are considered "mission-critical" for Sloan. Collaboration with MIT's Alumni Association and ANS will continue to play a critical role for Sloan alumni to address issues of timeliness of database updates, and policies concerning access to alumni information. Success in these areas will be key to Sloan's progress in building its alumni community.

Key challenges for FY99 will be to finally bring online an alumni directory; to continue to increase visibility of the programs and services available to alumni, including the launch of a new Sloan website; expansion of value-added services such as alumni continuing education and distance learning. Significant effort will be made to ensure the integrity of the Sloan alumni database and updating processes.

More information on this office can be found on the World Wide Web at the following URL:http://web.mit.edu/sloanalum//

Carmon Cunningham

CAREER DEVELOPMENT OFFICE

The demand for Sloan graduates continued unabated in the past year, though competition is intense among the top schools for positions with prestigious firms. Preliminary placement figures indicate a very strong year, with the median base salary increasing 7 percent over 1998, from $75,000 to $80,000. The average number of job offers increased from 3.2 to 3.4. For the first time this year, the Career Development Office received a higher student satisfaction rating than any of the other offices serving Masters' students.

Though headcount in the Career Development Office has remained essentially flat (6 full-time plus 1.2 FTE), there has been significant expansion in all three of our main areas of business:

The recruiting season was extended by three weeks, from early November into March. More than 200 companies participated in on-campus recruiting. Two special recruiting events took place in the Ting Foyer of the Tang Center: The Consulting Showcase in fall and the High Tech Career Fair in spring. Our marketing activities the previous summer yielded 55 new recruiting companies.

The Career Development Office expanded the recently instituted practice of outsourcing some of the career planning and counseling activities, enabling us to offer a greater number and wider variety of seminars and workshops while maintaining level headcount as mandated.

The Career Resource Center grew dramatically in popularity with students in the past year. The help desk was staffed evenings Monday through Thursday, and a demo workstation was configured nearby for ad hoc tutorials on electronic databases and web searches. The success of the CRC contributed significantly to our improved student satisfaction rating.

For the coming year, we plan to increase our focus on international markets, working with the Admissions Office and Executive Education to combine recruiting efforts and develop a solid employer base in key geographies. We are also working with Resource Development to strengthen partnerships with major recruiting companies, particularly in the technology sector.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/cdo/www

Ilse Evans

CLIENT PARTNERSHIP AND RESOURCE DEVELOPMENT

Highlights of the year include the following:

- FY '98 was another successful year for Sloan fundraising. In FY '98 the Sloan Development Team (SDT) helped generate nearly $14 million in new gifts and pledges.
- The Sloan Annual Fund raised almost $1.4 million, a 19 percent increase over the previous year. Almost $165,000 of the above amount was raised to support the School's Minority Fellowships program.
- The SDT made 12 percent more sales calls (1045 versus 937) as compared to the same period the previous year.
- The above results were achieved without a significant increase in the SDT budget. Sloan's productivity, as measured on a per capita basis (i.e. number of fundraisers and support staff divided by revenues generated) continues to be one of the highest of the top tier business schools.

The Team's strong fundraising results were achieved because of the commitment and tireless efforts of many faculty and staff, particularly Dean Glen Urban, Senior Associate Dean Alan White and Professor Lester Thurow. Furthermore, a growing number of key alumni volunteers made about 25 solicitation/cultivation calls in collaboration with SDT staff.

The fundraising momentum generated over the past five years has begun to show significant results that will become more dramatic in the years ahead. The Sloan prospect pool is considerably larger and more diverse than previously thought. The SDT intends to focus its efforts this year on reaching more of the 1,500 alumni/ae who have been identified as major gift prospects while targeting more of the 150 corporations and 25 foundations which are good prospects for the School.

Our optimism about the School's fundraising potential is based, in large part, on the ongoing cultivation of about 10 Sloan alumni and friends as well as several companies that have the ability and interest in making gifts in the $5 million to $25 million range to support select Sloan facilities, programs and activities. In fact, about five alumni have expressed their interest in making gifts in the $5 million to $10 million range to support the proposed new Sloan building and other priority projects/programs at the School. In addition, Sloan stands to benefit considerably from the evolving partnership between Merrill Lynch and MIT.

For FY99 the SDT has established a $25 million overall fundraising goal, including a goal of $1.7 million for the Sloan Annual Fund. The SDT will redouble its efforts to close a $25 million gift by working closely with MIT's President and Resource Development Office. As MIT prepares to launch another capital campaign, Sloan is in an excellent position to raise $150 million over 5-7 years.

At the same time the SDT will maintain momentum in building the Sloan Annual Fund by making about 1,000 prospect calls/moves per annum as we did in FY '98. A high number of prospect and the development of stronger relationships with more top donors are directly correlated to stronger results in the Annual Fund.. We plan to hold two Top Donor dinners in FY99: one in New York and the other in San Francisco to steward further the School's significant annual supporters.

The SDT will also develop a Class Reunion program in close collaboration with the Sloan Alumni/ae Affairs office in FY99. The potential success of the proposed Sloan Class Reunion program is very important to the School's external relations and long term fundraising programs. A new position has been created to develop such a program.

EDUCATIONAL SERVICES

Educational Services manages the infrastructure upon which Sloan's academic mission is carried out. The office team oversees all registration issues for approximately 1,100 Sloan students; manages the web-based course prioritization system used by more than 2,000 MIT students, which equitably resolves difficult supply and demand issues in a department with popular classes and high enrollments: schedules the nearly 175 class sections offered each term (up from last year by about 5 per term); maintains Sloan facilities; and produces both online and paper resource material for the School (including the PhotoBook, Directory, biocards, weekly News@Sloan, and student intranet).

The Educational Services team focused this year on better service through technology. Successful projects included refining the online calendar that lists all student events and recruiting presentations and upgrading the bidding system with a new system rollout. A major benefit for first year students was the bidding enhancement that split out higher-priority bids, so students knew what was left in the "market" when they spent their points. Efforts to enhance communication channels brought several new initiatives to the student intranet, including sites for hot topic discussions (Opinions@Sloan) rentals or sales, and course section swaps. The installation of email stations and local access modem jacks allows students and guests to quickly check messages from sites throughout the School. A major initiative made the popular CourseFest much more accessible — the videotaped faculty presentations are now presented on the web. Interactive websites developed this summer will allow wait lists to be created, sections to be swapped, and study space to be scheduled, all online.

As Sloan enrollment remains high (approximately 1,100) and Sloan classes become increasingly popular with MIT students in all departments, the Educational Services staff faces daily challenges to maintain high levels of service. Technology has provided the key both in terms of new and better kinds of services, and the ability to reach an expanding customer pool with the same staff resources.

Management of Sloan space was an addition to the Educational Services portfolio this year. Projects included coordinating the moves of more than 35 staff members, the complete renovation of a wing in E60, the creation of a 7-office research area, and the reconstruction of a set of restrooms (ongoing). Heavy involvement is expected in the analysis of options and needs as Sloan examines the possibility of a new facility.

Goals for 1998/99 include moving more completely to an electronic community by providing online biocard photos; switching the weekly News@Sloan newsletter to a totally electronic format; working with the Registrar's Office on

the possibility of online drops and adds; moving to electronic course materials management for all classes through the Virtual Campus system; and integrating database issues across student information, bidding, and registration systems. Publication of a handbook is planned for faculty, to help them navigate the administrative maze involved with teaching in a large Institute. In all areas, streamlining of services continues to be the focus. Our goal is to find new ways to provide even higher quality service to a larger client base.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/sloan/www/Services/Edservices/EDS.html

Lucinda Hill

LEMELSON-MIT AWARDS PROGRAM

The Lemelson-MIT Awards Program is a major national educational initiative promoting invention and innovation through prizes, spokespeople, and ongoing public education activities. In 1998, our goal was to increase visibility of the Program's spokespeople and year-long educational activities, and to raise public awareness of the contributions of innovators in science, engineering, technology, and entrepreneurship to our society.

Following are highlights of our success in accomplishing this goal: Introduction of Vice President Gore by our Student Prizewinner at the Council of Competitiveness' Innovation Summit; the PR industry's Bull Dog Award in recognition of our national public education campaign; ongoing citation of our activities in a wide range of media outlets, including CNN, Fox and national network affiliates; *Newsweek, Business Week, U.S. News & World Report, The Wall Street Journal, The New York Times*, and *USA Today*; expanded reach to middle school and high school audiences, including presentations by spokespeople at the Smithsonian Institution; incorporation of our educational resources, such as our *Invention Dimension* web site's inventor profiles, into multimedia materials like a national syndicated radio program, "Build Your Own Business"; and standing-room-only attendance at our first ever on-campus Inventor's Workshop.

Robert S. Langer, MIT professor and inventor of groundbreaking technologies in the fields of tissue engineering and internal drug delivery systems, was awarded the half-million dollar Lemelson-MIT Prize. Jacob Rabinow, creator of numerous devices in diverse fields such as horology, sound reproduction, computer technology, and automobiles, was honored with the Lemelson-MIT Lifetime Achievement Award. Both Langer and Rabinow also received a kinetic trophy designed specially for the Program by MIT artist-in-resident Arthur Ganson. Akhil Madhani, an MIT Mechanical Engineering doctoral candidate and inventor of several robotic innovations, was awarded the $30,000 Lemelson-MIT Student Prize.

Our goal this coming year is to strengthen existing relationships and generate external collaborations with nonprofit and corporate initiatives supporting science and engineering outreach. In addition, we will launch a hands-on mentoring initiative for high school students, the Invention Apprenticeship, an on-campus speaker series on invention and innovation, and a quarterly newsletter.

More information about this program can be found on the World Wide Web at the following URL: http://web.mit.edu/invent/

Annemarie Amparo

SLOAN COMMUNICATION OFFICE

The mission of the Sloan Communication Office is to develop and implement an innovative, multi-media approach to promote, market and publicize Sloan as a world-class business school. The tasks of the four-person staff include designing and executing a global media strategy, coordinating and managing Sloan's web presence, supporting the dean's office communication, executing effective communication with alumni, and coordinating the development and production of various marketing materials.

The office underwent considerable staffing change in FY97-98. The entire staff is new, and all jobs have been redefined to meet the changing and increasing communication needs of Sloan. A new director began the year. A new media relations person, also responsible for supporting marketing materials production, started in September.

A web coordinator, a one-year position designed to support Sloan's web relaunch, also joined the staff in September. At the close of the year, the office was still looking to hire an administrative assistant and an alumni communications manager.

Media Coverage Goes Up
Sloan enjoyed significant media attention during the year — from *The New York Times, Wall Street Journal* and *Business Week* to *Financial Times, Les Echos* and *Asahi News.* Following is just a sampling of that coverage.

In March, in an article on the $50K competition, *Inc Magazine* declared, "Not all business plan competitions on university campuses are equal. To put it another way, the one at the Massachusetts Institute of Technology in Cambridge, Mass., is *more* equal than all the others." *Mass High Tech, Financial Times* and other media covered the competition as well. Sloan's "virtual campus" and Web-based accounting course were featured in an issue of the International Association for Management Education's Newsline (spring '98).

BBC Scotland just completed a series on entrepreneurship that included interviews with Professor Simon Johnson; Ken Morse, Managing Director of the MIT Entrepreneurship Center; and John Preston, senior lecturer and Entrepreneurship Center Assistant Director.

Sloan's pioneering move to all on-line applications received tremendous coverage worldwide in print, broadcast and online media this August and September. *The New York Times, Houston Chronicle, The Los Angeles Times, Pittsburgh Post-Gazette, BBC On-line* as well as *CBS Up to the Minute, CNBC, Financial Times* and *The Globe* and *Mail* were among the 60 media outlets to cover the story.

Web Relaunch Under Way
The largest project undertaken by the Sloan Communication office this past year was planning and managing the reconceptualization and relaunch of Sloan's web presence of some 6,000 pages. The effort is led by a cross-functional project planning team that includes Mary Schaefer, communication director; Johanna Schlegel, web coordinator; Suzana Lisanti, MIT's web coordinator; and Glenn Johnston, Sloan's acting director of technology services. This schoolwide collaborative effort has more than 60 people in the school directly involved with the project.

A Web Action Board (WAB) is made up of program directors who provide overall direction and set priorities for the project. Another group called the Websters includes people who are involved in the day to day upkeep of the web. At least three groups of students are working with the project planning team to support marketing of the new site and to build portions of the site, particularly for alumni. In addition, faculty, staff, students and alumni have provided input and direction as the project has progressed.

The project integrates the marketing and communication aspects of the web with the increasing number of web-based applications that provide services to alumni, students, faculty and staff. A vendor, Interactive Bureau of New York, is doing the design and helping to build the infrastructure needed for the relaunch and for future development.

A worldwide launch is planned for early 1999 of the top 1500 pages. Phase 2 will take place the six months following and will convert another 4,000 pages and incorporate greater functionality.

Mary Schaefer

SLOAN TECHNOLOGY SERVICES

Sloan Technology Services (STS) supports the computing needs of faculty, staff and students at the Sloan School. It is dedicated to the support of research, teaching and the best uses of information technology (IT), implementation of new technologies, lifelong learning and changing infrastructure needs within an electronic community. STS undertook a number of initiatives during FY98:

- Took significant steps in developing and installing a web-based course management program called Virtual Campus. The effort standardizes web pages for Sloan classes, and facilitates group on-line discussions, distribution of course materials, and management of class assignments.

- Conducted significant upgrading and remodeling of student computer facilities including all new equipment and new Ph.D. and Teamwork Labs. The labs are computer workspaces tailored to meet the needs of student work groups.
- Also under way is the reconceptualization and relaunch of the Sloan web site of some 6,000 pages. The effort is designed to integrate communication needs with an increasing number of web-based applications and services to students and alumni. These applications include course bidding, student satisfaction, online student and alumni directories, job interview scheduling, and opinion bulletin boards and message boards for students and alumni. This effort is being coordinated with MIT's CWIS and alumni organizations.
- Migrated a significant portion of the core technology in the school to Windows NT, including student servers. Purchased and installed 125 faculty, staff and student lab computers, verifying compatibility and installation of software programs across the school.
- Installed four quick email stations in lobbies of Building E52 and the Tang Center.
- Installed and provided access to a number of research services for students and faculty including Zack's and Forresters.

Plans for FY99 are to:
- Move all Sloan courses onto the web via Virtual Campus by year-end.
- Install a core database infrastructure and application environment to support applications across the school that will interact with and link to MIT applications and databases.
- Use technology to provide and promote lifelong learning with alumni/ae.

Glenn Johnston

SLOAN MANAGEMENT REVIEW

Sloan Management Review is a peer-reviewed management journal that disseminates research from the top business schools, with the dual purpose of affecting management practice and publicizing the Sloan School. SMR had a good year. Revenues, profits, circulation size, and citation levels exceeded expectations and were at an all-time high.

The journal is closing FY98 with revenues of $2.6 million and earned operating profits of over $1.2 million. We were able to contribute over $600,000 to the School's operating expenses. SMR's paid circulation is now over 25,000, up 10 percent from last year despite significant price increases. Renewal rates have increased 4 points to 58 percent. SMR's citation and impact ratings, measured by the Social Science Citation Index, were higher than ever. It was ranked fourth in management journals. Until last year, when it ranked seventh, it had been ranked 13th or 14th.) Only one managerially directed journal has a higher ranking. In addition, permissions and reprints sales continue to grow.

Seventy-three percent of the academically generated articles came from top-20 business schools; of those, three were from MIT faculty. Well-known authors included Gary Hamel, Dave Ulrich, Thomas Davenport, Michael Cusumano, David Garvin, Max Bazerman, David Feeny, Michael Earl, Karl Ulrich, Corey Billington, Scott Shane, and Richard Y. Wang.

We redesigned the journal to make it more accessible to readers, adding new graphics and a second color. The reader response has been overwhelmingly positive. We plan to continue to update our electronic offerings and increase revenues from permissions, reprints, and advertising. Revenues, profits, and circulation numbers are projected to go up modestly.

Jane Gebhart

SCHOOL OF SCIENCE

The School of Science at MIT continues to play a leadership role in science education and research both nationally and internationally. Our faculty received a broad array of honors and awards during the past year, internal and external, national and international. We note particularly the award to Professor Christopher "Kit" Cummins of Chemistry of the 1998 NSF Waterman Prize. Various studies including especially the NRC study of Research Doctorate Programs in the United States show that our graduate programs quite broadly are ranked among the top few in the Nation. Of course, maintaining this high standard in the future will require continued dedication and diligence by all of the members of our community, especially in an era of constrained resources.

Our education programs continue to evolve and improve in response to ever-changing conditions. Mathematics has extensively revised introductory calculus 18.01 and has introduced an "intermediate difficulty" freshman calculus sequence 18.01A and 18.02A; the latter has proven to be quite popular. Biology has been successfully introduced into the core curriculum and is continuing quite successfully. One result of adding Biology to the core is a dramatic increase in the number of Biology majors over the past several years. Interestingly, several years ago Physics introduced a major change in the structure of 8.01 with most of the teaching taking place in small sections of ~ 20 students; it turns out that this revised format which was faculty intensive, was not very popular with the freshman so Physics has returned to the large lecture format for 8.01. The "hands-on" variants of freshman physics, 8.01x and 8.02x continue to attract about 15% of the students. BCS has revamped its Cognitive Science major dividing it into four core areas and has introduced a neuroscience major. As a consequence, B&CS now has close to 100 undergraduate majors. Overall, after EECS, the departments with the largest number of undergraduate student contact hours at MIT are, in order, Mathematics, Physics, Biology and Chemistry. Further, Biology is now the second most popular major after EECS. Thus, the School of Science continues to carry a major part of the undergraduate teaching responsibility at MIT. At the graduate level, EAPS successfully introduced its Master of Science in Geosystems program.

In 1993 the School of Science established the "School of Science Teaching Prize for Graduate Education" to complement the prize for undergraduate education established by John Deutch in 1983. The 1998 winner of this award was Professor Robert Sauer of Biology. The School of Science Teaching Prize for Undergraduate Education was won by Professor Rick Danheiser of Chemistry. Sylvia Ceyer of Chemistry and Bob Jaffe of Physics were selected as MacVicar Fellows in FY98. The overall excellence of teaching in the School of Science is exemplified by our exceptional representation (45%) among the MacVicar Fellows.

The quality of an academic enterprise such as the School of Science is determined primarily by the caliber of the faculty who make it up. Thus, one of the highest priorities of the current administration in the School has been to support properly our existing outstanding faculty as well as recruiting to MIT exceptionally talented young educators and researchers including especially women and underrepresented minorities. In 1997-98 twelve new faculty joined the School as assistant professors and one additional faculty was appointed as a full professor. We also have had to stave off an unprecedented number of outside offers to our most distinguished faculty. We were, unfortunately, not always successful in this endeavor. Faculty retention remains a major issue for the School of Science.

One of the most significant events of the recent past was the formation of the Committee on Women Faculty in the School of Science. This committee was created as the result of an initiative which involved all of the senior women in the School of Science. The committee has multiple purposes and responsibilities. First, the committee has collected data to be used in assessing the status and equitable treatment of women faculty in the School of Science. Second, the committee is facilitating communications between the women faculty and the dean and department heads. Third, the committee is acting as a resource for the Dean of Science and the department heads. Finally, the committee is also serving as a resource to the MIT community as a whole to provide advice about issues of concern to women faculty at MIT.

There are many new research initiatives in the School of Science. One of the most significant is our newly established partnership with the Carnegie Institution, the Harvard Smithsonian, the University of Michigan and the University of Arizona in the Magellan Project; this involves the design and construction of twin 6.5m telescopes at Los Campanas in Chile. In addition, the Alpha Magnetic Spectrometer (AMS) is scheduled to be one

of the premier scientific experiments on the International Space Station to be launched in 2002. The AMS project, which involves an international consortium, will look for anti-matter and dark matter candidates above the Earth's atmosphere. The AMS had a successful flight on the shuttle Discovery in June 1998 with over 100 million events being recorded. These data are currently being analyzed. In Biology, Professor Lenny Guarante and coworkers made major progress in understanding the molecular mechanisms of aging.

Fund raising in the School of Science reached all-time highs over the past three years with total cash received exceeding $50M. Of particular note is the "Chemistry Campaign 2000."

ACADEMIC PROGRAMS

There were 805 undergraduate majors in the School of Science during the past academic year, a 8.7% decrease from the previous year. The number of minority student majors at the undergraduate level changed as follows:

Blacks	No change (41)
Hispanics	No change (62)
Native Americans	2 to 6 (200% increase)
Asian Americans	279 to 239 (14% decrease)

The number of minors in the School of Science in 1997-98 were 161.

School of Science faculty and staff participate actively in the UROP program. In academic year 1997-98, 225 SOS faculty and staff acted as UROP supervisors. In all, there were 1079 UROP projects over the five terms: summer 97, fall 97, IAP 98, spring 98 and summer 98. The largest number of these were in the Department of Biology which had 419 projects.

The female undergraduate population decreased marginally from 434 to 429 (-1%). Twenty-five percent of the Institute's upperclass undergraduates were enrolled in the School of Science.

Graduate enrollments in science decreased from 1,001 to 990. The total enrollment represents 19 percent of the graduate population at MIT. The number of minority students at the graduate level changed as follows:

Blacks	23 to 17 (26% decrease)
Hispanics	No change (23)
Native Americans	0 to 2 (200% increase)
Asian Americans	51 to 50 (2% decrease)

The number of female graduate students decreased from 295 to 292 (-1%). However, the overall percentage of female graduate students stayed unchanged at 30%.

The 258 faculty members in the School this past year represents a 1.5% decrease from the previous year. The undergraduate student-to-faculty ratio was 3.1 to 1, and the graduate student-to-faculty ratio was 3.8 to 1.

RESEARCH VOLUME

The FY98 research volume was $118.6 million, a slight increase over the FY97 research volume. This figure does not include the significantly increased research volume by MIT faculty at the Whitehead Institute (>$30M), HHMI faculty (>$10M) as well as the research volume associated with School of Science research carried out in the interdisciplinary laboratories reporting to the Vice President for Research.

Robert J. Birgeneau

DEPARTMENT OF BIOLOGY

The Biology Department currently has 57 active faculty members of whom 14 are located in the Whitehead Institute, 11 are located in the Center for Cancer Research, 3 are joint appointees with the Department of Brain and Cognitive Sciences, 1 is joint with Chemistry and 1 is joint with the Department of Civil and Environmental Engineering. Including active Emeriti faculty, 3 of the faculty are Nobel laureates, 24 are members of the National Academy of Sciences and 10 are investigators of the Howard Hughes Medical Institute. The department has a very strong international reputation in research and teaching and has been a leading contributor to the development and application of molecular biology.

EDUCATIONAL ACTIVITIES

In the past year, the number of undergraduates registered as Biology majors was 405. We now have the second largest number of majors following electrical engineering. The Bachelor of Sciences in Biology degree was awarded to 117 students this past year: 105 in the regular Course VII Program, 12 in the VII-A Program.

A number of Biology majors received awards in 1997-98. One of The Straight "T" Athletic Awards, which is the highest award given for athletic excellence in a particular sport, went to Jane J. Sohn, for pistol. The Chemistry Undergraduate Research Award went to Christina Eng a Chemistry and Biology major. Several biology students received writing prizes: the S. Klein Prize for Scientific and Technical Writing (Top Honor) went to Carmen R. Berg, a Biology and Chemical Engineering major; Rita Leung was the recipient of the Louis Kampf Prize in Women's and Gender Studies; and second place for the Robert Boit Writing Prize in the short story category went to Saurabh Asthana. Pooja Shukla received the William L. Stewart J. Award, which recognizes students who have made outstanding contributions to extracurricular activities and events during the preceding year. The 1998 Randolph G. Wei UROP Award went to Jeremy Heidel. Elenita Ashminova was the recipient of one of the Eloranta Summer Undergraduate Research Fellowships. Andrew Tan was the recipient of the Todd Anderson Undergraduate Teaching Prize, which recognizes undergraduate tutors who have shown sustained excellence in teaching at the Experimental Study Group. Six biology majors were named as Burchard Scholars in the School of Humanities and Social Science for 1998: Christy Canida, Paraskevi Farazi, Jean Lee, JaHyun Shin, Pooja Shukla, and Carina Fung. The Whitehead Undergraduate Prize, given to an undergraduate majoring in Biology, who shows outstanding promise for a career in biological research as demonstrated by academic scholarship and contributions to research and to the MIT community, was awarded to Cary K Lai. The recipients of the John L. Asinari Award were Susan Y. Kim and Adam G. Eldridge in recognition of outstanding undergraduate research in the field of life sciences. Tomas D. Perez and Deborah Weinstein were the recipients of the Salvador E. Luria Prize honoring outstanding scholarship and research of publication quality. Carmen Berg and Corinna Cosmas received the Ned Holt Prize for excellence in scholarship and service to the MIT community. The following biology majors were elected to Phi Beta Kappa: Corrina Cosmas, Adam Eldridge, Eric K Fynn-Thompson, Joel P. Johnson, Andrew Y,Tan, Lucy Y. Wang, Deborah M. Weinstein, Maya R. Said, Charles Wykoff, Nikolay A. Fidelman, and Celeste Nelson.

During the period from July 1, 1997 to June 30, 1998, 35 Ph.D. degrees were awarded in the Department; and 8 Ph.D. degrees were awarded in the Joint Program in Biological Oceanography with the Woods Hole Oceanographic Institute (WHOI). The maximum number of Ph.D. candidates registered in the Department in 1997-1998 was 188, with another 36 in the Joint Program. The entering class in 1997, including 8 in the Joint Program, was 29. The class arriving in September, 1998 will be 36 students, with an additional 8 students in the Joint Program.

RESEARCH

The research activities of the department are in the areas of biochemistry, genetics, microbiology, cell and developmental biology, immunology, neurobiology, and virology. The FY98 total direct cost of research in the department (including the Center for Cancer Research and the Whitehead Institute) was approximately $44.2 million, $27.2 million of which was at the Whitehead Institute. MIT overhead on the funding in the department and the Cancer Center was approximately $8.5 million.

There were many research achievements over the last year, too numerous to all be mentioned here. There were, however, several significant advances in the areas of human health and disease. The Guarente lab demonstrated that a yeast gene plays a crucial role in determining the life span of yeast cells. This suggests that scientists may be able to identify and perhaps, one day, to control, a universal aging mechanism. In another article the Guarente lab

reported on the identification of a mechanism of aging in yeast cells which suggests that scientists may be able to intervene in, and possibly inhibit, the aging process in certain human cells. The Weinberg lab made a discovery of a key molecule linked to the immortalization of human tumor cells which provides an important new target for anti-cancer drug design. Researchers in the Weinberg lab isolated and cloned the gene for the catalytic subunit of human telomerase, a molecule believed to play a major role in the transition from normal to cancerous growth. In collaboration with James Berger's lab and others, Peter Kim's laboratory reported on the first high-resolution structure of any retrovirus receptor-binding domain. The report showed images of the crystal structure of a piece of the virus envelope protein, the piece required to recognize and bind to receptors on the surface of a mammalian cell. These new images of an L-shaped molecule on the surface of a mouse leukemia virus could help scientists realize the promise of human gene therapy. Research in Monty Krieger's lab is focusing on studies of the function of a key protein involved in cells' uptake of the so-called "good" cholesterol. This protein could be an attractive target for therapeutic intervention to manipulate levels of "good" cholesterol in the blood and could lead to new treatments for atherosclerosis. Research led by David Page has shown that the Y chromosome is a crucial player in the evolution of sex chromosomes and also is a safe haven for male fertility genes. This study has implications for understanding the genetic differences between men and women and the genetic underpinnings of chromosomal disorders such as Turner syndrome.

PERSONNEL

Professors Paul Matsudaira and Terry Orr-Weaver were promoted to full Professor, effective July 1, 1998. Professor Chris Kaiser was promoted to Associate Professor with tenure and Professor Stephen Bell was promoted to Associate Professor (without tenure).

Three new faculty members, previously reported, arrived during the past year to assume their positions and set up their laboratories: Dr. Frank Gertler and Dr. Paul Garrity joined the Department as Assistant Professors, and Dr. Ilaria Rebay joined the Whitehead Institute and Department of Biology as an Assistant Professor.

We are pleased to report that Drs. Angelika Amon and Jamie Cate have accepted positions in the Department.

Dr. Amon will join the Center for Cancer Research and the Department as an Assistant Professor. She plans to continue her investigations on the control of cell cycle in yeast and cell proliferation. Dr. Amon received her Ph.D. from the University of Vienna and is currently a Whitehead Fellow at the Whitehead Institute for Biomedical Research.

Dr. Cate will join the Whitehead Institute and the Department as an Assistant Professor. He received his Ph.D. from Yale University and is doing postdoctoral studies at the University of California, Santa Cruz. He plans to continue studying the structure of ribosomes by using X-ray crystallographic techniques to obtain a high resolution structure and then use biochemical and genetic techniques to discover how ribosomes work.

Three faculty left during the past year: Dr. David Baltimore assumed the presidency of the California Institute of Technology; Dr. Hidde Ploegh accepted a position at Harvard Medical School and Dr. Paul Schimmel accepted a position at the Scripps Research Institute.

It is a pleasure to report the following honors and awards to Biology faculty during the past year:

Tania Baker was the recipient of the 1998 Schering-Ploegh Scientific Achievement Award from the American Society for Biochemistry and Molecular Biology.
Stephen Bell received the Everett Moore Baker Memorial Award for Excellence in Undergraduate Teaching.
Jianzhu Chen was named the Latham Family Career Development Professor.
Andrew Chess was named the Robert Swanson Career Development Professor.
Arnold Demain received the 1998 Alice C. Evan Award from the American Society of Microbiology.
Paul Garrity is the recipient of a McKnight Scholar Award in Neurosciences.
Nancy Hopkins was elected a fellow of the American Academy of Arts and Sciences.
H. Robert Horvitz received the 1998 General Motors Cancer Research Foundation Sloan Prize. Prof. Horvitz was also the recipient of the 1998 Passano Award and was awarded Brandeis University's 1998 Lewis Rosenstiel Award for distinguished work in basic medical research.

David Housman was elected to the Institute of Medicine.
Tyler Jacks was the recipient of the 1998 American Society for Biochemistry and Molecular Biology-Amgen Award.
Peter Kim received the 1998 Ho-Am Prize for Basic Science from the Samsung Corporation. Prof. Kim was also elected to Fellowship in the American Academy of Microbiology.
Jonathan King was named the President of the Biophysical Society.
Eric Lander received the Woodrow Wilson Award for undergraduate alumni exemplifying Princeton in the Nation's Service. Prof. Lander also received the 1998 Chiron Corporation Biotechnology Award, the Robert J. and Claire Pasarow Foundation Award and the Phi Beta Kappa Associates Award.
Carl Pabo was elected a member of the National Academy of Sciences.
Ilaria Rebay is the recipient of a Rita Allen Scholars Award.
Alexander Rich was the 1998 recipient of the American Society for Biochemistry and Molecular Biology-Merck Award.
Frank Solomon was a recipient of the Frank E. Perkins Award for Excellence in Graduate Student Advising.
Robert Sauer assumed the Presidency of the Protein Society. Prof. Sauer was also the recipient of the 1998 School of Science Prize for Excellence in Graduate Teaching.
Robert Weinberg was the recipient of the 1998 Pasarow Research Award in Cancer.

Last fall the first graduate student fellowships and postdoctoral fellowships under the Merck/MIT Research Collaboration Agreement were announced. Eight graduate fellowships were awarded for two years to students outside the biological sciences who are working on biology-related projects. Ten postdoctoral fellowships were awarded for support for a year for projects in the biological sciences that are already underway. The Merck/MIT Research Collaboration Agreement is also funding nine research projects. Twice yearly, Merck scientists come to MIT for a symposium with the fellowship and research grant recipients. The Merck spring symposium focused on neuropharmacology and featured talks by two Merck scientists who discussed an exciting development in neuropharmacology that may point to a new means of treating depression and anxiety. The MIT/Amgen Research Agreement, begun in 1994, continues to flourish and provides for funding up to $3 million a year for joint research initiatives. The inaugural issue of the MIT BUG Journal was published in May, 1998. This MIT Biology Undergraduate journal publishes scholarly reports based on research done in either Project Lab or in a UROP and celebrates the future generation of scientists. In April the Whitehead Institute co-sponsored a major interdisciplinary conference exploring the impact of new genetic technologies on law, medicine, public health and other sectors of society. The conference, "The Human Genome Project: Science, Law and Social Change in the 21st Century" brought together hundreds of physicians, lawyers, journalists, ethicists, scientists and students from around the country.

More information about this department can be found on the World Wide Web at http://web.mit.edu/biology/www/

Phillip A. Sharp

DEPARTMENT OF BRAIN AND COGNITIVE SCIENCES

To study the brain and its complexities, the Department of Brain and Cognitive Sciences combines the experimental technologies of molecular and systems neuroscience with the theoretical power of computational neuroscience, while our cognitive science program focuses on the mind-brain connection.

FACULTY RESEARCH DEVELOPMENTS

LEARNING AND MEMORY

Tomaso Poggio's research in the Center for Biological and Computational Learning examines learning as a gateway to understanding intelligence in man and machines. During the last year, his group established the foundation of a unified theory for supervised learning that connects regularization, Support Vector Machines and Basis Pursuit Denoising. A surprising mathematical result they obtained suggests an equivalence, under certain conditions, between generalization power and sparsity of the representation. The new work on sparse representations led to the development of an architecture that can 'learn' to perform rather difficult object detection tasks in images, such as detection of faces or detection of people in isolated cluttered images.

Earl Miller's laboratory provided several insights into the neural basis of memory and cognition in the primate prefrontal cortex. One study explored the role of prefrontal neurons in selecting the sensory information that is fully processed and reaches awareness. It is well established that our cognitive functions are severely limited in capacity; we can only think about a few things simultaneously. This experiment identified neural mechanisms in the prefrontal cortex that select the information relevant for guiding thoughts and actions.

Guosong Liu studies how synaptic activity regulates the strength of interconnections between neurons in the central nervous system and what role activity plays in the process of synapse formation, elimination, and consolidation. In the last year, he focused on uncovering the molecular and cellular events in the process of synaptogenesis. His laboratory found that influx of Ca2+ through neural activity plays a critical role in the maturation of presynaptic terminals. Furthermore, the proper level of neural activity is essential for postsynaptic receptor clustering, because both increase and removal of neural activity can block clustering.

VISION AND MOTOR CONTROL

During the past year, there were three major accomplishments in Barton Anderson's laboratory. First, he developed the first quantitative theory of the information available from binocular occlusion junctions, and experimentally demonstrated that the human visual system uses this information. Second, he demonstrated that the mechanisms responsible for synthesizing coherent contours from moving image sequences exhibit a strong velocity dependence. All prior work and theory assumed that these completion mechanisms can be understood with static geometric principles, which his data shows is incorrect. Third, he developed a general theory of how the human brain computes lightness, opacity, and depth from stereoscopic images, and experimentally demonstrated how these computations are related in the human brain.

Several projects initiated in Mary Potter's laboratory within the last year concerned the perception and encoding of meaningful material presented in a continuous sequence, as is characteristic of normal experience in which we look around or read with three or four fixations per second, or listen to continuous speech at three or more words per second. They showed that people have little difficulty in understanding sentences that switch several times between auditory and visual modalities of presentation, demonstrating that language processing is fundamentally amodal and abstract. In a study of attention switching, they found evidence that changing the nature of the attentional task, or having to note target events that appear in a rapid temporal sequence, create distinct kinds of attentional deficits.

Emilio Bizzi's laboratory provided a novel perspective on how the vertebrate nervous system produces movement. They demonstrated that the neural circuitry within the frog spinal cord produces motor responses to hindlimb cutaneous stimulation by the combined recruitment of a small number of distinct muscle groups. Such a muscle group, in which the activation level of a set of muscles is specified together, has been termed a "muscle synergy." Laboratory results provided direct support for their proposal that such spinally organized muscle synergies might underlie the production of movement.

Ann Graybiel's laboratory succeeded in applying ensemble recording techniques to ask what neural processing goes on in the basal ganglia as animals become conditioned in a T-maze task. They found striking changes in the responses of neurons as the animals learn to run the maze. During this time the neurons acquire novel responses very early in the task. The researchers suggest that the animals are building up expectancy signals in the basal ganglia and that these allow the basal ganglia to work in cooperation with the neocortex in a feed-forward loop.

NEURAL DEVELOPMENT

Gerald Schneider obtained evidence that a particular kind of interneuron in the mammalian brain has plastic potential in the adult mammal. The neuron type is defined by the presence of a molecule (GAP-43) that in many systems is prominent only in the developmental period. His laboratory demonstrated that short-axon interneurons sprout after a brain lesion that causes a loss of axonal input in part of the thalamus of adult hamsters. The lesion is followed by a progressive filling in of the denervated areas by GAP-43 enriched neuronal processes, believed to be the axons of the interneurons. Similar cell types are prominent in parts of the human neocortex believed to play major roles in higher cognitive functions.

Mriganka Sur's laboratory identified signaling mechanisms that are important for the activity-dependent development of connections in the visual system of the mammalian brain. Synchronous neuronal activity is used widely in the developing brain for tuning synapses and their strength. A class of glutamate receptor, the NMDA receptor, is crucial for detecting this activity. Downstream of this receptor, the laboratory demonstrated the role of nitric oxide, a diffusible messenger, and cGMP, a cyclic nucleotide, as key components mediating the structural changes that follow synaptic plasticity.

LANGUAGE

Steven Pinker's laboratory studied the language development of almost seven hundred monozygotic and dizygotic twins, and found evidence of the heritability of several major milestones of language development: vocabulary growth, first word combinations, and first creative grammatical errors. The hope is that these results will be among the first studies in a new field, cognitive genetics, that will combine cognitive science and psycholinguistics with genetics to seek the genetic roots of higher mental processes.

The research in Edward Gibson's laboratory over the past year concentrated on investigating the relationship between the language comprehension mechanism and the available computational resources in working memory. Reading-time and questionnaire experiments revealed that language processing is highly locality-based: the greater the distance between an incoming word and the most local word to which it connects, the greater the integration cost, as measured by reaction times and complexity ratings. The resulting theory of sentence understanding accounts for a large array of phenomena across constructions in many languages.

EDUCATION

Graduate students have been very successful in winning competitive fellowships to finance their education. These awards include the Clare Boothe Luce Foundation Fellowship, the John Merck/MIT Graduate Fellowship in Informatics, the Poitras Predoctoral Fellowship, and two Howard Hughes Medical Institute Predoctoral Fellowships. In addition, two students won Glenn/American Federation for Aging Research Scholarships for their summer projects involving research on the Biology of Aging.

The number of students who have chosen a major in the department increased from 74 last year to 91 this year. The department also continues to draw large numbers of undergraduates into UROP positions for course credit and employment in research projects. In addition, the Committee on Curricula accepted our proposed revisions for the new undergraduate major program. The first of the new courses, Statistical Methods, was very well received in the Spring semester. Additional new courses, including Neural Plasticity in Learning and Development, Language Acquisition, and Visual Cognition, will be offered in the coming academic year.

FACULTY HONORS AND AWARDS

Suzanne Corkin	Named Neuropsychologist of the Year by the Massachusetts Neuropsychological Society
Ann Graybiel	President, International Basal Ganglia Society Board of Scientific Councilors, NIMH

	Board on Neuroscience and Behavioral Health, Institute of Medicine
Guosong Liu	Selected as the Edward J. Poitras Assistant Professor in Human Biology and Experimental Medicine
Earl Miller	John Merck Foundation Scholar
Steven Pinker	Elected to the American Academy of Arts and Sciences Los Angeles Times Book Prize in Science and Technology Literary Lights Award, Boston Public Library Books to Remember (25 Best of 1997), New York Public Library
Tomaso Poggio	Elected to the American Academy of Arts and Sciences Member, Daimler-Benz Circle Member Group, 1997 Honorary Chair, International ICSC/IFAC Symposium on Neural Computation, Technical University of Vienna
Mriganka Sur	Board of Editors, The MIT Press
Mriganka Sur	

DEPARTMENT OF CHEMISTRY

In the 1997-98 academic year, the Chemistry Department continued its strong program in research and undergraduate and graduate education. Associated with the department currently are 193 graduate students, 88 postdoctoral researchers, and 125 undergraduate chemistry majors.

As of July 1, 1998, the Chemistry Department Faculty comprises 27 full-time faculty members, including 5 Assistant, 1 Associate, and 21 Full Professors. New faculty appointments in the past year include Peter Seeberger in January, 1998 and Jianshu Cao and Andrei Tokmakoff on July 1 (all as Assistant Professors). In July 1997, Daniel Nocera, formerly Professor of Chemistry at Michigan State University, joined the Department as a Full Professor. Departures from the faculty during the past year include Professor William Orme-Johnson who retired in March and Jamie Williamson who left the department to move to the Scripps Research Institute in January, 1998. In addition, the appointment of Assistant Professor Scott Virgil ended in June, 1998.

FACULTY AWARDS AND HONORS

- Professor Sylvia T. Ceyer was appointed a MacVicar Faculty Fellow in recognition of her outstanding contributions to undergraduate education at MIT. Five of the 31 MacVicar Fellows are members of the Chemistry Department (Professors Ceyer, Danheiser, Essigmann, Kemp, and Silbey), the highest representation among any departments at the Institute.

- Professor Christopher "Kit" Cummins was awarded the 1998 National Science Foundation Waterman Prize, the National Science Foundation's most prestigious prize for young researchers. This is the first time an MIT faculty member has been honored with this award. Professor Cummins was also honored this year with the 1998 American Chemical Society Award in Pure Chemistry.

- Professor Rick L. Danheiser won the School of Science Prize for Excellence in Undergraduate Teaching.

- Professor John Essigmann received the MIT Arthur C. Smith Award for "meaningful contributions and devotion to undergraduate student life at MIT".

- Professor Robert Field was elected to the American Academy of Arts and Sciences.

- Professor Gregory C. Fu was honored with an American Chemical Society Arthur C. Cope Scholar Award.

- Professor Mario Molina received the American Chemical Society Award for Creative Advances in Environmental Science and Technology sponsored by Air Products & Chemicals, inc.

- Professor Irwin Oppenheim won the Joel Henry Hildebrand Award in Theoretical and Experimental Chemistry of Liquids sponsored by Exxon Research and Engineering Co.

- Professor JoAnne Stubbe received the American Chemical Society's Alfred Bader Award in Bioinorganic and Bioorganic Chemistry. Professor Stubbe was also honored with the F. A. Cotton Medal for Excellence in Chemical Research awarded at Texas A&M University.

- Professor Scott Virgil received the 1998 MIT Graduate Student Council Teaching Award".

INFRASTRUCTURE DEVELOPMENTS

The MIT Chemistry 2000 campaign, helping to finance the renovation of 90,000 square feet of laboratory space, is almost complete more than a year ahead of schedule. Generous gifts and pledges from department alumni/ae this year have brought us to within the last $300,000 of the external funding target. These campaign resources (including a challenge grant from Visiting Committee Chair Richard Simmons), combined with department and Institute commitments, will enable $15 million of reconstruction.

To date, renovations begun in early 1997 have been completed to house the Department of Chemistry Instrumentation Facilities (DCIF) in the subbasement of the Dreyfus Building (Building 18), the laboratories of

Professor Daniel Nocera, who joined the faculty in the summer of 1997, and the newly consolidated Chemistry Education Office, including undergraduate and graduate student lounges. In July of 1998, renovations will be completed to create state-of-the-art laser labs for Professor Bawendi and a laboratory to house a new experiment for Professor Ceyer. Also nearing completion is the design phase for the laser labs of Professors Nelson, Field, Steinfeld, Nocera, and Tokmakoff, the last being a new appointment effective July 1998, for the wet labs of Professors Schrock and Cummins, for the new Departmental X-ray Crystallography Facility, and for relocated shop support facilities. Construction on these projects will begin in August of 1998 and be completed on a rolling basis over the first and second quarters of 1999. With the exception of the DCIF and the Bawendi Laser labs which are located in Building 18, all of these projects are housed in Chemistry's space in the main group, Buildings 2, 4 and 6. During this past year, a separate team of architects and engineers began to plan for renovations in the Dreyfus Building. During the course of these activities, the need for substantial increases in budget was revealed, resulting from legally mandated building code changes, highly deficient infrastructure, and a variety of safety considerations in both the main group space and building 18. These building code and safety changes are mandated by regulatory authorities and are triggered by the scope of the proposed renovations. We have been advised by the design team that, even if we were drastically to cut back on the scope of the renovations to that of a purely "cosmetic" level, the price of doing even that minimal amount of work would, together with the square footage involved, force us to bring the building into compliance with codes. In simpler terms, if we do any renovations at all, we must do the full renovations. With the scope of the renovations as envisioned and justified in Campaign Chemistry 2000, we are can no longer postpone such action. Whether mandated or not, the only prudent and acceptable course of action to take following disclosure of these infrastructure shortcomings is to correct them, at least to the level required by law, if not further. By its very nature, research in the chemical sciences involves significant hazards and the use of hazardous substances. To provide anything less than the safest possible facilities to our students, postdoctoral research associates, and faculty would be unacceptable and place the Institute in a position of serious moral and legal risk.

EDUCATION

In the Fall of 1997, 35 students entered the graduate program of the Chemistry Department and from September, 1997 to June, 1998 the Department awarded 9 M.S. and 44 Ph.D degrees. In December we opened our new Chemistry Education Headquarters in Building 2, combining two previously-separated offices, the Undergraduate Education Office and the Chemistry Graduate Office. Included in the new Chemistry Education Headquarters are the offices of Dr. Miriam Diamond, Coordinator of Chemistry Education, and Ms. Susan Brighton, Graduate Administrator, and their staff, as well as new Undergraduate and Graduate Student Common Rooms. Also opening this past academic year was a new Computational Chemistry Classroom in Building 6.

The Committee on the Chemistry Curriculum is continuing their review of our undergraduate educational program and this past year saw the introduction of several new courses as a result of their evaluation of the chemistry curriculum. To encourage undergraduate research, a new optional undergraduate thesis was introduced (course 5.ThU) and three seniors submitted theses at the end of the spring semester. An exciting new "active-learning" style course (5.21, "Design and Synthesis") was introduced this spring and taught by Professors Danheiser, Stubbe, and Tidor. In order to provide first-year students with an opportunity for "hands-on" experience in laboratory chemistry, a new IAP course on "Chemistry Labortory Techniques" (Chemistry 5.30) was introduced with great success.

In the area of graduate student education, we continued to expand our intensive training program for Graduate Teaching Assistants and introduced mid-semester "tune-up" sessions on teaching technique. Our academic orientation program for new graduate students was expanded to include a workshop on scientific ethics. In the fall, we held the first of an annual series of workshop/conferences on "Careers for Chemistry Ph.Ds"; the topic of the 1997 conference was "Careers in Education at Principally Undergraduate Institutions".

At the Senior Recognition Dinner in May, the recipients of the 1998 Undergraduate Chemistry Awards were announced:

- The Hypercube Scholar Award for outstanding contributions to the advancement of computers in teaching was awarded to Timothy Shiau.

- The Chemistry Undergraduate Service Award for outstanding service to the department by an undergraduate was presented to Maria Manzoni.

- The Merck Index Award for outstanding scholarship was given to Janelle Brown, Raquel Lieberman, and Timothy McAnaney.

- The American Institute of Chemists Award was presented to John Gavenonis in recognition of his outstanding achievement, ability, leadership, and character.

- The Chemistry Undergraduate Research Award for outstanding research in the field of chemistry by an undergraduate was awarded to Christina Eng, Maria Manzoni, and Laura Turculet.

- The Frederick D. Greene Teaching Award was presented to Timothy Shiau for outstanding teaching in the field of chemistry by an undergraduate.

- The Alpha Chi Sigma Award for achievement in research, scholarship, and service to the department was given to Steven Klei and Michelle Machacek.

- In addition, the following chemistry majors were noted for their work as educators, both at MIT and in the community. For teaching: Songpon Deechongkit, Jennifer Espinosa, Sarah Folscroft, Jennifer Lee, Raquel Lieberman, Maria Manzoni, Nathan Scott, Timothy Shiau, and Jason Wong. For tutoring: Spencer Behr, James Chen, Qinghao Chen, Janet Chieh, Victoria Gomez, Cynthia Liang, Maria Manzoni, Yelena Margolin, Marco Mena, Juliet Midgley, Shirley Mihardja, Preeyanuch Sangtrirutnugul, Chris Thomas, and Alice Wang. For their contributions to the "Chemistry Magic Show" performed at area elementary schools: Joshua Bittker, John Gavenonis, Jennifer Lee, and Timothy Shiau.

- Graduate student Kevin Shea was presented with the MIT Goodwin Medal which is awarded annually to recognize outstanding teaching by a graduate student at the Institute.

The Department of Chemistry Outreach Program, created in 1988, continues to be one of the most successful programs of its kind in the country. Currently our graduate students visit over 50 schools each year (including ca. 10 inner-city schools), performing a program of lectures and demonstrations before more than 3,000 high school students.

RESEARCH HIGHLIGHTS

Professor Moungi Bawendi: The Bawendi group has built a system for single molecule fluorescence spectroscopy and applied it to study single quantum dots of CdSe under a variety of conditions, including under applied electric fields. They found that the dots have large enough polarizabilities that potential applications in optoelectronics may be feasable and they have also developed a synthetic methodology for highly fluorescent quantum dots where the emitted light can be tuned throughout the visible by changing the size of the dots.

Professor Sylvia Ceyer: Both surface-bound H atoms and bulk H atoms, upon emerging from the bulk of Ni metal to the surface, are demonstrated to react with C2H2 adsorbed on Ni(111) and to have unique product distributions. This observation is in stark contrast to the unreactivity of surface-bound H and the singular reactivity of bulk H with C2H4, but is consistent with the need for the H atom to have a co-planar approach to the p orbitals of the unsaturated hydrocarbon for reaction to occur. Both bulk H and surface-bound H react with C2H2 to produce adsorbed ethylidyne, CCH3, while only bulk H hydrogenates C2H2 to gas phase ethylene and ethane, the products of interest in acetylene hydrogenation catalysis for the purification of ethylene streams. These results demonstrate that the distinctive reactivities of surface-bound H and bulk H arise from both their distinct energies and directions of approach to the adsorbed unsaturated hydrocarbon.

Professor Robert Field: The Field group is involved in collaboration with scientists in China, France, Switzerland, Canada, and several universities and an Air Force Laboratory in the USA, because his collaborators have functioning laboratories. At MIT they have developed some powerful pattern recognition techniques (Extended Cross Correlation, XCC, and Extended Auto-Correlation, XAC) that are capable of extracting an unknown number

of a priori unknown patterns that are repeated in multiple spectra. The XCC method was used to observe the first example of "local bender" behavior in the dispersed fluorescence spectrum of the acetylene molecule. Information extracted from spectra about the structure and dynamics of local benders, unlike normal modes, should be transportable among all molecules that have a similar functional group. This local bender motion lies along the minimum energy isomerization path from acetylene to vinylidene. This brings the goal of actually observing the spectral signature of bond breaking isomerization, a goal I articulated almost 20 years ago as the cornerstone of his research, within their grasp. They have also built a new apparatus designed for the study of triplet states of small polyatomic molecules (e.g. acetylene). From the initial spectra recorded with this apparatus, they have been able to demonstrate that InterSystem Crossing (ISC) in acetylene follows a "gateway mediated" rather than a statistical mechanism. The reason they have been able to accomplish this is the sensitive Auger-effect detection scheme for detecting exclusively triplet states with electronic excitation energy above a specifiable value set by the work function of the "Auger detector". Another new apparatus, designed to measure the multipole moments of molecular cations by millimeter-wave spectroscopy of core-nonpenetrating Rydberg states, is ready to record its first spectra.

Professor John Essigmann: The Essigmann group completed genetic analysis of three oxidized cytosines and found that two of these bases are potently mutagenic. Moreover, they have the mutagenic specificity to explain GC to AT transition mutations. This transition is the most frequent spontaneous mutation observed in aerobic organisms, and they completed total synthesis of the first psoralen-thymine crosslink. This product is being used for studies of crosslink repair.

Professor Alex Klibanov: The Klibanov group has discovered the possibility of correct protein refolding/reoxidation in a nonaqueous solvent, glycerol. Moreover, the refolding yield in glycerol, as well as in various aqueous-organic (predominately organic) mixtures, but not in water, can be markedly enhanced by common salts, Parallel NMR and CD studies have given insights into the structure of proteins dissolved in such nonaqueous medial.

Professor Stephen Lippard: The Lippard group has demonstrated loss of telomeres in cells treated with cisplatin. and modelled DNA methyl phosphotriester repair as well as modelled the centers in methane monooxygenase and ribonucleotide reductase.

Professor Peter Seeberger: The Seeberger laboratory has been concerned with the development of novel glycosylation reactions and their application to the preparation of biologically active oligosaccharides and glycoconjugates in solution and on a solid support. Particular progress has been made with the synthesis of carbohydrate based vaccines against tropical diseases and cancer as well as novel drug targeting devices.

Professor Robert Silbey: Optical transitions in molecules are very sensitive to the environment of the molecule. In collaboration with the experimental group of Professor Haarer (Bayreuth University, Germany), they compared the long time changes in optical line shape for chromophores in proteins and in organic glasses. The group found that these can be explained by the dynamics of the side chains in the glasses and proteins, while the short time spectral diffusion is explained by the collective backbone dynamics. The differences between proteins and glasses is attributed to the amount of disorder and organization in their respective energy landscapes.

Professor Jeffrey Steinfeld: An IntraCavity laser Absorption Spectrometer has recently been installed in Prof. Steinfeld's laboratory. This instrument is especially suitable for studies of atmospheric trace species, since it provides sensitivity equivalent to a path length of hundreds of km through the atmosphere, but in a controlled laboratory environment in which the pressure, temperature, and composition of the sample may be specified and varied at will by the investigator. Intensity and pressure-broadened linewidth measurements are currently under way on the atmospheric oxygen bands, water vapor, water dimer, and water complexes with atmospheric trace molecules.

Professor Larry Stern: Highlights of research in the Stern Laboratory for 1997-1998 include the demonstration of T-cell activation by MHC dimers and its dependence on the relative orientation of MHC molecules within the dimer, showing that activation requires a particular molecular complex, and discovery of a large conformational change that accompanies peptide binding to class II MHC proteins.

Professor Timothy Swager: The Swager group is actively involved in the design of novel chemical sensors, liquid crystals, and functional supramolecular assemblies. Highlights from the last year include the demonstration of a new highly sensitive sensory material for the detection of TNT, a widely used explosive. This approach involved the synthesis of a new class of conjugated polymers with rigid three-dimensional structures create a porous "honeycomb" type of structure. These porous materials behave as a sponge for electron poor molecules such as TNT and also provide unique stability as well as very bright fluorescence in the solid state.

In the area of supramolecular assemblies, novel procedures utilizing Langmuir-Blodgett techniques have been developed for the organization rigid-rod electronic polymers into nanoscopic fibrils and grids. The nanoscopic grids, which could not be synthesized by conventional methods, and are potential candidates for separating and discriminating different biological molecules.

Professor Bruce Tidor: A theory has been developed for determining optimum electrostatic charge distributions complementary given protein receptors. These optima provide the most favorable balance of ligand desolvation penalty and favorable interactions formed in the complex. This development has important implications for rational ligand design.

More information about the Deparment of Chemistry can be found on the World Wide Web at the following URL:http://web.mit.edu/chemistry/www/

Rick L. Danheiser, Stephen J. Lippard

DEPARTMENT OF EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Research and education within the Department of Earth, Atmospheric and Planetary Sciences (EAPS) engage a broad array of scientific disciplines: geology, geophysics, geochemistry, physical and chemical oceanography, meteorology, atmospheric chemistry, and planetary sciences. Particular emphasis is placed on the study of the complex geosystems involving the Earth's atmosphere, ocean, crust, and deep interior and the similar systems on other planets. The Department comprises 40 faculty, including two with primary appointments in Civil and Environmental Engineering, 209 graduate and undergraduate students, and approximately 150 staff members.

EDUCATIONAL ACTIVITIES

During the past academic year, 170 graduate students were registered in the Department (Course 12) and the MIT/Woods Hole Oceanographic Institution (WHOI) Joint Program (Course 12W). Each disciplinary area of EAPS continues to be ranked among the top graduate programs in the country, with most areas being rated either first or second nationally. The EAPS graduate program currently focuses on the Ph.D. degree, which is the goal of over 90% of its graduate students. There is a growing need, however, for professionals trained at the master's level who can solve geoscience problems in a broad, systems-oriented context. In response to this need, EAPS has developed a new degree program, which awards the Master of Science in Geosystems. The new Professional Masters program had a first year enrollment of five students this past year, with ten being projected for the 1999 academic year. A second major educational initiative has been the establishment of the Program in Atmospheres, Oceans and Climate (PAOC), which coordinates graduate study in atmospheric science, oceanography, and climate physics and chemistry. The Program offers a broadly based curriculum for students interested in studying climate at the system level, and in performing research in oceanography and atmospheric science.

EAPS continues to maintain a strong presence within the undergraduate program at MIT. The Department continues to offer by far the most freshman advising seminars at the Institute, and EAPS faculty advised 10% of the freshman class for the fourth consecutive year. The EAPS Independent Activities Program (IAP) continues to be one of the most vibrant at MIT, and faculty have maintained a healthy Undergraduate Research Opportunities Program (UROP). The bachelor of science curriculum has been reorganized to include three areas of concentration: geoscience, physics of atmospheres and oceans, and planetary science and astronomy. Each concentration encompasses a set of required courses, a sequence of field and laboratory subjects, and independent study or thesis preparation. An undergraduate minor degree program has also been developed to complement degrees in other disciplines, providing a foundation for careers that incorporate areas of geoscience.

FACULTY

Ronald G. Prinn, TEPCO Professor of Atmospheric Chemistry, became EAPS Department Head effective July 1, 1998, replacing Thomas H. Jordan who served as EAPS Department Head for a decade 1988 - 1998. The Department flourished under Professor Jordan's leadership. He continued to strengthen the Department by appointing exceptional young faculty addressing fundamental problems in the earth sciences. Professor Jordan recognized talent across the disciplines, and helped to create an environment where significant scientific advances were achieved. These advances allowed the Department to further enhance its national and international preeminence.

Robert D. van der Hilst was promoted to Associate Professor without tenure. Dara Entekhabi, Associate Professor with tenure in the Department of Civil and Environmental Engineering, was granted a joint appointment in EAPS.

Thomas H. Jordan was elected to the National Academy of Sciences, and was awarded the George P. Woolard Award by the Geological Society of America. Maria T. Zuber was appointed to the Earle A. Griswold Professorship. John P. Grotzinger was awarded the Waldemar Lindgren Distinguished Scholar Award in Geology. Rafael L. Bras was named the Horton Lecturer of the American Meteorological Society, and was awarded the Clarke Prize for excellence in water research by the National Water Research Institute. Clark B. Burchfiel was awarded the Friendship Medal of China, and elected a corresponding member of the Chinese National Academy of Sciences. Charles C. Counselman received the biennial Kershner Award of the Institute of Electrical and Electronics Engineers for his contributions to electronic positioning technology. R. Alan Plumb was elected a Fellow of the Royal Society (London) for his contributions to atmospheric science.

CURRENT RESEARCH

GEOLOGY AND GEOCHEMISTRY

Samuel Bowring's research group's most significant finding of the past year involves the largest extinction event (85% of all marine fauna) in Earth's history, the Permo-Triassic boundary. Using high precision U-Pb geochronology, this extinction has been constrained to have occurred over a very short interval of time -- between 160,000 and 10,000 years -- at 251.3 Ma. The extreme rapidity of this event suggests a catastrophic mechanism for the extinction (results published in Science magazine). Kip Hodges has focused his recent research on understanding the behavior of mountain ranges as complex systems, with an eye toward documenting positive and negative feedback relationships between thermal and deformational processes.

Timothy Grove and colleagues have used methods of experimental petrology to understand the nature of mantle/magma interactions in the formation of lavas from Kilauea volcano. They find that magmas have chemically eroded the shallow mantle beneath Kilauea as they ascend to the surface. The mass that reacts is on the order of two to three times the erupted magma mass. This process occurs at a relatively shallow depth of 42 km. Thus, any deep melting signature in the huge volcano is masked by shallow mantle/melt interaction. Frederick Frey's research continued to focus on understanding the evolution of large oceanic volcanoes that are attributed to partial melting of ascending regions of relatively hot mantle "plumes". In the Hawaiian Island region, a new result is that large areas of submarine volcanism occur 200-400 km distant from the main volcanoes. The temporal and spatial geochemical variations of these Hawaiian lavas show that several mantle sources contribute to Hawaiian volcanism, and that their proportions change systematically during the one million year growth of the volcano.

Leigh Royden and Clark Burchfiel spent time in the eastern and southeastern part of the Tibetan plateau studying the uplift and formation of the Tibetan plateau, and how the river drainage system off the plateau has been shaped and reshaped by tectonic and climatic effects. From field and modeling studies they hope to determine the age of uplift and river incision in this part of the plateau, which are thought to have greatly affected and been affected by global climate changes between about two and ten million years ago. John Grotzinger is extending his work on sediment gravity flow deposition, looking further into the poorly understood rapid deposition of structureless sediment by powerful turbidity currents by means of high speed cinematography. John Southard, in cooperation with Grotzinger, is building small scale models of submarine fans, and studying rapid deposition of sands from submarine turbidity currents to aid in exploration for petroleum in deep offshore areas. Kelin Whipple's research in this past year has yielded several papers focused on analysis of the dynamics of bedrock river incision, with implications for height limits of mountain ranges, timescales of landscape response to climatic and tectonic forcing, and hypothesized global scale interactions between climate, erosion, and tectonics using a combination of field, theoretical, and remote sensing approaches.

GEOPHYSICS

In the past year Robert van der Hilst has made further improvements to the high resolution tomographic models of aspherical mantle structure. After showing that the upper mantle transition zone does not produce layering of mantle convection, he is now working to obtain evidence for a complex change in seismic properties in the lower mantle (at approximately 2000 km), which may hint at chemical stratification at much larger depth than previously thought. The waveform imaging of the Australian continent is in its final stage, and scientists can now determine and evaluate the relationship between continental thickness and the age of its formation on the scale of an entire continent. In addition to his duties as Department Head, Professor Thomas Jordan participated in deployment of a large aperture seismic array in southern Africa as part of the multi-institutional, multi-disciplinary Kaapvaal Project. He and his group obtained preliminary results that indicate the presence of anisotropic deep structure beneath the ancient core of the Kaapvaal craton.

Chris Marone has focused on the frictional properties of granular materials, the rheology of brittle fault zones, and the mechanics of earthquakes. His recent work has shown that loading rate has an important effect on frictional healing and the evolution of fault strength during the seismic cycle. Experiments being carried out in his laboratory are leading to an important revision of the slip rate and friction constitutive laws that are heavily used in modeling of earthquake rupture. Supported by a von Humboldt prize, Brian Evans has been working during the last year at the Geoforschungs Zentrum in Potsdam, Germany, on the brittle ductile transition in rocks and on grain boundary structure and properties in carbonate and feldspar rocks. Peter Molnar, along with Philip England of Oxford

University, has demonstrated that the Navier-Stokes equation, for which horizontal gradients in stress are balanced by the gravitational body force (via crustal thickness differences), governs the large scale deformation of Asia, which behaves as a non-linear viscous fluid.

Bradford Hager and colleagues published the best estimate to date of the signature of delayed postglacial rebound in Earth's gravity field, a result that requires a substantially more viscous mantle beneath Hudson Bay than had previously been recognized. Thomas Herring, with research scientists Robert King and Simon McClusky, has been applying the Global Positioning System to global and regional scale deformation problems, and to remote sensing atmospheric water vapor. Professor Herring has also been working on aircraft and spacecraft laser altimetry for topographic profiling. In fundamental studies of erosion, Professor Daniel Rothman has found novel theoretical and empirical evidence of coupled physical processes acting across widely disparate length scales in the evolution of natural landscapes.

Dale Morgan is developing extensive technologies for imaging underground caves and structures. He continues a variety of geophysical investigations of groundwater contaminant sites, and is also measuring and modeling electrical signals generated when rocks are fractured in an attempt to understand electrical phenomena in earthquake source regions. Robert Reilinger and Robert King have shown that extensional tectonism reaches north of the North Anatolian fault into central Bulgaria, Macedonia and Albania, and must be considered the northern part of the Aegean extensional regime. Nafi Toksöz, along with Robert Reilinger, Robert King and Simon McClusky, is coordinating an international project to use GPS to map crustal deformation in the Eastern Mediterranean, providing new constraints on lithospheric rheology and dynamics in this plate collision zone. They are also using new GPS measurements in Southern California and Northern Baja, Mexico to map deformation along the San Andreas fault system to quantify fault slip rates for earthquake hazard studies. Toksöz has also developed techniques for using seismic reflection measurements to characterize the orientation and density of fractures in petroleum reservoirs.

PLANETARY SCIENCE

Jack Wisdom has found that the Earth-Moon system passed through strong orbital resonances early in its evolution, which may resolve a long standing inconsistency between lunar formation scenarios and previous dynamical histories of the Earth-Moon system. Professor Maria Zuber's laser altimeter entered into orbit around Mars in September of 1997, and has been mapping elevations in the northern hemisphere with 30-cm range resolution. Preliminary findings have shown the Amazonis Planitia region to be the smoothest large scale surface yet identified in the solar system, and suggests possible origins due to a thick dust cover deposited by wind or deposition in a water rich environment. Among the many features that the altimeter has sampled are canyon systems and outflow channels where results are being used to quantify the energetics of erosion and water transport early in Mars' history. The instrument also made the first direct measurements of atmospheric cloud heights on Mars which will provide much needed constraints on the vertical structure of the atmosphere.

Richard Binzel has utilized ground based telescopes to investigate the compositional properties of asteroids passing near the Earth, and has discovered numerous source bodies for the most common class of meteorites, the ordinary chondrites. Binzel's continuing Hubble Space Telescope observations of the second largest asteroid (530 km diameter) Vesta have revealed an enormous 400 km impact basin, containing a 13 km high central peak, in the vicinity of the south pole. Color measurements of the basin suggest the exposure of the olivine upper mantle on this small planetary world. James Elliot and colleagues recorded a stellar occultation by Neptune's largest moon, Triton, with the Hubble Space Telescope. From these data they have deduced that Triton's surface frost has been undergoing a period of global warming since the time of the Voyager encounter in 1989. Heidi Hammel obtained visible wavelength images of the atmosphere of Uranus using the Hubble Space Telescope. The data reveal cloud features in the planet's northern hemisphere, which permit the first determination of winds at those latitudes. She also has continued her ongoing studies of Neptune and Jupiter using Hubble imaging.

OCEANOGRAPHY

Jochem Marotzke has formulated a theory of the ocean's thermohaline circulation, which for the first time predicts the amount of cross equatorial mass transport purely from the external parameters of the idealized problem. Carl Wunsch and collaborators have shown that the heat transport of the ocean -- a primary deteriminant of the Earth's climate -- may well be controlled through mechanical mixing by the tides. If correct, it suggests that a knowledge of the tides through time may be critical to understanding climate change. Detlef Stammer has shown that there is a

strong global scale correlation between sea surface temperature (SST) and the dynamical sea surface height, implying that accurate computation of SST requires understanding of the interior ocean dynamics. John Marshall has been studying possible mechanisms of decadal climate variability that involve the interaction of the atmosphere and ocean in middle and high latitudes. Paola Malanotte-Rizzoli and collaborators have been modeling the ocean's circulation in different regions of the world's oceans using data assimilation to constrain and improve the models. She is also investigating tropical/subtropical interactions through assimilation of TOPEX altimetry, and the physical biochemical dynamics of the Eastern Mediterranean and Black Sea ecosystems in the context of multinational collaborative programs. Glenn Flierl is conducting research on the instabilities of oceanic jets and the effects on their circulations, the generation of eddies in the mid-ocean, and the biological effects of time varying flows, including both changes in productivity and the influence of turbulence on the distribution of marine organisms. He is also studying vortex dynamics on Jupiter and in the solar nebula.

Edward Boyle's research group has shown that deep sea corals can be used to trace abrupt century scale changes in deep sea circulation. In a paper which garnered the cover of Science, they used precise Th-230/U dating, carbon-14 data, and trace cadmium measurements, and have shown that an abrupt decrease in the percentage of North Atlantic deep water occurred 15,400 years before present. John Edmond's recent summation of two decades work on the pristine rivers of the Tropics (Amazon, Orinoco) and the Arctic and sub-Arctic (Eastern Siberia] demonstrates that there is no correlation between weathering rates, CO_2 consumption and climate. Global warming models must now be re-examined. Maureen Raymo has been studying a wide range of paleoclimate problems, including the mechanisms by which Earth's orbital variations control climate, the Cenozoic record of carbonate deposition and volcanism, and the climate conditions under which millennial scale variations in ocean thermohaline circulation occur.

Dara Entekhabi's research activities include topics in hydrology, land-atmosphere interaction and earth remote sensing. Last year Entekhabi assembled a group of research scientists from several universities and research institutes to develop a prospectus for the hydrologic sciences in the coming decades. The prospectus calls for a Second International Hydrologic Decade dedicated to coordinated international observations and data gathering on the global hydrological cycle and its role in the climatic system.

ATMOSPHERIC SCIENCE

Mario Molina and his research group have continued their laboratory studies of the mechanisms and rates of chemical reactions of atmospheric importance. Their results have led to significant improvements in the quantitative understanding of stratospheric ozone balance. Ronald Prinn and his colleagues have measured the recent rapid rise of hydrofluorocarbons and hydrochlorofluorocarbons (chlorofluorocarbon replacements) in the atmosphere, and used some of these gases to provide new estimates of atmospheric levels of the key oxidant OH, which agree well with their previous estimates based on trichloroethane. Reginald Newell's group has collected research and commercial aircraft measurements of atmospheric trace constituents that show layers about one kilometer thick that occupy a significant fraction of the atmosphere. They are now studying the sources and evolution of these layers and their associated radiative heating rates with the goal of assessing whether they should be included in atmospheric models. Peter Stone and his colleagues have completed several studies, which demonstrate that the stability of the ocean's thermohaline circulation is underestimated in global warming projections made with the most sophisticated coupled-atmosphere-ocean general circulation models.

Kerry Emanuel continued his work on adaptive sampling techniques, and analyzed the results of a field experiment conducted last year to test such methods. Edmund Chang analyzed observational data, and found that a majority of significant troughs are organized into wave packets that can be tracked for extended periods of time. He is now studying the forecasting implications of his findings. Alan Plumb and his students have continued their investigations of atmospheric transport, especially the theory of the "age of air", and of the dynamics of upper tropospheric and stratospheric vortices. Richard Lindzen and colleagues are examining the capacity of existing and planned satellite systems to directly ascertain climate sensitivity and feedback processes. During the past year Lindzen used atmospheric tides to demonstrate the need for anomalous solar absorption in the atmosphere, studied the observed climatic response to volcanoes to estimate climate sensitivity, and investigated the dynamic contribution to the seasonal cycle in carbon dioxide in order to show that previous estimates of the biospheric component have been too low.

More information about this department can be found on the World Wide Web at the following URL: http://ginuwine.mit.edu

Ronald G. Prinn

DEPARTMENT OF MATHEMATICS

The Department of Mathematics at MIT seeks to improve upon its top ranking in both research and teaching by aggressively hiring the very best faculty, with special attention to the recruitment of top women and under-represented minority candidates, and by continuing to serve the broad and varied educational needs of its graduate students, the mathematics majors, and all undergraduates of the Institute.

STUDENTS

During the academic year 1997-98, there were 212 undergraduates majoring in mathematics, 175 in Course XVIII, Mathematics, and 35 in Course XVIII-C, Mathematics/Computer Science. Bachelor of Science degrees, including double majors, were awarded to 76 students, 61 in Course XVIII and 15 in Course XVIII-C.

There were a total of 89 graduate students in mathematics, all in the Ph.D. program. This year 23 students received the doctoral degree.

FACULTY CHANGES

Professor Aise Johan de Jong will join the Mathematics Department from Princeton University. He is a leading figure in arithmetic algebraic geometry.

Assistant Professor Alan Edelman will be promoted to Associate Professor of Applied Mathematics. His specialization is in numerical analysis.

Dr. Sara Billey in combinatorics and Dr. Santosh Vempala in theoretical computer science will be promoted to Assistant Professor from Instructor in Applied Mathematics. Dr. John Bush joined the department as an Assistant Professor of Applied Mathematics in January, 1998. He came from Cambridge University, and is an experimental and theoretical fluid dynamicist. Dr. Pavel Etingof at Harvard University will be appointed as Assistant Professor. He works in representation theory and related mathematical fields.

Associate Professor James Propp resigned from MIT for a faculty position at the University of Wisconsin at Madison. Assistant Professors Scott Axelrod and Fabian Waleffe also resigned from MIT.

HONORS, PRIZES AND AWARDS

Professor Michael Artin received an Honorary Doctoral degree from the University of Hamburg.

Professor Gian-Carlo Rota was selected by the department faculty to be the next Norbert Wiener Professor of Mathematics through June 2003, following the tenure of Professor Victor Guillemin.

Professor Gilbert Strang was made President-Elect of the Society for Industrial and Applied Mathematics (SIAM) for 1999-2000.

Associate Professor Bonnie Berger received the Dayhoff Award of the Biophysical Society for research by a non-tenured faculty member.

Assistant Professor Michael Brenner was selected for a Career Award by the National Science Foundation, and Assistant Professor Lars Hesselholt was awarded a Sloan Research Fellowship.

Graduate student Daniel Dugger received an Alfred P. Sloan Doctoral Dissertation Fellowship.

Graduate students David Amundsen, Dimitri Kountourogiannis, and Monica Nevins were selected for the Housman Graduate Student Teaching Award, given to a graduate student(s) in mathematics who has demonstrated exceptional skill and dedication to teaching.

Graduate students Alessandro D'Andrea and Salil Vadhan received the Charles W. and Jennifer C. Johnson Prize for an outstanding research paper accepted in a major journal by a graduate student in mathematics

In the summer of 1997, five MIT undergraduates and four mathematics graduate-student mentors participated in the Department's first Summer Program in Undergraduate Research (SPUR). For the undergraduates, this six-week program was a full-time ``research experience'' culminating in written papers and lectures to faculty. The program will continue in 1998.

Last summer seven mathematics graduate students participated in the Research Sciences Institute Program, a national program offering select high school students six weeks of research experience. Of the eleven research projects mentored by the Department's graduate students, four were selected as finalists and two as semi-finalists in the Westinghouse National Talent Search Competition. One of the finalists' projects ranked first overall (in all areas of science and technology), and one ranked fifth.

In the Putnam Intercollegiate Mathematics competition, four MIT undergraduates ranked among the top 25 out of approximately 2500 participants. The MIT team of three undergraduates placed fourth in the competition.

Senior David Jao was awarded the Jon A. Bucsela Prize in Mathematics in recognition of distinguished scholastic achievement. Among those seniors awarded degrees in mathematics, four were elected to Phi Beta Kappa.

ADMINISTRATION

Professor Michael Sipser succeeds Professor Hung Cheng as Chairman of the Applied Mathematics Committee. Professor Michael Artin will continue as Chairman of the Undergraduate Committee, Professor Richard Melrose as Chairman of the Graduate Committee, Professor James Munkres as Chairman of the Committee of Advisors, and Professor David Vogan as Chairman of the Pure Mathematics Committee.

EDUCATIONAL

Among the educational initiatives of the department, here are the ones that involve the undergraduate core.

Two calculus offerings introduced in recent years continue to prove attractive. Most MIT freshmen have had calculus in high school, and about half place out of 18.01 Calculus (single variable). For many of the rest, the pace of 18.01 Calculus is too slow. For these students the Department offers a sequence 18.01A & 18.02A Calculus, taken by more than 220 students last year (compared to 175 in 18.01 Calculus). It covers the 18.01 material in the first half of the fall term, and then begins with the 18.02 material at the standard pace. Students can complete 18.02 Calculus either in an intensive course during IAP (the most popular choice) or in the first half of the spring semester. Separating these better-prepared students has also made it possible to aim 18.01 Calculus more directly at students with little or no calculus background. For some students who do receive 18.01 credit, the standard fall semester 18.02 (several variable calculus) is a bit too fast-paced. For those students we offer 18.02S; this alternative had about 76 students last fall, compared to 336 in 18.02 Calculus.

We are continuing the experiment of increasing the number of weekly recitation hours from one to two in 18.03 Differential Equations. With an annual enrollment of about one thousand students, this is quite a difficult experiment for the teaching staff. The success we seek—most of all a stronger connection between students and their recitation instructors—is not easy to measure, but we have been pleased with the results.

The Department's practice teaching program, supervised by Professor Haynes Miller, is now required for our graduate students, and is available to new instructors as well. In this program, Teaching Assistants are put into a classroom situation before they are assigned a recitation of their own. We are also continuing the videotaping program organized many years ago by Professor Arthur Mattuck; all new teaching staff are videotaped during their first semester, and Professor Mattuck provides detailed comments on the tapes.

More information about the Mathematics Department can be found on the World Wide Web at the following URL: http://www-math.mit.edu

David J. Benney

DEPARTMENT OF PHYSICS

The mission of the Physics Department is to gain a fundamental quantitative understanding of nature, and to teach the analytic approach required for that understanding both to students pursuing careers in physics and to those entering other fields. The Department is one of the best in the world, with strengths in an extraordinarily broad range of research. A few highlights of very recent research advances are given below. In the past year the Department has started the process of renewal, as the large number of faculty hired in the Sputnik era has begun to retire. Five assistant professors have been hired during this academic year, and four more will join the faculty in the next year, two of these nine are women. To better fulfill the educational component of our mission, we have completely reorganized the administration of teaching and student activities.

Physics faculty members continue to receive recognition by the outside community. We are especially proud of our four Nobel Laureates. Some of the recent major awards are the following: Professor Roman Jackiw was elected to the National Academy of Sciences. Professor Eric Ippen won the Arthur Schawlow Prize of the American Physical Society. Professor Wolfgang Ketterle received the Gustav-Hertz Prize of the German Physical Society and a Discover Magazine Award for Technological Innovation in recognition of his atom laser. Professor Toyoichi Tanaka is the 1997 recipient of the Toray Science and Technology Prize. Professor Claude Canizares received the Goddard Medal of the American Astronomical Society. Professor Robert Jaffe's contributions to physics education were recognized by two awards: he was named a MacVicar Faculty Fellow and received the Department's 1997 Buechner Prize for excellence in teaching. Alfred P. Sloan Foundation awards have been given to three of the junior faculty who joined the Department during the past academic year: Professors Victoria Kaspi, Krishna Rajagopal, and Kevin McFarland. Professor Washington Taylor, who has accepted an Assistant Professorship for next year, has also won a Sloan. Rajagopal has been awarded the Class of 1958 Career Development Professorship.

Members of the Department provide leadership both at MIT and in the Federal Government. Professor Robert Birgeneau serves as Dean of Science, and Professor J. David Litster is Vice President and Dean for Research and Dean of the Graduate School. This year Professor Ernest J. Moniz was confirmed as Undersecretary of the Department of Energy.

Boleslaw Wyslouch was promoted to Associate Professor with tenure, and Raymond Ashoori and Leslie Rosenberg were promoted to Associate Professor without tenure.

EDUCATION

In past years only two faculty members, an undergraduate officer and a graduate office, have supervised all the educational activities of the Department. In an effort to better serve our students, we have reorganized our educational administration under the supervision of Professor Thomas Greytak, Associate Head for Education. Tasks have been assigned to 11 faculty members, who are also members of the Physics Education Committee.

The size of the Department has decreased from a high of over 100 in the late 1960s to 81 this year and 79 two years from now. This reduction in teaching faculty has required significant changes. First, teaching responsibilities of each faculty member will increase somewhat. Second, graduate students will teach more freshman recitation sections. Many of the graduate students are enthusiastic about this opportunity to gain classroom teaching experience. In the fall of 1998, the Department will initiate a training program for graduate students to prepare them for this important responsibility. The new 8.01 format, which has been tried for two years, requires many more teachers than the conventional format. Since the students have not been enthusiastic about the new format, the previous one will be restored next year.

To encourage students to minor in Physics, the education committee, with the consent of the entire department, has liberalized the requirements for a minor. Whereas the previous curriculum was very specific, students will now be allowed to fulfill the physics requirements with any courses for which they have the prerequisites.

MIT's Center for Advanced Educational Services (CAES) and Professor Walter Lewin have received a $735,000 gift from an anonymous donor to create a video tutoring web site for students taking 8.01. The gift requires matching funds of about $250,000, thereby making nearly $1,000,000 available for this two year project in which Professor Lewin will create a video archive of answers to frequently asked questions. The web-based learning environment

will simulate a private question and answer session that a student might have with Professor Lewin during his office hours. At each step in the process, the student may select from a menu of currently available answered questions or submit a free-form question. Once the 8.01 web-based system is completed and tested on the MIT campus, CAES plans to offer it to other learners as well (possibly with a tuition fee), including high school physics students and physics students at other universities. The system is not meant to replace traditional physics teaching and learning, but rather to supplement them. In a related initiative, Professor John Belcher is developing web-based animation, simulation, and visualization to enhance the teaching of 8.02. The latter effort is made possible by a gift from James A. Earl and The Helena Foundation.

Our undergraduate majors are among the best in the United States. As an example, Anna Lopatnikova won the Apker Award of the American Physical Society for research done under the supervision of Professor Nihat Berker. This is the second student of Berker's to win the Apker.

RESEARCH HIGHLIGHTS

Most physics research is done through participation of our faculty in labs and centers. The research of the Physics Department faculty is specifically addressed in the following lab and center reports: Laboratory for Nuclear Science, including the Bates Linear Accelerator Center and the Center for Theoretical Physics; the Center for Materials Science and Engineering; the Research Laboratory of Electronics; the Center for Space Research; the Plasma Fusion Center; the Harrison Spectroscopy Laboratory; and the Haystack Observatory. Rather than an overview, we discuss here a few highlights to give a sense of the excitement of research in the Department.

The Alpha Magnetic Spectrometer (AMS) experiment had a very successful first flight on the Space Shuttle Discovery in June 1998. AMS is an experiment designed to look for cosmic anti-matter and evidence for dark matter by operating a large magnetic spectrometer above the Earth's atmosphere. The international AMS collaboration is composed primarily of particle physicists and is led by Samuel C.C. Ting, Thomas Dudley Cabot Professor of Physics at MIT. The centerpiece of the AMS experiment is a large permanent magnet that takes advantage of significant recent improvements in permanent magnet technology. The recent 10-day mission on Discovery was designed to shake down important aspects of this challenging project and to take initial data. The mission accomplished all of its objectives, despite the fact that failure of a primary communications channel meant that not all of the data could be transferred to the ground during the mission. The detector operated well in all respects. The AMS experiment is scheduled for a 3-year data-taking period on the International Space Station starting in 2002.

Professor Edward H. Farhi and his collaborators have shown how certain computationally interesting problems can be cast in terms of decision trees that can then be searched by quantum evolution. In one example, they showed that the quantum search method significantly outperforms the associated classical search method, although the specific example is not of serious computational interest. On the other hand, they have shown that a quantum computer cannot outperform a classical computer in determining the parity of a function. This may be the most important result to date in defining the limitations of quantum computation.

When two heavy nuclei, such as lead or gold, collide at high energy, a region of space is filled with nuclear matter at extremely high temperatures and densities. By some estimates, the temperature at the center of the resulting fireball can reach 10^{12} degrees Kelvin. At these high temperatures nuclear matter is expected to undergo a phase transition to a new state, known as the quark-gluon plasma. This is a phase in which ordinary sub-atomic particles, like protons and neutrons, do not exist and quarks are no longer confined inside protons and neutrons as they are at lower temperatures. Furthermore, the temperature is so high that the vacuum itself is expected to undergo a phase transition. It is thought that the entire universe was in this state at about a millionth of a second after the big bang.

A group led by Professors Wit Busza and Boleslaw Wyslouch are building a new detector called Phobos to observe these phase transitions in heavy ion collisions at the Relativistic Heavy Ion Collider (RHIC) being built at Brookhaven National Laboratory. While preparing for the first experiments at RHIC, a group led by Wyslouch has recently completed data collection and analysis of an experiment at CERN, studying similar physics at lower energies. One of the most exciting predicted phenomena is the formation of an excited state of the vacuum, called the Disoriented Chiral Condensate (DCC). Modern particle physics has shown that the vacuum is not really empty. Instead, it is filled with a uniform background of quarks and antiquarks, but with a specific composition of different kinds of quarks and antiquarks. If one heats the vacuum to extremely high temperature, the mixture of quarks and

anti-quarks evaporates, freeing Nature to make a different choice as the vacuum cools down again. In rapid cooling one may produce a small region filled with a "disoriented" vacuum, with the wrong composition of quarks and antiquarks. The search at CERN showed that higher energy collisions are required to observe the DCC, and it is hoped that Phobos will reveal it.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/physics/www/

Marc Kastner

CENTER FOR LEARNING AND MEMORY

The Center for Learning and Memory was established in May 1994 as an interdepartmental research center between the Department of Brain and Cognitive Sciences and Department of Biology. The Center's primary research interest is to study the mechanisms underlying learning and memory using multifaceted approaches. Susumu Tonegawa was appointed as the first Director of the Center in May 1994. Matthew A. Wilson joined as an Assistant Professor on July 1, 1994. William G. Quinn who has been a faculty member in Department of Brain and Cognitive Sciences since July 1, 1994 joined the Center on April 1, 1995. Guosong Liu and Earl Miller joined as Assistant Professors on September 1, 1996. Elly Nedivi will join the Center on July 1, 1998.

RESEARCH

Dr. Tonegawa's laboratory continued to characterize the CA1-specific NMDA receptor knockout mice and demonstrated that these mice lack functional NMDA receptors at only one kind of synapse, namely Schaeffer collateral-CA1 pyramidal cell synapses. Combined with the earlier physiological and behavioral studies, the data strengthened substantially the evidence for the causal relationship between synaptic plasticity and explicit memory. Dr. Tonegawa's laboratory also studied the mechanism for the neural activity-dependent development of the visual system. Using the transgenic mouse technology they obtained evidence for the hypothesis that a maturation of inhibitory neural circuitry in the neocortex which is mediated by a neurotrophin, BDNF, is crucially involved in the termination of the plastic period called the "critical period."

Dr. Wilson's laboratory has been studying the pattern of interaction between brain areas during sleep. They have discovered that two areas which are involved in memory and decision-making during the waking state, the hippocampus and prefrontal cortex, communicate during specific windows of activity in slow-wave sleep known as sleep spindles. When combined with earlier results revealing the reactivation of recent memory patterns in the hippocampus during these sleep periods, these results point to what may be a process of memory consolidation involving the coordination of multiple brain regions during slow-wave sleep in which sleep spindles serve as the vehicle for mnemonic information. This is the first demonstration of an interaction between these two regions in the behaving animal.

Dr. Miller's laboratory made an important discovery regarding our ability to integrate the "what" and "where" information of objects. What and where are known to be processed separately in the visual system. Dr. Miller's laboratory identified prefrontal neurons that respond to both types of information of an object. Many can simultaneously represent both an object and its precise visual field location. These neurons may comprise a crucial link that allows actions to be directed toward objects. They can also help synthesize the unified representation of a visual scene that corresponds to our conscious experience. In a second line of investigation, Dr. Miller's laboratory has identified mechanisms in the prefrontal cortex that select the sensory information and stored knowledge that is fully processed and reaches awareness. It is well established that mechanisms that underlie our conscious thoughts and intended actions are severely limited in capacity; we can only think about a few things simultaneously. Thus, these mechanisms may play a major role in regulating the information that gains control of cognitive functions.

Our most exciting results are with the *amnesiac* gene. The *amnesiac* mutant in Drosophila was isolated on the basis of its short memory span(1). The gene was transpositionally cloned, sequenced, and found to encode a peptide neuro-transmitter that had significant homology to mammalian PACAP (pituitary-adenylyl-cyclase-activating-peptide (2). More recently, another lab has selected for ethanol-sensitive mutants, and, on the basis of this screen, has isolated new alleles of *amnesiac* (3). The gene, therefore, is evidently important both for intermediate-term memory storage and for resistance to alcohol intoxication. The crucial questions are: how and where does the amnesiac gene product (a neurotransmitter) act in the fly brain, and are there close mammalian homologues, which might have potential relevance to human memory storage and psychoactive drug metabolism. To this end we have created rabbit antibodies to the inferred *amnesiac* gene product, we have affinity-purified these antibodies, and we have demonstrated their specificity and functional localization in *Drosophila.* This sets the stage for an informed screen for mammalian homologues using expression libraries.

In Dr. Liu's laboratory, the overall research objective is to study how synaptic activities regulate the strength of interconnections between neurons in the central nervous system and what role activity plays in the process of synapse formation, elimination, and consolidation. In last year, we focused on uncovering the molecular and

cellular events in the process of synaptogenesis. We found that influx of Ca2+ through neural activity plays a critical role in the maturation of presynaptic terminals. Furthermore, proper level of neural activity is essential for postsynaptic receptor clustering, because both increase and removal of neural activity can block clustering of postsynaptic receptors.

Susumu Tonegawa

GEORGE R. HARRISON SPECTROSCOPY LABORATORY

The George Russell Harrison Spectroscopy Laboratory is engaged in research in the field of modern optics and spectroscopy for the purpose of furthering fundamental knowledge of atoms and molecules and pursuing advanced engineering and biomedical applications. Professor Michael S. Feld is Director; Professor Jeffrey I. Steinfeld and Dr. Ramachandra R. Dasari are Associate Directors. An Interdepartmental Laboratory, the Spectroscopy Laboratory encourages participation and collaboration among researchers in various disciplines of science and engineering. Professors Moungi G. Bawendi, Feld, Robert W. Field, Daniel Kleppner, Stephen J. Lippard, Keith A. Nelson, Steinfeld, Toyoichi Tanaka, Steven R. Tannenbaum and Dr. Dasari are core investigators.

The Laboratory operates two laser resource facilities. The MIT Laser Biomedical Research Center (LBRC), a Biotechnology Resource Center of the National Institutes of Health, develops basic scientific understanding, new techniques and technology for advanced biomedical applications of lasers; core, collaborative and outside research are conducted. The National Science Foundation-supported MIT Laser Research Facility (LRF) provides resources for core research programs in the physical sciences for 13 MIT Chemistry and Physics faculty. Information about the equipment and facilities of the LRF and the LBRC can be found in the Spectroscopy Laboratory Researcher's Guide.

RESEARCH HIGHLIGHTS

Powerful pattern recognition techniques have been developed in Professor Field's research group: extended cross correlation(XCC), extended autocorrelation and baseline stripping. These techniques have been adopted by scientists at many laboratories. In the Spectroscopy Laboratory, XCC has been used to discover local bend and counter-rotator vibrations in highly excited HCCH, as well as other unexpected dynamical features.

Professors Field and Steinfeld, in collaboration with Drs. Alexander Kachanov and Sergei Panov have studied cavity ringdown, an untrasensitive absorption technique. They have developed a new variant which employs relatively low-reflectance mirrors (99.5% rather than the usual 99.9995%), yet still provides quantum limited sensitivity. This scheme is ideal for UV and IR applications, where high reflectance mirrors are often not available, and for double resonance studies, where the cavity decay time and the ~1 μs lifetime of the labeled level should be comparable.

Professor Field and Dr. Steven Drucker developed a sensitive new spectral technique for studying triplet states of small unsaturated hydrocarbon molecules. This scheme is based on electron ejection from a metal surface when impacted by an electronically excited molecule, with electronic (not vibrational) excitation energy greater than the metal's work function. A clear example of "gateway mediated intersystem crossing" was observed. Statistical methods are being developed for extracting information about the bright and gateway states from complex spectra.

Professor Bawendi's group has developed an apparatus to study the optical spectroscopy of individual quantum dots. Ultranarrow linewidths, < 0.120 meV, have been observed. Individual dots have been found to be highly polarizable. Large spectral diffusion effects have also been observed; these are attributed to changes in local electric fields caused by the thermal motion of trapped charges. These findings are important for quantum dot applications to electro-optic systems. An apparatus is now being constructed to study the time resolved spectroscopy of single dots.

Prof. Steinfeld and Dr. Arturo Gonzalez-Casielles, a postdoctoral fellow supported by the Fundacion Repsol (Spain), are investigating the use of self-assembled monolayers incorporating colloidal metallic particles as substrates for surface-enhanced Raman spectroscopy. With these substrates, molecular explosives such as TNT have been detected with good reproducibility in 10^4 molar solutions.

Professor Mildred Dresselhaus and Drs. Gene Dresselhaus, Marcos Pimenta, Alessandra Marucci and Huiming Cheng studied resonant Raman scattering of single wall carbon nanotubes, and discovered a new way to observe differences in behavior between metallic and semiconducting nanotubes. The diameter dependence of the Raman spectra of tubes less than 2 nm in diameter was studied. Other carbon-based systems that have been investigated include polyparaphenylene to study conformational changes associated with heat treatment.

Professor Feld and Drs. Dasari, Kyungwon An and Chung-chieh Yu continued their work on the single atom laser. They have observed nonlinear dependence of laser output on atom density, and also in the large atom-cavity detuning range, and have developed a two-laser optical pumping scheme for improved atomic velocity selection.

Professors Tanaka, Kevin Otto, Jane Morningstar and Feld and Drs. Taro Oya, Yasar Yilmaz, Takashi Enoki and Dasari are developing polymer gels that reversibly change their affinity to target molecules by orders of magnitude. The gels are made of copolymers of backbone monomers and monomers that attract the target through electrostatic interactions. Fluorescence spectra revealed the target being in two states, free and attached to absorption sites. Phase transitions in single network gels that undergo phase transitions in response to pH and temperature changes are also being studied. Raman and IR spectroscopy were used to study the level of hydrogen bonding.

Professor Lippard and his collaborators characterized synthetic models of metalloenzyme active sites using Raman spectroscopy. They measured the O-O stretch frequencies of peroxo-bridged species resulting from the interaction of diiron (II) complexes with dioxygen. Azido- and peroxo-bound models of the diiron active site in hemerythrin, a dioxygen carrier in marine invertebrates, were synthesized by Dr. Tadashi J. Mizoguchi and characterized by resonance Raman spectroscopy. Resonance energy transfer was used to study the interactions of high mobility group domain proteins with cisplatin-modified DNA containing pendant fluorescent donor and acceptor molecules.

Professor George Benedek and Drs. Jayanti Pande and Manoharan continue investigating molecular changes in the protein crystallin and eye lens using Raman spectroscopy. Oxidative stress in crystallins is the major cause of cataract formation. The oxidation of crystallin protein was studied by monitoring the intensity changes of the S-S and S-H stretching modes. The results show that sulfur centered oxidative dimerization occurs in crystallins, and suggest that disulfide formation or oxidation does not cause significant changes in secondary protein conformation.

Professor Tannenbaum and Drs. Paul L. Skipper and Dasari have analyzed and quantified levels of benzo[*a*]pyrene (BP) adducts in samples of human serum albumin and human lung histone proteins using the ultrasensitive HPLC with laser-induced fluorescence detection system. Human albumin samples from volunteers have been analyzed, with some showing BP adducts ranging from 0.05 to 4.8 fmol adduct per mg of albumin. Additional results from albumin and lung histone samples, currently under analysis, will provide a comprehensive epidemiological study.

Professor Kleppner and his students have completed their study of Rydberg atoms in an electric field to explore the connections between quantum mechanics and classical motion. Using the technique of recurrence spectroscopy in a microwave field, periodic Rydberg orbits were identified from the Fourier transform of the spectrum. By applying microwave fields near resonance with the periodic orbits, the recurrence intensities were shown to be systematically modified in a fashion that could be related to the detailed motion of the corresponding classical system.

Professor Alexander Rich and Drs. Imre Berger and Ramasamy Manoharan established that a human protein, ds RNA deminase (ds RAD) has specificity for binding Z-DNA. Raman spectra of poly (GC) in low and high salt solutions, control protein, protein/poly (GC) complex were obtained, and spectral features of left and right-handed DNA conformers were characterized. By comparing these with the spectra of the protein/poly (GC) complex, it was concluded that DNA exists in the left-handed conformer when it binds to ds RAD.

Professor Feld and Drs. Dasari, Rajan Gurjar, Eugen Hanlon, Irving Itzkan, Lev Perelman and Qingguo Zhang are pursuing basic and applied applications of lasers and spectroscopy in biology and medicine. Reflectance, fluorescence, coherent and acousto-optical techniques and near-IR Raman spectroscopy are being used for biochemical analysis of tissues and diagnosis of disease. Clinical studies are being conducted with researchers from the Cleveland Clinic Foundation, Brigham and Women's Hospital, Metrowest Hospital, Beth Israel Hospital and New England Medical Center. Highlights include: (1) Demonstration that Raman spectroscopy can accurately measure concentrations of glucose and other blood analytes in serum and blood at physiological levels. (2) Clinical demonstration of a light scattering technique to detect the precancerous condition known as dysplasia, accomplished by determining the size distribution of epithelial cell nuclei. (3) The use of fluorescence spectroscopy of brain tissue to identify Alzheimer's disease, opening the prospect of non-invasive diagnosis and perhaps also determining the severity of this disease *in vivo*. (4) The use of Michelson interferometry to study the interplay of stress waves and cavitation in soft biological tissues, induced by short pulses of laser light. (5) The use of heterodyne detection to study forward-scattered light propagating in a turbid medium (such as biological tissue); the degree of spatial coherence was found to be significantly higher for photons scattered just once, and to approach a small constant value for a large number of scattering events. The experimental and theoretical work being conducted in this program is advancing new laser diagnostic technologies in the field of medicine.

More information about the Laboratory can be found on the World Wide Web at http://web.mit.edu/spectroscopy

Michael S. Feld

GEORGE R. WALLACE, JR., ASTROPHYSICAL OBSERVATORY

The George R. Wallace, Jr., Astrophysical Observatory is a teaching and research observatory located in Westford, Massachusetts. Its facilities consist of a 24-inch telescope, a 16-inch telescope, several 14- and 8-inch telescopes, a 5.5-inch astrograph, and a building that houses a workshop, darkroom, computer facility, and observers' quarters. Instruments used during the past year include a portable high-speed CCD occultation system, several small CCD systems, photographic cameras, and a high-resolution spectrograph.

Last year, course 8.287J-12.410J (Observational Techniques of Optical Astronomy) drew 8 students, who used the Wallace facilities for a variety of astronomical projects, including measurements of the periods both of a dwarf variable star and of an asteroid's lightcurve. For subject 12S23/12.409 (Observing the Stars and Planets, the first subject number distinguishes first-year vs. upperclass registrants), an additional 24 students used the Observatory for laboratory work. Informal field trips were offered for courses 12.401 (Beyond the Solar System; 6 students) and 12S22 (Hands-on Astronomy; 14 students), as was an observing session for freshmen last fall. An open house held during MIT's 1998 Independent Activities Period attracted over 30 people (mostly undergraduates, though faculty and staff from other departments came).

The 24-inch was used by Steve McDonald, Michael Person, and summer students to obtain astrometric CCD data for Pluto and Neptune's moon Triton, in addition to the star fields through which they will move during the next decade. These data will be used to identify and quantitatively assess stars that these bodies will occult so that observations can be carried out with telescopes that would happen to lie in the path where an occultation will be visible. The occultation data will be used to investigate how the thin nitrogen atmospheres of Pluto and Triton respond to changes in season and distance from the sun. Stars which were identified as probable occultation candidates were further observed to determine their apparent colors and magnitudes. In a related program, Mr. McDonald and the summer students produced refined predictions for the occultation of the star Tr180 by Triton. The 4 November 1997 event was successfully observed using the Hubble Space Telescope.

Mr. McDonald, Mr. Person, and students continued to develop a program to search for large, slowly moving objects that may be part of the Kuiper Belt population in the outer solar system. Dr. Steven Slivan continued a long-term project of imaging objects from the Messier Catalog.

Professor James Elliot and Dr. Heidi B. Hammel (with students Paul Collins, Adam Einarsen, Charles Borges, and Adam Gould) continued a collaboration with Professor Paul Schechter on the design of the MANIAC CCD camera for the Magellan telescopes in Chile, of which MIT has a 10% share of the observing time. Mr. Collins, along with contributions from Mr. Einarsen, drafted plans for a filter wheel mechanism. An evaluation of the expected dispersion caused by an instrument window was carried out by Mr. Borges. Mr. Gould created a top-down overview of information flow in the system. Current plans are to use Wallace Astrophysical Observatory as a local test-bed for MANIAC implementation.

Plans are continuing for a modern replacement to an older CCD system which was retired last year. Work is ongoing to improve the optics and drive system of the 24-inch telescope, and a prototype low-resolution spectrograph has been developed for the smaller telescopes.

Prof. Elliot continued his duties as Observatory Director. Dr. Hammel assisted with site management and telescope scheduling, with the help of Research Specialist Richard Meserole. Mr. Person has served as a part-time Technical Assistant for making observations, helping with observatory maintenance, and training students. Mr. McDonald continued his part-time work on software and computer management. Dr. Slivan assisted with supervision of summer student activities. Other staff (usually students) are coordinated through research programs. Undergraduates working on the spectrograph project (Lisa Kwok) and MANIAC instrument design (Paul Collins, Charles Borges, and Adam Gould) were funded in part by NSF's Research Experiences for Undergraduates (REU) program, as were the summer students (Shaida Bouramand, Adam Einarsen, Edgar Gonzalez, Lorraine Hertzog, Eric Nielsen, Rosa Villastrigo).

Heidi B. Hammel

EXPERIMENTAL STUDY GROUP

This coming year, the Experimental Study Group will celebrate its 30th year offering first year students at MIT a unique educational alternative to the regular curriculum. Learning is based on the concept of self-motivated study through small interactive groups, tutorials, independent projects, and seminars. Students have found this approach beneficial for a number of reasons: the opportunity to work closely with instructors and be able to ask questions, the chance to be part of a close-knit academic program with a strong community focus, and a flexible structure which allows students to study material at their own pace and depth. This program attracts and works well for freshmen who are highly motivated and who are ready to take more responsibility for their own learning than is usual in the regular curriculum.

The total number of students enrolled for the year included 47 freshmen and 1 sophomore transfer, for whom ESG was primarily a full time activity. Forty-four percent of ESG's freshman class were female, twenty-two percent were underrepresented minorities, and eight percent were international students. In addition, 22 upperclassmen who had been in ESG as freshmen took one or two subjects in ESG, and 12 undergraduates who had not previously been in ESG enrolled in seminars and HASS subjects taught in ESG.

Professor Vernon Ingram (Director of ESG) and Dr. Holly Sweet (Associate Director) administered and monitored program offerings and activities. In addition to her administrative work at ESG, Dr. Sweet also directed GenderWorks (MIT's peer training program in gender relations), team taught an undergraduate seminar on gender roles, and served on MIT's newly formed Orientation Committee in the fall. Julie Banda replaced Renee Hoffman as ESG's administrative assistant in September. Ms. Banda brings with her not only solid administrative and financial experience, but also interest and expertise in health education and maintenance, including working part-time as an EMT in the Greater Boston area.

The ESG advisory committee met once with Professor Ingram and Dr. Sweet during the year to supervise the academic portion of ESG. The committee is headed by Professor Alan Davison (Department of Chemistry), and includes Dean Robert Birgeneau (School of Science), Dean Philip Khoury (School of Humanities and Social Sciences), Professor Ernest Moniz (Department of Physics), and Professor Alar Toomre (Department of Mathematics).

The physics staff included Professor Emeriti Robert Hulsizer and Robert Halfman, Dr. Peter Dourmashkin (Lecturer), and David Custer '82 (Lecturer). The mathematics staff was headed by Craig Watkins and included graduate student Adam Lucas. The chemistry offerings at ESG were supervised for the second year by Christopher Morse, a graduate student in the Department of Chemistry. The biology staff was headed by Professor Ingram and included Cindy Limb, who taught biology and maintained the biology wet lab.

ESG also offered several HASS and HASS-D courses to its students. Dr. Lee Perlman taught 21L001 Foundations of Western Culture in the fall term and 24.00 Problems in Philosophy in the Spring term. Mr. Custer was on leave for the fall term and was replaced by Ms. Lorraine Lippincott who taught 21W730 Expository Writing. Mr. Custer returned from his climbing trip in the Himalayas to teach 21W735 Writing and Reading the Essay in the spring term.

Our staff was assisted by 20 undergraduate tutors (who maintained an impressive GPA of 4.6), and 7 graduate tutors. New undergraduate tutors were required to participate in a fall teaching seminar run by staff. Dr. Sweet interviewed all freshmen during the fall term about their academic progress and overall satisfaction with both ESG and MIT. Several staff retreats were held to develop new ESG policies, which included emphasizing self-paced study, increasing the size of the student body, and revising our orientation procedures to emphasize the intellectual component of ESG.

ESG continued to sponsor new academic initiatives, which were funded through both a special grant given to ESG during the previous academic year by Dean Birgeneau and by funds from our alumni. The alumni gifts came from 28 different alumni and ranged from gifts of $10 to a gift of $1,000. In addition, one of our alumni from the Class of 1973 started an endowment fund for ESG with a gift of $60,000. We are very happy with these contributions, which allow us to continue experimentation in curriculum development which is beyond the scope of our annual budget.

Teaching initiatives included a project-oriented class in engineering (developed and taught by Max Davis '99 under staff supervision), and a new seminar on Western Mysticism taught by Dr. Perlman during IAP98. We continued the development of textbooks and on-line learning through several ventures. The ESG hypertext in molecular biology on the Internet continued to progress under the direction of Professor Ingram, with the assistance of Ms. Limb and Dr. Laura Willis (from the Department of Biology). As part of ESG's efforts to offer self-paced versions of freshman level math and physics classes to qualified students, subject material for 18.03 Differential Equations has been placed on the World Wide Web by Mr. Watkins, who is overseeing the expansion of the independent study portion of ESG. Dr. Dourmashkin and Professor Emeritus John King (from the Department of Physics) are writing a book on the Physics X courses at MIT (8.01x, 8.02x); this book will be used as a class text when completed.

Dr. Todd Anderson, a former chemistry graduate student at MIT and a staff member at ESG from 1991-1995, contributed $1,050 towards an annual prize for superior undergraduate teaching at ESG. The award recognizes sustained excellence in teaching at ESG through the following criteria: a minimum of three terms teaching at ESG, consistently positive reviews by both students and staff supervisors, innovation in teaching methods and/or content, and dedication to teaching and the welfare of students. The award was restricted to graduating seniors this year because of an outstanding field of candidates. The seniors who shared the prize included Noemi Giszpenc, Kevin Simmons, and Andrew Tan.

Ms. Giszpenc taught three different chemistry subjects at ESG and developed a new IAP activity, a political science discussion group which continued for several years after its initial funding. Mr. Simmons developed and taught two new undergraduate seminars at ESG under staff supervision - Introduction to Photography, and Zen and Philosophy (which looked in depth at the different philosophers mentioned in Zen and the Art of Motorcycle Maintenance.) Mr. Tan taught 8.01 Physics I and 8.02 Physics II for several years to students who commented on his superb knowledge of physics and his sensitivity to the needs of his students which one student called "inspirational."

ESG continues to support educational innovation in both teaching and learning. Funds have been raised from ESG alumni (matched by funds from the Dean of the School of Science) to fund new seminars and project-oriented classes, support on-going initiatives which have proven to be successful, and continue work on the biology and math hypertexts. We look forward to contributing to the educational mission of MIT by using our resources to encourage curricular and pedagogical experimentation by both staff and students at ESG.

More information about the Experimental Study Group can be found on the World Wide Web at the following URL: http://web.mit.edu/esg/www/home.html

Vernon Ingram, Holly Sweet

LABORATORY FOR NUCLEAR SCIENCE

The Laboratory for Nuclear Science (LNS) provides support for research by faculty and research staff members in the fields of high energy and nuclear physics. These activities include those at the Bates Linear Accelerator Center and in the Center for Theoretical Physics. Almost half of the faculty in the Department of Physics conduct their research through LNS. During fiscal year 1998, the Department of Energy is expected to provide LNS a total of $29,663,000 in research funding.

EXPERIMENTAL HIGH ENERGY PHYSICS

LNS researchers in experimental high energy physics are active at a number of laboratories around the world, including CERN (Switzerland), SLAC (California), Fermilab (Illinois), and Brookhaven (New York). The overall objective of current research in high energy physics is to test as precisely as possible the Standard Model, which has been very successful in describing a wide variety of phenomena, and to look explicitly for physics beyond the Standard Model. LNS researchers are playing leading roles in much of this research, as described below.

The L3 experiment at CERN is the largest of four detectors at the Large Electron Positron (LEP) Collider, which is the highest energy such collider in the world. The aim of the experiment is to deepen our knowledge of the Standard Model by measuring with high precision the properties of the intermediate vector bosons, Z and W, their couplings to other particles and, perhaps, the mechanism of spontaneous symmetry breaking. One of course always keeps open the possibility of finding new phenomena beyond the Standard Model. This project has been led from the beginning by an LNS group, and broke new ground in bringing together a large number of scientists from many countries into a highly successful collaboration. Important recent L3 tests of the Standard Model include precise measurements of the properties of the Z^0 particle (the carrier of the neutral electroweak force); demonstration, by two independent methods, that there are only three types of light neutrinos in the Universe; limits on the possible mass of the Higgs boson; and the measurement of the strong coupling constant α. After a number of years of operation at the maximal Z^0 production energy, LEP is now running at energies high enough to produce large numbers of the $W^{\pm}$ particle, the carrier of the charged electroweak force. This next stage of the L3 experiment is testing the Standard Model in an even more stringent fashion. So far no disagreements with the Standard Model have been observed. It is possible that the higher LEP energies will even reveal the existence of the Higgs boson.

LNS researchers are playing a leading role in exploiting the unique properties of the SLD detector at SLAC. With micron size beams, very high resolution vertex detection, excellent particle identification and calorimetry, and a polarized electron beam, SLD is making important contributions to the precise determination of Standard Model parameters and to our understanding of heavy quark physics. Measurements of the left-right cross section asymmetry, A_{LR}, for Z^0 boson production using polarized electrons have yielded a determination of the effective weak mixing angle which is even more precise than the individual LEP results.

The Collider Detector Facility (CDF) Experiment at Fermilab is designed to study the Standard Model and its possible extensions at the highest energy accelerator in the world, the Tevatron $\bar{p} - p$ collider. A highlight of the project is the discovery of the top (t) quark, by far the most massive elementary particle ever seen. The MIT group played an important role in the data acquisition and analysis which led to this result. As the measured mass of the t quark has become more precise, this information combined with other results has begun to provide significant constraints on the mass of the undiscovered Higgs boson. Current objectives of CDF include studies of the b quark, the low mass partner of the t quark; precision measurement of the mass of the W; and the search for possible quark sub-structure. With the anticipated completions of a major upgrade of CDF and of the new Main Injector at Fermilab, important new data will soon be available.

An experiment to search for the axion, a particle predicted to exist as a minimal extension of the theory of strong interactions as well as a possible solution to the "dark matter" problem in cosmology, is now providing a precise scan of possible axion energies. This experiment is the first to search for the axion in a physically interesting region with sufficient sensitivity to mean a discovery is plausible.

LNS is involved in both large detector initiatives at the Large Hadron Collider (LHC) project at CERN, viz., the CMS and ATLAS detectors. In CMS, LNS scientists are engaged in the development of the data acquisition system;

in ATLAS the effort is mainly in the development of the muon detection systems. LNS scientists have considerable expertise in both data acquisition and muon detection systems and expect to be major participants in the U.S. projects at the LHC. Our efforts on the LHC experiments are now growing rapidly.

The Alpha Magnetic Spectrometer (AMS) experiment had a very successful first flight on the Space Shuttle Discovery in June 1998. AMS is an experiment designed to look for cosmic anti-matter and evidence for dark matter by operating a large magnetic spectrometer above the Earth's atmosphere. The international AMS collaboration is composed primarily of particle physicists and is led by an LNS group. The centerpiece of the AMS experiment is a large permanent magnet which takes advantage of significant recent improvements in permanent magnet technology. The recent 10-day mission on Discovery was designed to shake down important aspects of this challenging project and to take initial data. The mission accomplished all of its objectives, despite the fact that failure of a primary communications channel meant that not all of the data could be transferred to the ground during the mission. The detector operated well in all respects. The AMS experiment is scheduled for a 3-year data-taking period on the International Space Station starting in 2002.

EXPERIMENTAL NUCLEAR PHYSICS

Experimental nuclear physics at present has two main thrusts: medium-energy physics and heavy-ion physics. LNS has active, leading groups in both of these sub-fields.

The focus of LNS medium-energy activities is of course the Bates Linear Accelerator Center, which is operated by LNS for the Department of Energy as a national user facility. Bates has been a premier national and international resource for nuclear and particle physics studies for more than two decades. A major upgrade of its capabilities, the South Hall Ring, has recently been completed. This upgrade allows both external and internal-target experiments using the continuous (as opposed to pulsed) beam from the Ring. The continuous nature of the beam is critical for a number of experiments, such as those using coincidence techniques. The opportunity to pursue internal target experiments, especially those involving polarized beams and polarized targets, maintains a unique and important position for Bates in the international community. A new detector (BLAST) for internal target experiments is now under construction.

In addition to the new capabilities provided by the South Hall Ring, Bates has recently constructed several major new detectors. The Focal Plane Polarimeter is now being used very successfully for experiments which require measurement of outgoing proton polarization. The Out-of-Plane Spectrometer allows unique measurements of kinematic correlations of outgoing reaction products. These new experimental capabilities, coupled with ongoing improvements in accelerator operation, provide an unprecedented opportunity to address critical issues in medium-energy physics.

The SAMPLE experiment at Bates, designed to provide crucial information on the structure of the proton, is now in its main data-taking run. This experiment places very demanding requirements on beam quality, polarization, and stability, but represents a world-class physics contribution which uses the unique capabilities at Bates.

LNS nuclear physics researchers are also leading several important efforts at accelerator facilities other than Bates. These facilities include TJNAF (Virginia), LANSCE (New Mexico), DESY (Germany), and Mainz (Germany). The project at DESY is an experiment to study the spin structure of neutrons and protons, using among other targets a polarized ^{3}He target constructed at MIT. The first few years of data-taking have been notably successful and a recent detector upgrade promises important new coincidence data. LNS researchers have also led the design and construction of detectors for experiments at other facilities, such as TJNAF. Our programs at TJNAF are now producing precise new data for a variety of reactions.

LNS has a major role in the field of heavy-ion physics. In recent years the emphasis has been on studies of relativistic interactions of heavy-ion projectiles, especially as they may shed light on the question of the existence and properties of the so-called "quark-gluon plasma". This new state of matter is predicted to exist at temperatures and densities higher than those present in normal nuclear matter, which may be present for a brief time in collisions of heavy ions. LNS researchers led the recent experimental efforts using heavy-ion beams at the Brookhaven AGS. The LNS group is also the leader of one (PHOBOS) of the few experiments for the Relativistic Heavy Ion Collider (RHIC) under construction at Brookhaven. This experimental project is now well underway and will be ready for

RHIC startup in 1999. A complementary effort of the heavy-ion group is a recent search at CERN for the possible creation of a new excited state of the vacuum known as a disoriented chiral condensate.

THEORETICAL NUCLEAR AND PARTICLE PHYSICS

Research at the Center for Theoretical Physics (CTP) seeks to extend and unify our understanding of the fundamental constituents of matter and the theory that governs them. In addition, it uses our present knowledge of this theory to advance our understanding of a variety of subjects, including the structure and interactions of hadrons and nuclei, new forms of matter which may be created experimentally or observed astrophysically, and the behavior of the early universe. A few examples of recent work are mentioned below.

String theory aims to unite the strong, electroweak, and gravitational interactions and to explain the observed hierarchy of particles and interactions. An important contribution at MIT has been the development of a general field theory of closed strings. It has been shown that this theory is independent of the background field that is used in its construction. Recently an MIT theorist (with collaborators) showed that string theory leads to a successful microscopic description of low-energy Hawking radiation, reproducing the semiclassical results both for the emission rate and for the angular momentum distribution. We have recently significantly strengthened our efforts in the area of string theory.

Since string theory reduces to traditional quantum field theory at low energies, it can be used to analyze the properties of field theory. An MIT researcher (in collaboration) has uncovered strong evidence that some of the exciting dualities (i.e., exact equivalences between seemingly disparate theories) recently found in quantum field theories can be understood as low-energy consequences of string theory symmetries.

MIT theorists have also been pursuing the use of the early universe as a complement to accelerator experiments in testing particle theory ideas. Recently they have developed, and are pursuing, a new version of inflationary cosmology based on the underlying particle of supersymmetry breaking.

A major thrust in the CTP has been in the area of lattice gauge theory, which provides a unique tool to solve, rather than model, QCD. Recent lattice solutions have provided strong evidence that the structures of nucleons, pions, and other light hadrons are dominated by topological excitations of the gluon field. The recent donation of a 24-Gigaflops cluster of symmetric multiprocessors has greatly enhanced lattice calculations in LNS.

MIT has played a pioneering role in exploiting high energy scattering to determine the quark and gluon structure of nucleons and nuclei. Significant new developments have been the determination of the behavior of structure functions in the regime being studied at TJNAF, the discovery of new ways to measure spin-dependent structure functions, and the first successful theory of the fragmentation function for pions. Electroweak interactions are a continuing focus of research. The unique opportunities provided by the South Hall Ring at the Bates accelerator have motivated studies of reaction mechanisms, of new ways to use nuclei to test fundamental symmetries, and of spin and polarization observables.

EDUCATION

Since its founding LNS has placed education at the forefront of its goals. At present approximately 75 graduate students are receiving their training through LNS research programs. A number of undergraduate students are also heavily involved in LNS research. Evidence shows that LNS educates a significant portion of the leaders of nuclear and high-energy physics in this country and abroad.

Robert P. Redwine

CENTER FOR CANCER RESEARCH

The Center for Cancer Research was established in 1973 to study fundamental biological processes related to cancer. The goals of the Center's research can be generally stated as developing an understanding of (1) the genetic and molecular basis of cancer, (2) how alterations in cellular processes affect cell growth and behavior, and (3) how the immune system develops and recognizes antigens. These goals are related to the Center's major research programs in oncogenes and mammalian genetics, molecular, cellular and developmental biology, and immunology. Approximately 231 people work in the Center, distributed among the research laboratories of 12 faculty. In addition, three faculty members in the Whitehead Institute, two in Biology, and one in Chemistry are Affiliate Members of the CCR.

Financial support for research in the Center comes from many sources. The core of this support, which provides much of the funds for administration, partial faculty salary support, and central research facilities (i.e. glass washing facility, specialized laboratories and partial support for new faculty), is a Center Core grant from the National Cancer Institute. The current term extends to April 30, 2000. In addition to the core grant, the Center's faculty have a total of 46 fully funded projects (plus over half a million dollars of competitive support in fellowships for postgraduate studies). This support comes largely from the National Institutes of Health and the Howard Hughes Medical Institute and from a variety of foundations supporting research in particular disease areas (American Cancer Society, Hereditary Disease Foundation, Muscular Dystrophy Association, National Neurofibromatosis Foundation, etc.). This latter type of support is particularly valuable for starting projects which later mature into federally funded grants. The Center's success in attracting grant support is a reflection of the excellence of the research and educational activities of its faculty members. The FY97 research volume was approximately $11.6 million, which does not include $3.9 million in additional support from the Howard Hughes Medical Institute.

Several groups in the Center study the identities and functions of oncogenes and tumor suppressor genes. This work includes the recent identification of two genes disposing to acute myeloid leukemia as well as basic molecular studies on other oncogenes and tumor suppressor genes that regulate gene expression controlling the cell cycle and tumor growth. Another focus is on the biochemical mechanisms controlling RNA transcription and splicing, including studies of genes of the AIDS virus, HIV.

The immunologists in the Center study the development of cytotoxic and helper T lymphocytes, their antigen-specific receptors, and the molecular mechanisms of antigen presentation as well as the development and memory properties of B lymphocytes which produce antibodies. Since the immune response to tumors is poorly understood, these basic studies are crucial to a more profound analysis of tumor rejection. Immune cells can destroy cancer cells and it may be possible to stimulate this process.

The cell biologists study cell surface proteins involved in cellular adhesion and migration, as well as cytoskeletal proteins involved in cell motility and shape. Alterations in cell adhesion proteins contribute to the malignant phenotype of tumor cells including involvement in invasion, metastasis and angiogenesis. These proteins as well as cytoskeletal proteins are important targets for antitumor drugs, and deeper understanding of their structure and function should contribute to better therapeutic agents.

Since the cellular processes of development and cancer have much in common, useful insights into the behavior of tumor cells can be obtained from studies of normal embryos; several projects in the Center focus on developmental processes. Recent advances in the generation of transgenic mice and mice with mutations in targeted genes are being exploited to investigate the roles of a variety of proteins important in tumorigenesis, including oncogene proteins, tumor suppressor genes, cell adhesion receptors, T-cell receptors and protein kinases.

Major recent research advances include:

- The development by the Hopkins lab of efficient procedures for insertional mutagenesis in the model organism, zebrafish. These procedures allow identification of novel genes controlling development, cancer and other processes. A major screen for such mutations is now underway.

- The discovery and isolation by the Housman laboratory of genes causing acute myeloid leukemia. Two such genes were identified by sophisticated genomic analyses. Both represent fusions of other genes and their structures provide fascinating insights into the mechanisms for initiation of leukemia.

- The generation by the Hynes laboratory of strains of mice lacking vital cell adhesion molecules leading to failures in protection against bacterial infections; these mice provide models for human immunodeficiency diseases. Other mutant mice developed in the laboratory are models for human bleeding disorders.

- The discovery by the Lees laboratory of a novel level of regulation of gene transcription factors important in control of the cell cycle, which is altered in cancer cells.

- The discovery by the Liu lab of a target for a very promising anticancer drug inhibiting tumor angiogenesis, the development by tumors of blood vessels necessary for their survival.

- The development by the Tonegawa lab of methods for ablating specific genes at defined locations in the brain in order to study the processes of learning and memory.

In addition to its strengths in basic research, the CCR performs an important role in training future researchers in biomedical science, including undergraduate and graduate students, postdoctoral and clinical fellows. The faculty of the Center fulfill critical roles in the educational programs of the Department of Biology. Our colleague, Dr. Phillip Sharp, has served as Head of the Department for the past seven years. Extensive collaborations exist with medical schools, hospitals and the biotechnology/pharmaceutical industries. Thus, the research in the CCR has a major impact both on the fundamental understanding of cancer and on translation to and from the clinical arena.

A major strength of the Center remains its attractiveness as an environment for the training of young scientists. The Center has 49 graduate and undergraduate students and 65 postdoctoral fellows/associates. The Center also benefited from a number of international faculty-rank visitors during the past year.

It is a pleasure to report the following honors and awards to faculty of the Center during this past year:

- Jianzhu Chen was named the Latham Family Career Development Professor.

- Nancy Hopkins was elected a Fellow of the American Academy of Arts and Sciences.

- David Housman was elected to the Institute of Medicine.

- Tyler Jacks is the recipient of the 1998 American Society for Biochemistry and Molecular Biology—Amgen Award, which recognizes significant achievements in the application of biochemistry and molecular biology to the understanding of disease by an investigator within 15 years of receiving a doctorate.

- Frank Solomon was a recipient of the Frank E. Perkins Award for Excellence in Graduate Student Teaching.

Richard O. Hynes

CENTER FOR SPACE RESEARCH

CSR conducts an active program of research in astronomy, astrophysics, space science, and related technology, with emphasis on investigations in support of various National Aeronautical and Space Administration (NASA) flight missions. Specific areas of research include gravity-wave, X-ray, optical, radio, and radar astronomy; theoretical and experimental space plasma physics; planetary surfaces and atmospheres; and the space life sciences. CSR is heavily involved in several ongoing or upcoming NASA missions and supports MIT participation in several major research facilities. Research carried out in CSR is reported by the following departments: Physics, Earth Atmospheric & Planetary Sciences, and Aeronautics & Astronautics.

HIGHLIGHTS

The orbiting Bruno B. Rossi X-ray Timing Explorer (RXTE), named in honor of late MIT Prof. Rossi, is in its third year of successful observations. The All Sky Monitor (ASM), one of two instruments prepared at CSR, records long-term intensity variations in some 100 X-ray sources revealing new phenomena like superorbital periods and recurring transients. Discovery of simultaneous radio, infrared, and X-ray outbursts from the galactic black-hole systems called "microquasars" show evidence of the disappearance of a portion of the accretion disc during formation of relativistic jets of ejecta. In other systems, X-rays are probing strong-field General Relativity and may show the signature of a spinning black hole. The discovery and subsequent studies of oscillations in X-ray flux at kiloHertz frequencies have demonstrated that neutron-star binary systems are the precursors of the famed millisecond radio pulsars. RXTE has also helped identify and study several gamma ray bursters (Profs. Bradt and Rappaport, Drs. Levine, E. Morgan, R. Remillard, W. Cui, D. Chakrabarty). In related activities, Prof. W. Lewin continues his study of quasi-periodic oscillations of low-mass X-ray binaries. CSR's CCD X-ray detectors (developed in collaboration with Lincoln Laboratory) continue to operate well on the Japanese ASCA satellite. Investigations of galaxy clusters, active galactic nuclei, supernnova remnants X-ray binaries, and active stars have also been pursued using data from ASCA and the ROSAT satellites (Prof. C. Canizares, Drs. D. Davis, K. Flanagan, J. Houck, D. Huenemoerder, H. Marshall, D. Schultz and M. Wise).

Prof. J. Hewitt has initiated a new radio survey for gravitational lenses in the southern sky; and she has preliminary measurements of a time delay in a previously known lens 0218+357 which could provide another independent measurement of the Hubble constant. Prof. V. Kaspi is involved in a major survey of radio pulsars in the southern Galactic plane, which is only 10% complete but has already found 130 new pulsars. She has also discovered a 69 ms pulsar near the supernova remnant RCW103.

In optical astronomy MIT is a member of the Magellan Project consortium, which is building two 6.5 meter diameter optical telescopes on Cerro Las Camapanas in Northern Chile, the first scheduled for completion in 1999. Construction of enclosure and fabrication of the telescope structure are nearly complete, and polishing of the mirror is underway, and planning has begun for an MIT camera to be permanently mounted on one of the telescopes (Profs. Canizares, J. Elliot & P. Schechter, Dr. H. Hammel). Hubble Space Telescope images in the IR of stars in their final death throes show remarkable structure depending on the circumstellar environment (Dr. J. Kastner).

The interplanetary plasma group monitors solar wind conditions from three spacecraft, two near Earth (IMP 8 and WIND) and one over 50 Astronomical Units away (Voyager 2). Voyager 2 is seeing a decrease in solar wind pressure as it approaches the termination shock in the outer solar system; the phenomenon is being modeled with 2-D hydrodynamics. As we approach solar maximum in ~2001, IMP 8 and WIND continue detecting "space weather" events, which can affect satellites, terrestrial communications and electric power grids (Prof. J. Belcher, Drs. A. Lazarus, J. Richardson, J. Steinberg, Ms. K. Paularena).

The Mars Global Surveyor (MGS) was successfully placed in orbit around Mars this year. The Mars Orbiting Laser Altimeter (MOLA) experiment on board has been returning precision data on the planet's surface, including the discovery and analysis of immense clouds of carbon dioxide ("dry") ice, covering much of the northern polar cap. (Profs. G. Pettengill, M. Zuber, Dr. P. Ford).

Construction of the Caltech/MIT LIGO (Laser Interferometer Gravitational-wave Observatory) continues on schedule and budget at the Livingston, Louisiana and Hanford, Washington sites, with observations to start in 2001. The two L-shaped 4x4 km-long vacuum beam tubes are nearly finished. First articles of all scientific subsystems

were tested, and no obstacles to the planned performance are anticipated. An experiment at MIT showed the ability to split an optical fringe to one part in ten billion. The group is moving to a new lab that enables next-generation LIGO research and development. (Prof. R. Weiss & Drs. D. Shoemaker, M. Zucker, P. Fritchel)

Theoretical investigations include: supercomputer simulations of large scale structure in the universe (Prof. E. Bertschinger) and of the hydrodynamics of binary star coalescence (Prof. F. Rasio); work on the origins and dynamical evolution of extrasolar planetary systems (Prof. F. Rasio); studies of the evolutionary histories of collapsed stars (white dwarfs, neutron stars, and black holes) in binary systems, including cataclysmic variables, low mass X-ray binaries, binary millisecond pulsars, and the effects of binary membership on supernovae (Profs. S. Rappaport & P. Joss). Theory of anomalous plasma viscosity first seen in the lab has been applied to the long-standing problem of angular momentum transport in accretion disks (Prof. B. Coppi). Closer to Earth, a new innovative theory of multiscale intermittent turbulence has been developed for the description of the Earth's magnetotail. (Dr. T. Chang).

In the area of aerospace technology, an Enhanced Dynamic Load Sensors Experiment has been conducted on the MIR space station by astronauts Shannon Lucid and Jerry Lingenger to assess the impact of human activity on the microgravity environment of space station (Prof. D. Newman). Flight simulator research continues on cockpit displays and virtual microgravity simulation (Drs. C. Oman and A. Beall). Dr. Oman's experiment on human visual orientation was successfully conducted on the STS-90 "neurolab" mission in April. MIT is one of seven institutions selected for NASA's new National Space Biomedical Research Institute; Prof. L. Young is the first NSBRI director.

UPCOMING PROGRAMS

Development is underway for a new High Energy Transient Experiment (HETE), to search for gamma ray burst sources, and launch options are being negotiated with NASA (Drs. G. Ricker, J. Doty, R. Vanderspeck, J. Crew). New X-ray CCD cameras are nearly complete for the next Japanese/U.S. mission, Astro-E, to be launched in 1999 (Drs. G. Ricker & M. Bautz). Periodic nano-structures have been fabricated for use as UV filters on the Magnetopause to Aurora Global Exploration (MENA) mission, due for launch in January 2000. They give an unprecedented million-fold rejection of UV while passing neutral particles which will image zones of auroral activity (Dr. Schattenburg).

AXAF is a major NASA mission of the "great observatory" series, scheduled for launch during the next year. Two of the four scientific instruments, the High-Energy Transmission Grating Spectrometer (Prof. C. Canizares, D. Dewey, K. Flanagan, M. Schattenburg) and the AXAF Charge-Coupled Device (CCD) Imaging Spectrometer (Drs. Ricker & M. Bautz, F. Baganoff), have now been successfully completed and delivered to NASA. Final spacecraft integration and testing is underway and the first set of AXAF observations are fully planned. CSR is also active in the AXAF Science Center, which will oversee the operation of AXAF during the mission (Prof. Canizares, Drs. D. Davis, D. Dewey, K. Flanagan, J. Houck, D. Huenemoerder, H. Marshall, D. Schultz and M. Wise).

The EDLS experiment flown on MIR was returned to Earth in April and an advanced version is being developed for space station (Prof. D. Newman). A follow-on to the neurolab experiment on human spacial orientation in real and virtual environments, EVA biomechanics and human factors is also in development for space station (Profs. L. Young and D. Newman, Dr. C. Oman).

Work on advanced X-ray optics, ultra-smooth reflection gratings and advanced X-ray CCD's continues. Potential applications include NASA's future Constellation X-ray mission. (Prof. Canizares, Drs. Ricker, Bautz, Schattenburg). Possible concepts are being developed for a mission in gamma ray burst detection (Drs. Ricker, Doty, Levine), and for a laser-ranged drag-free spacecraft to probe parameters in general relativity, solar flattening, and celestial mechanics (Prof. Zuber, Dr. W. Mayer, Mr. R. Goeke).

More information about this center can be found on the World Wide Web at the following URL: http://space.mit.edu

Claude R. Canizares

CHAIR OF THE FACULTY

FACULTY POLICY COMMITTEE

This year the Faculty Policy Committee (FPC) oversaw those aspects of educational and academic policy that are specific responsibilities of the Faculty and provided faculty input toward policy development at the Institute. The Committee met twice with President Vest and once with Provost Moses. It also met with the Deans of the five Schools and the chairs of the Task Force on Student Life and Learning. The FPC used these opportunities to convey faculty opinions on a variety of topics ranging from the quality of community interactions to teaching issues and campus facilities. The FPC Subcommittee on Faculty Work and Personal Life continued its work from last year, and in the spring, the FPC charged two additional subcommittees: the Subcommittee on the Bachelor of Arts and Science Degree Option and the Subcommittee on Exam and Term Regulations. The FPC also heard from and coordinated the work of the other Faculty committees and reviewed several changes in procedures and programs. In addition, the Committee reviewed several proposed degree programs; two of the programs were approved and forwarded to the Faculty for a vote, and two will be reviewed further during 1998–99.

FACULTY PRIORITIES

Throughout the year, the FPC engaged in discussions concerning faculty priorities. The Committee identified three primary areas of concern: community interactions, quality of faculty life, and faculty governance; highlighted a number of concerns; and made several recommendations.

Community Interactions

The FPC discussed the need for improved community interactions at MIT, particularly between faculty and students and between faculty in different departments. Members identified several themes that are conducive to increased and improved interaction among groups of people within the MIT community: a new liberal education (as defined by the Task Force on Student Life and Learning), a new paradigm for faculty life (possibly with an increased reliance on internal assessment in the tenure evaluation), technology and its use, and interdisciplinary research.

In addition, the FPC considered the current state of campus facilities and the impact of campus planning decisions on the quality of community interactions. The Committee supported continued commitment to classroom renovations, and undergraduate, graduate student, and faculty housing. Furthermore, members urged the administration to give careful consideration to expanded child-care facilities, undergraduate dining facilities, and public and community space.

Quality of Faculty Life

The Committee ennumerated issues that seem to contribute to faculty time pressures including: extensive travel mandated by research, pursuit of research funding, the demands of teaching responsibilities, and insufficient administrative and technical support. Since discussions about undergraduate and faculty interaction consistently identify faculty time as a problem, members agreed that some relief must be found if the situation is to improve. Furthermore, the FPC advocated placing stronger value on faculty contributions through teaching, advising, and Institute service and continuing to explore faculty housing, flexibility in the tenure clock, and other initiatives to relieve the stress on MIT faculty members. Fear was expressed taht faculty recruitment and retention, particularly of women faculty, will be adversely effected without careful attention to this issue.

Faculty Governance

The FPC discussed the shortcomings of the faculty governance structure and took steps to modify several areas:

- A small working group met regularly throughout the year in an effort to more closely coordinate the work of key faculty committees dealing with issues of undergraduate life and curriculum.
- Strong efforts were made at improving communications with the Faculty. Permanent Web-sites have been established for *Rules and Regulations of Faculty* (URL: http://web.mit.edu/faculty/rules/) and the term regulations (URL: http://web.mit.edu/faculty/termregs/); these sites are updated as changes occur. In addition, reports made at the March and April Faculty meetings were simultaneously posted on the Web, and e-mail messages were sent to all faculty members encouraging them to read the reports and respond with feedback.
- Faculty Chair Lotte Bailyn, in conjunction with the Dean for Graduate Education, agreed to establish an FPC subcommittee on Graduate School policy with one member from each School, and the president of the Graduate

Student Council and Senior Associate Dean of the Graduate School as ex officio members. The subcommittee, to be chaired by the Dean, is in the process of being formed.

- Finally, the faculty officers will be working with the senior administration during 1998–99 to clarify the procedures for seeking approval of new degree programs.

These discussions were continued by some of the other Faculty Committees, notably the Committee on Faculty-Administration, the Committee on Student Affairs, and the Committee on the Undergraduate Program. In addition, the work of the FPC subcommittees addressed some of these issues in more depth.

SUBCOMMITTEE ON FACULTY WORK AND PERSONAL LIFE

During 1997–98, the subcommittee was chaired by Professor Leigh Royden. Other members included Professors John Grotzinger, Seth Lloyd, and Jeffrey Shapiro, and Chairman of the Corporation Mr. Alexander d'Arbeloff. The group identified tractable issues in four areas where change would have an impact on improving faculty morale:

- Family support: the degree to which the Institute enables faculty to succeed in being faculty members and raising families, including issues of child and elder care, housing, etc. The subcommittee has information from a questionnaire and is exploring data sharing with peer institutions. A separate initiative is examining child care, and the subcommittee will look at faculty housing during 1998–99.

- Retention: the subcommittee gathered data on the percentage of faculty job offers that are accepted, the number of faculty who receive tenure, and the number who leave within seven years of receiving tenure (a low number). Although it is still processing those data, the group feels there may be more to gain from examining recruitment than from looking at retention.

- Facilities: the subcommittee discussed issues relating to the need for increased and improved common meeting places across campus, technical support for grant writing, and administrative and computer support. In particular, the subcommittee feels that MIT could be better organized in the area of computer support and will look more closely at how peer institutions are handling this issue during 1998–99.

- Intellectual community: the subcommittee is considering a proposal to establish a source to fund interdepartmental or inter-School events, e.g., summer school. It will continue to explore this idea during 1998–99.

SUBCOMMITTEE ON THE BACHELOR OF ARTS AND SCIENCE DEGREE OPTION

In April, the FPC charged a subcommittee with exploring the possibility of creating a new undergraduate degree option at MIT, tentatively titled the bachelor of arts and science degree (BAS). The notion for such a degree came out of discussions with the chairs of the Task Force on Student Life and Learning and Provost Moses. The subcommittee's membership included Professor Samuel Allen as chair; two FPC members, Professor Jeffrey Shapiro and Mr. Dedric Carter; Professor Jeanne Bamberger from the arts; Professor Isabelle de Courtivron from the humanities; and Professor Paul Schechter from the sciences. In addition, three of the members, Professors Allen and Shapiro and Mr. Carter, were from engineering. The group was charged with three tasks: setting up a rationale for offering such a degree, sketching out some possible options, and looking at some of the potential issues that might arise.

The group's discussions highlighted three periods in an undergraduate's experience where the existence of the BAS might have a significant impact: 1) when a student chooses whether to enroll at MIT or at another institution; 2) when an undergraduate at the Institute is defining what her/his academic experience ought to encompass; 3) when an individual enters the work environment of the twenty-first century upon graduation from MIT.

Although the limited time frame prevented the subcommittee from recommending specific parameters for the degree, the group felt that the BAS would enrich undergraduate academic life at MIT and, therefore, strongly urged further consideration of the proposal. A follow-up group will be charged with further development of the BAS proposal.

SUBCOMMITTEE ON EXAM AND TERM REGULATIONS

In the spring, the FPC, concerned over the increasing number of reported violations, charged a subcommittee with reevaluating current faculty regulations governing the administration of quizzes, tests, and exams.

Subcommittee members include Professor Donald Sadoway as chair; Professors Paola Rizzoli and Arthur Smith, the chairs of CAP and COC; Associate Dean Alberta Lipson from the office of Undergraduate Academic Affairs; and Mr. Jeremy Sher, chair of the UA Student Committee on Educational Policy. One more student may be added. The subcommittee is focusing on both issues related to the end of term and those related to term time. The group is looking at the history behind the issues and reviewing current policies. It advocates fewer, more broadly agreed-upon rules that allow for sensible experimentation and has articulated several guiding principles with the goal of enhancing MIT's educational mission:

- to protect the students from overload caused by excessive demands on their time that go outside the bounds of regular class hours or what has been determined as a reasonable end-of-term load;
- to enhance the learning experience of students by recognizing that some of these apparent violations have pedagogical strengths worth acknowledging; and
- to support educational experimentation when a faculty member is trying something new.

The subcommittee considers no topic taboo and is reviewing MIT's policies for take-home and evening exams, as well as considering creative scheduling ideas. The group feels that wide faculty acceptance of the regulations is critical to their success, and that raising awareness of the regulations would reduce some violations. Finally, the regulations should address violations and deviations with a complaint-handling mechanism that operates in a swift and logical manner. The group will continue to meet during the summer and hopes to report to the Faculty in the fall.

CHILD CARE

FPC member Professor Leigh Royden spearheaded an initiative seeking an Institute commitment to establish a centrally located child-care facility that could accommodate approximately 100 children, particularly infants. FPC members felt that the issue of child care is directly connected to faculty recruitment and, after discussing the initiative, the FPC resolved that:

> The ability of research universities to survive and flourish into the twenty-first century will be determined largely by the quality of their faculty. Because the career demands on young faculty often compete with their shared family responsibilities, the availability of high-quality, proximally located child care is becoming increasingly important in MIT's ability to recruit and retain young faculty. Thus, the establishment of a high-quality, centrally located child care facility that includes infant care on the main MIT campus is a top priority in MIT's near-term planning for campus construction, for example within the new CIIS building or in the Media Lab extension. Identification of funds for construction of child care facilities is urgent and should be a top priority for the MIT administration.

The Planning Office has appointed a faculty committee to advise on child care needs. This committee, chaired by Professor Royden, includes eight other faculty members.

JOINT MIT/WHOI M.ENG. IN OCEAN ENGINEERING

In April, Professor J. Kim Vandiver and Dean Isaac Colbert came to the FPC to present a proposal to establish a joint MIT/WHOI M.Eng. in Ocean Engineering. The proposed program mirrors an M.Eng. that has been offered by the Department of Ocean Engineering for several years, but would allow for the full participation of the Woods Hole Oceanographic Institute (WHOI). MIT and WHOI already offer joint S.M. and Ph.D. programs. Due to a variety of circumstances, this proposal had progressed partially through the approval process, but was never brought to the Committee on Graduate School Policy (CGSP), the FPC, the Faculty, or the Corporation. There were four students ready to graduate in June, approximately 10 more who were close to finishing the first year of the program, and others who had been admitted for the fall. The FPC voted separately on the granting of the degree to students currently enrolled and approval of the program as a whole. Both issues were approved. The Joint MIT/WHOI M.Eng. in Ocean Engineering was brought to the Faculty at the April meeting and approved in May.

MASTERS OF SCIENCE IN COMPARATIVE MEDIA STUDIES

Also in April, Dean Philip Khoury and Professor Henry Jenkins visited the FPC seeking approval for an M.S. program in Comparative Media Students. In presenting the proposal, Professor Jenkins spoke of the increasingly central role media technology plays in the global, digital revolution and of the need to understand its effects on families, work, education, law, etc. He stressed that industry thinks across media, e.g., film, television, and the Web, and this program will strive to address the social science questions around this trend in a way that is not medium specific. It is anticipated that the program will attract students with related professional experience and prepare them for further professional work or graduate studies. It will be overseen by a steering committee and result in a Course 21 degree.

FPC members inquired about the impact of the program on the undergraduate program, the development of new subjects, and the need for new faculty. Professor Jenkins indicated that several new subjects will be developed for the program, but a number of the courses included in the curriculum are already being offered. Initially, there would be no need for additional faculty slots; however, the ultimate goal is to build a core group of faculty who teach exclusively in media studies. FPC members approved the proposal and acknowledged the long-term potential of the program, which was presented to the Faculty at its April meeting and approved in May.

PROPOSED EVENING PROGRAM FOR A MASTERS OF BUSINESS ADMINISTRATION

The FPC engaged in considerable discussion about the proposal to establish an evening MBA program, and the impact such a program would have on Sloan and the rest of the Institute. The Committee met with Professors Berndt and Yates, and later with Dean Urban about the proposal and conveyed concern regarding a variety of issues including allocation of faculty and space resources, undergraduate access to Sloan courses, and the viability and advisability of an evening program. Sloan received CGSP approval to continue to develop the proposal, and the FPC will review the proposal again in 1998.

INTERDISCIPLINARY DOCTORATE IN ARCHAEOLOGICAL MATERIALS

Professor Linn Hobbs visited the FPC in the spring to discuss a proposal to establish an interdisciplinary doctoral program in archaeological materials. The initiative preserves and consolidates MIT's reputation in the area of archaeological materials. There is a strong feeling in the department of Materials Science and Engineering and the discipline that this area of study should be pushed forward. Although interdisciplinary Ph.D. programs are generally reviewed by the CGSP on an ad hoc basis and do not require a Faculty vote, the department is seeking to establish a formal program in an effort to attract NSF and foundation funding.

The curriculum includes Course 3 work, but extends to urban studies, archaeology, STS, geology, and engineering. It is anticipated that graduates will go on to work in museums or find academic jobs in archaeology or materials science departments. For this reason, the program has been intentionally balanced between the two fields and will be overseen by an auxiliary committee working in conjunction with a departmental committee. It is hoped that this structure will safeguard the elements of the program that fall outside Course 3 jurisdiction.

The department expects an enrollment of up to 10 students. Most of the inquiries regarding the status of the proposal have been from undergraduates with materials science majors and archaeology minors. However, Ph.D. candidates might also come from the pool of archaeology/anthropology undergraduates who seek a clear, rigorous, analytical, and scientific approach to the field. Applicants will need a background in science or engineering rather than an undergraduate degree in historical archaeology or anthropology.

In reviewing the curriculum, the FPC expressed concern that a number of core courses during the first year would be taken at Harvard. The Committee recommended establishing an MIT-based seminar to follow up on the Harvard subjects and strengthen the student cohort. The proposal was approved by the FPC and will be taken to the Faculty for a vote in the fall.

DIVISION OF BIOENGINEERING AND ENVIRONMENTAL HEALTH

In accordance with the recommendations of the Widnall Report for cases involving moving or restructuring academic departments and in consultation with the Faculty Chair, Dr. Vest appointed a committee to review the procedures concerning the shift of Toxicology to the School of Engineering. The committee was chaired by Professor Canizares and included Professors Murman and Rogers. In the spring, the FPC met with Dean Brown

regarding the proposal to establish a Division of Bioengineering and Environmental Health in the School of Engineering. At the same time, the FPC reviewed the report of the review committee. The Committee found the procedures to be appropriate and thorough in both cases. The proposal to establish the Division was discussed at the May Faculty meeting.

COMMITTEE ON THE UNDERGRADUATE PROGRAM

The CUP reviewed recommendations brought forward in the spring of 1997 by the Subcommittee on Freshman Advising (chaired by Professor Linn Hobbs) and charged a follow-up group, chaired by Professor Stephen Benton, to direct the future of the Freshman Advisor Seminar (FAS) program. Professor Benton and others worked with Provost Moses to establish a pilot, one-time, scholarly allowance of $1,500 for faculty who elected to lead an FAS in the fall of 1998. Professor Benton's subcommittee, working with Ms. Donna Friedman and others in the Academic Services office, was successful in increasing the yield of faculty-led seminars for the coming year. Final recommendations for the future of the Freshman Advising program will be forthcoming.

The CUP reviewed several proposals brought forward by Professor Thomas Greytak, chair of the Subcommittee on the First-Year Program. A proposal was approved to flag the registrations of students who sign up for subjects without record of having taken the listed co-requisite or prerequisite subject; the Academic Services office has launched a series of pilots in this area. In response to a letter unanimously endorsed by members of the subcommittee which recommended that all freshmen be housed in MIT residence halls, the CUP entered the discussion begun by Professor Greytak's committee. Discussions on housing also touched on related areas, such as residentially based advising for first-year students. In another related area, Dean Kip Hodges reported on his efforts to revamp the freshman orientation program for Fall 1998.

The CUP approved an experiment to develop a degree program in Archaeology and Materials within the Department of Materials Science and Engineering. The curriculum, which had been approved by the Committee on Curricula but forwarded to CUP because of concerns about some aspects of the proposal, was discussed with members of the Materials Science and Engineering department at several CUP meetings during the fall term. The experiment will be reviewed within the next three years.

The CUP heard updates from two groups involved in experiments licensed by the Committee. The Subcommittee on Intermediate Grading, chaired by Professor Paul Lagace, made an interim report to the Committee that included data gathered by the Registrar's office and by surveys of faculty and students. Final results of the experiment will not be formally presented until Fall 1998 so that data from Spring 1998 may be included in the report.

Professors Gene Brown and Langley Keyes, chairs of the Subcommittee on the Communication Requirement, presented highlights from pilot projects that were initiated by the subcommittee during the 1997–98 academic year.

The CUP collaborated with the Task Force on Student Life and Learning at a day-long retreat in January that focused on the theme of improving cross-institutional educational collaborations. Beginning with meetings in March, the CUP devoted six sessions to planning for a review of the undergraduate program that would begin in the next academic year and to hearing a variety of perspectives on what skills and information students might need for the twenty-first century. Guests included Dr. Marshall Lih from the NSF, Professor Paul Joskow, Dean Philip Khoury, and Professors Harriet Ritvo, Philip Sharp, and Paul Lagace.

CUP business in other areas included the following:

- The CUP tabled a proposal from the Subcommittee on Freshman Advising to exempt Freshman Advising Seminars from the freshman credit limit.
- In preparation for the five-year review of the M.Eng. degree in Electrical Engineering and Computer Science, the CUP began discussions with Professor Jesus del Alamo, who represented the department and who planned to spend the remainder of the academic year undertaking an internal review of that program. The CUP will hear from the department in the fall of 1998.
- The CUP met with representatives from the Office of Minority Education and the Office of Preprofessional Advising. Under the leadership of Professor Suzanne Flynn and Faculty Chair Lotte Bailyn, it was agreed that a Preprofessional Advising and Education Committee would be re-formed.

- A proposal that would allow an academic exchange program in the visual arts between MIT and the Massachusetts College of Art and the School of the Museum of Fine Arts was brought to the CUP and approved as an experiment.
- The CUP worked with the Educational Studies Working Group to define categories of interest for the 1998 Senior Survey.
- The CUP approved the CAP-initiated proposal to implement a strengthened policy on student financial holds and retroactive registrations.
- Following an enthusiastic recommendation from the Subcommittee on the First Year Program, the CUP heard a proposal from Media Arts and Sciences to introduce a first-year program that would provide the Media Lab with a more formal mechanism to work with freshmen. The CUP will continue this discussion in the Fall.
- In another area where discussion will continue next year, members heard from the ROTC Oversight Committee and from the three ROTC unit commanders about the current status of the MIT program. In particular, the units wish to re-open discussion of MIT credit for ROTC subjects.

OTHER FACULTY COMMITTEE REPORTS

During the 1997–98 academic year, the Committee on Academic Performance (CAP) operated without one faculty member, i.e., with only five faculty members (including the Chair, who voted in case of a tie) and three student members.

The CAP acted on a total of 611 petitions, a decrease of 5% from the previous year. More than half of these petitions (357) were acted upon administratively by the Chair. The Committee saw an increase of 12% in the number of petitions for late registration due to financial hold. It is the Committee's hope that next year's implementation of the new Financial Hold Policy will greatly reduce the number of petitions for late registration. The number of petitions to complete incompletes was down 14% due to the new policy whereby a student only needs to petition to complete incompletes awarded prior to the Fall 1996 term. CAP received very few petitions to exceed the IAP credit limit of 12 units, probably due to increased publicity of the enforcement of the credit limit through memos to instructors, freshmen and their advisors, and ads in *The Tech.*

CAP actions voted at the end-of-term grades meetings resulted in a total of 58 Required Withdrawals (RW), up from 51 during the previous year; and in 413 Warnings, down from 446 during the previous year. However, the number of RWs for Freshmen was only five, down from the 16 RWs voted in 1996–97. The summary of CAP actions taken on undergraduates in 1997–98 is:

	Warnings	RWs
Freshmen	175	5
Sophomores	100	23
Juniors	83	15
Seniors	55	15
Totals	413	58

In Fall 1997, CAP finalized the policy on Financial Holds and Retroactive Registration, which had been initiated two years earlier. The revised policy was brought to the Faculty Governance working group and the CUP in Spring 1998 and was approved in April 1998. A memo was drafted to be distributed to future CAP chairs and committees to insure that the procedure for consideration of retroactive awarding for students on financial hold becomes part of the standard action of the Committee. The process of widely publicizing the new policy needs to be undertaken as soon as possible for the policy to become effective by spring semester of the 1998–99 academic year.

Following a series of meetings in the fall term on the abuse of the evening exam policy by faculty, the CAP and UA Student Committee on Educational Policy (SCEP) jointly initiated the design and administration of a short survey of undergraduates in the spring semester to elicit their opinions about evening exams for daytime classes. The survey was prepared by the CAP Chair, the Associate Dean for Educational Research, and student representatives from the UA, CAP, and SCEP. Paper copies of the survey were administered by SCEP members, and the survey was placed on Feedback Forum during the second week of May. The summary of the Evening Exam survey was provided by the Associate Dean during the second week of June.

Starting in Fall 1997, the CAP Chair worked closely with Ms. Mary Enterline to revise and finalize the so-called *CAP Guide,* the last printed version of which dates back to 1990. The revisions were completed by late spring, and the *Academic Guide for MIT Undergraduates and their Advisors* was put on the Web as a PDF file in the first week of June. The hard copy is expected to be ready by late Summer 1998. The URL is: http://web.mit.edu/academics/academic-guide/.

The *Committee on Corporate Relations* (CCR) met actively throughout the year to identify the issues facing Corporate Relations (CR) as MIT moves into a capital campaign and the new millennium. Committee members recognize that the landscape of corporate relationships is changing on both the domestic and international fronts. In order to satisfy the needs of the mission statement, it is recommended that CR seek a proper balance in applying its finite resources to its internal customers (administration and faculty) and external customers (local and global companies, major corporate partners, and international academic and government programs). It is essential that attention be given to motivation and retention of key CR personnel. There is a need to continue to enhance communication with faculty and expand the base of faculty involvement in corporate relationships. An increased involvement in large international initiatives that overlap with innovation in education and research programs places additional demands on CR resources, which need to be balanced with commitments to corporate clients. Expansion of our major corporate partnerships requires new and major efforts in stewardship of these relationships. There is a need to identify an employee metrics by which CR can measure its effectiveness in meeting its mission and advancing toward the goals of the capital campaign.

The *Committee on Curricula* (COC) met 16 times during the 1997–98 academic year. The Committee approved proposals for new, canceled, and revised subjects, and reviewed student petitions for substitutions for the General Institute Requirements, as well as approving substantive curricular changes and upholding policy.

The COC approved the following: a new S.B. in Archaeological Materials as recommended by the Department of Materials Science and Engineering (Course III-C), which was approved by CUP on an experimental basis; major changes to Course 1-C that encouraged a project-based approach; a proposal to revise the Minor in Cognitive Science and rename it Minor in Brain and Cognitive Science; and minor changes to Course 15's undergraduate program.

The *Committee on Discipline* (COD) heard charges against two students this year. One charge was for academic misconduct, and one was for personal misconduct. Three other charges for academic misconduct remain to be heard. The sanction for the charge of academic misconduct was informal probation; the sanction for the charge of personal misconduct was formal probation with a notation on the student's transcript. The Committee also reviewed a number of petitions for a variety of requests: the granting of a degree, returning to the Institute, and removal of disciplinary notations from transcripts.

The COD, in conjunction with the Office of the Dean of Students and Undergraduate Education (ODSUE), continued its policy of regularly reporting disciplinary actions at Faculty meetings. Members hope that this practice will alert faculty members to the need for consistent reporting of incidents to the COD or ODSUE, so that students may become more aware of the risks they run by engaging in academic dishonesty.

This year the *Harold E. Edgerton Award Selection Committee* reviewed six nominations, all of them outstanding, for the Edgerton Award. After considerable deliberation, the committee selected Professor Steven Leeb as the recipient of the Harold E. Edgerton Award. Professor Leeb of the Department of Electrical Engineering and Computer Science was commended for his work on mechatronics and the medical applications of polymer gels. He was also cited for his strong commitment to both undergraduate and graduate teaching. In addition, the Committee worked with the faculty officers and the Academic Council to clarify the criteria for the award, which now state:

> The Harold E. Edgerton Faculty Achievement Award Selection Committee chooses one individual from among the junior (non-tenured) members of the MIT Faculty to be awarded the Harold E. Edgerton Faculty Achievement Award. Faculty members are ineligible for this award in the year that their tenure decision is mandatory. The purpose of the Award is to recognize exceptional distinction in teaching and research or scholarship.

This year the *Committee on Faculty-Administration* (CFA) developed recommendations concerning leaves and part-time appointments. These included an untenured faculty career development leave to occur between the second and fifth years of service, expanded unpaid personal leaves with more emphasis on part-time leaves, and provisions for part-time professorial appointments after the age of 59.5 designed to encourage transitions into retirement and promote faculty renewal.

The CFA worked closely with the Strategic Review of Benefits Committee to encourage the reduction of the normal retirement date to 62 and to provide for the withdrawal of 401(k) contributions after age 59.5 in order to allow for earlier retirement and part-time service.

Further recommendations were made regarding facilities for retired faculty and ways they could continue to be involved in life at MIT. These included recommendations that a retired faculty member serve on the CFA and on the Strategic Review of Benefits Committee and that faculty holding the rank of Professor Without Tenure (Retired) be allowed to vote at faculty meetings.

The Committee also enthusiastically backed new initiatives for expanded child care on campus and recommended that some form of subsidy be considered.

In 1997–98, the *James R. Killian, Jr. Faculty Achievement Selection Committee* implemented changes in the nomination procedures. Under the new procedures, solicitations for nominations made to the faculty-at-large, with several follow-up reminders. A short list of candidates was selected, and additional information requested from nominators. The choice was both difficult and pleasurable as the candidates were outstanding. At the May Faculty meeting, the Committee announced Professor Pauline Maier as the 1998 Killian Award winner. She has been called "an historian's historian" and is one of this country's most distinguished experts of early America.

In its first meeting of the 1997-98 academic year, the *Committee on the Library System* heard and discussed a detailed presentation by Director Ann Wolpert on the State of the Libraries. Data were presented on library operations and activities. Other agenda items concerned strategies for the Library System budget in the period FY98-02, and possible capital campaign initiatives. A reexamination of the current policy of access privileges for non-MIT-affiliated library users was also discussed. The second meeting was devoted to a discussion of the FY99 budget and of future space needs for the libraries. A proposed user survey, to be distributed to students and faculty, was also considered. The third meeting was primarily devoted to a demonstration of the electronic resources available in the libraries and a discussion of how these extensive resources might best be publicized within the MIT community.

At the April Faculty Meeting, the *Committee on Nominations* presented the names of faculty members to serve on the 14 Standing Committees of the Faculty as well as the names of the faculty members to serve as Chair of the Faculty and Associate Chair of the Faculty. At its May meeting, the Faculty approved the nominations for the next Chair of the Faculty, Professor Steven Lerman, and Associate Chair, Professor Leigh Royden, as well as the names of 42 faculty members to serve on the Standing Committees.

The *Committee on Outside Professional Activities* (COPA) had a relatively quiet year. The COPA advised in several situations involving potential conflicts of interest for faculty, students, or staff. In none of these situations, however, were serious problems or obvious violations of MIT policy reported.

The *Committee on Student Affairs* (CSA) met a dozen times over the year. Stimulated by discussions of the undergraduate residential system taking place throughout the Institute, the CSA focused its efforts on seeking to understand and, where possible, appraise, the role and effectiveness of the graduate resident tutors in the on-campus residences. It heard from graduate residents, housemasters, administrators, and others and concluded in its draft report to the Dean for Student Life that the graduate resident system is an excellent resource which, like any system, will benefit from judicious fine-tuning. The Committee also followed closely the actions stemming from the Institute Dining Review in which it had played a key role in previous years.

During the 1997–98 academic year the *Committee on Undergraduate Admissions and Financial Aid* (CUAFA) addressed both operational and strategic issues. Throughout the year, a constant theme was the Institute's need to do more to invite qualified students to apply and encourage admitted students to enroll. MIT will need to create expanded services and opportunities in order to enroll the best students in an increasingly competitive admissions and financial aid environment.

CUAFA encouraged new efforts to increase the yield of admitted students. The Admissions Office set up a new web page for admitted students, cross-organizational teams of people were formed to address answers to prospective students' and parents' questions, and faculty were recruited to telephone students and encourage their attendance. The Committee reviewed and endorsed plans to link faculty members with science magnet high schools to encourage early awareness of the Institute and its offerings. CUAFA strongly endorsed the moderation of the self-help level for the prospective aid year, primarily to reduce the growing level of debt incurred by MIT aid recipients. The Committee lauded the 12% reduction in self-help for all classes that was approved by the Academic Council for the 1998–99 academic year.

In 1997–98 a number of MIT's competitors initiated significant changes in financial aid policies. These changes were designed to attract target populations to those schools. In response, CUAFA initiated the creation of a task group to study the effects of these changes as well as the overall effect of price on application and enrollment patterns. This group will make recommendations for action to the Academic Council in November 1998

In addressing strategic issues, CUAFA recommended that students become involved with the reading of prospective freshman admissions applications. The Admissions Office included undergraduate and graduate student participation in the process for the first time in 1997–98 and will continue in the future on a limited basis. The Committee reviewed the process by which final admissions decisions are made. As a result, procedures were implemented to review admission decisions to assure the reliability and validity of these decisions across the application matrix cells. Finally, the Committee strongly endorsed the proposal that financial aid and admissions processing schedules be modified so that aid decisions could be mailed to students at the time of the admissions decisions. This was implemented for the first time in the 1997–98 academic year.

The *Committee on the Writing Requirement* (CWR) continued to oversee the current Institute Undergraduate Writing Requirement. In addition, it coordinated its activities to support the CUP Subcommittee on the Communication Requirement's development of the communication-intensive experiments and pilot programs mandated by the MIT Faculty.

To provide students with sufficient incentive to participate in these experiments, the CWR allowed, on an experimental basis, specifically designated communication-intensive subjects to satisfy one of the two phases of the Writing Requirement. Students receiving a grade of B- or better in the Sloan experimental seminar "Communication in the Workplace" or in the communication-intensive component of the Integrated Studies Program's subject SP354 "Technologies in Historical Perspective," automatically satisfied Phase One. For the 1998–99 academic year, the CWR has also granted automatic Phase One credit to students receiving a grade of B- or better in pilot subjects designated as communication-intensive by the HASS Overview Committee. Students successfully completing communication-intensive activities in Biology and Physics have been granted credit for Phase Two. The CWR will be assessing these arrangements as substitutes for the traditional methods of completing the Requirement and considering the expansion of these experiments to other departments during the 1998–99 academic year.

The Committee, in collaboration with the Office of the Dean of Students and Undergraduate Education, is currently offering entering members of the Class of 2002 the opportunity to take the Freshman Essay Evaluation over the summer via the Web. This pilot Web-based test provides writing contexts that more closely resemble the writing situations students will encounter as undergraduates at the Institute. Furthermore, it will allow students and their advisors to receive detailed and specific written evaluations of the student's writing rather than just summary scores. Finally, by taking the test over the summer, students reduce some of the pace and pressure of Orientation. The preliminary results of this experiment are very promising: 61 students have already taken the first of the three administrations planned this summer, and over 200 additional students are expected to take the other two. This fall, the Committee will evaluate the experiment's overall potential as a replacement for the traditional essay evaluation.

This year, the Committee concluded that many students at the Institute are unsure and confused about the standard academic rules governing the appropriate use of the language, information, and ideas from outside sources. The Committee has charged Professor James Paradis, the Head of the Program in Writing and Humanistic Studies, and Dean Leslie Perelman, the Director of the Writing Requirement, with developing a prototype interactive Web site that will instruct students in 1) the general standards for acknowledging outside ideas and information, 2) the rules for appropriately using another person's language, and 3) general guidelines citing Web-based sources of information. The Committee will review the prototype in the fall.

Sincere appreciation is extended to the following faculty members for their special contributions and service as appointed Chairs of the Standing and Special Faculty Committees during the past year: Paola Rizzoli (Academic Performance), Charles L. Cooney (Corporate Relations), Arthur C. Smith (Curricula), Stephen C. Graves (Discipline), Richard M. Locke (Edgerton Award), Roy E. Welsch (Faculty-Administration), Rafael L. Bras (Killian Award), June L. Matthews (Library System), Arnoldo C. Hax (Nominations), Robert T. Sauer (Outside Professional Activities), John P. de Monchaux (Student Affairs), Harold Abelson (Undergraduate Admissions and Financial Aid), Suzanne Flynn (Undergraduate Program) and Winston R. Markey (Writing Requirement). Many thanks to Steven R. Lerman and Samuel M. Allen for their service as Associate Chair and Secretary of the Faculty.

Lotte Bailyn, Anna Frazer

SENIOR VICE PRESIDENT, OPERATIONS

While much progress has been achieved as a result of the administrative process changes reported in prior years, the most dramatic shift from last year involved the groundwork and planning by the various departments in the Operations area in preparation for the undertaking of a major campus expansion. The first of the projects, the new CIIS/Stata Complex which will be built on the site of Building 20, will house five laboratories and departments. During the year, Frank Gehry, the internationally recognized architect, was chosen to design the new complex.

Several construction and renovation projects of note were completed this year. The Student Service Center located on the first floor of Building 11 opened in time for the fall term; ten all-purpose classrooms in Building 2 were totally renovated; Room 9-150, an outdated lecture hall, was transformed into a state-of-the-art distance learning facility; and the total renovation of Building 16 was completed and the building was occupied during the year. In addition, the newly renovated Music Library in Building 14E received the "Building of the Year" award in the category of Spatial Planning and Interior Furnishings at the Facilities Management Expo.

The Copy Technology Centers successfully completed their first full year of operation as an independent department and, within Physical Plant, the Repair and Maintenance group also successfully completed their first year under the redesign consisting of five local zones and twelve central teams. Cost-saving efforts implemented by the redesigned Mail Services group saved the Institute over $850,000. As a result of the success of last year's pilot program, the Visa Procurement Card (VIP Card) was introduced to the community this year and is available for Institute personnel to make small dollar purchases.

Due to the increased demand for on- and near-campus housing that the Institute faces, the Planning Office engaged in preparing for new undergraduate and graduate residences.

Campus safety continued to be a priority during the year in order to ensure that Institute policies and procedures remain in compliance with city, state, and federal regulations. The Environmental Protection Agency (EPA) conducted a compliance review late this spring. Staff from the Safety Office worked with members of the EPA inspection teams during the enforcement review. The Safety Office also coordinated preparatory efforts prior to the site inspection.

Affirmative Action efforts in the operating areas continued throughout the year. Our on-going goal is to hire minorities and women, whenever possible, and to promote women to non-traditional roles. In an effort to identify a greater pool of minority candidates, a revised program within the Physical Plant Department, the largest single operating unit, has been established with the formation of several diversified search committees, all trained in the legal aspects of interviewing. The operating areas are also working with the Special Assistant to the Vice President for Equal Opportunity and Affirmative Action to identify resources and attract minority candidates. In addition, the development of minorities and women will continued through enhanced training programs and education.

We will continue to strive toward a goal of a more diverse work force.

Following are individual department reports.

William R. Dickson

AUDIO VISUAL SERVICES

Audio Visual Services is dedicated to meeting the Institute's needs for presentation support for a wide variety of activities, including classes, special events, and cultural programs. Through the use of audio, video, and computer projection and amplification systems, the department works with students, faculty, and staff to produce daily classes, seminars, conferences, concerts, and special events reaching thousands of people each year, both on campus and at remote sites, around the world.

Support for the Institute's educational activities comprised 65 percent of the department's work orders throughout the year. The operation of audio visual equipment for daily classes and support for seminars and colloquia continues to be the largest area of business for the department. A highlight was the operation of audio teleconferencing equipment for Sloan School classes, enabling students to talk to entrepreneurs worldwide and interact with them in a class setting. The incorporation of computer technology into the curriculum continues to require a greater level of technical skill in the interfacing of personal computers to projection systems and other display equipment.

Support for special events continues to be another focus of the department. Complex computer projection and audio systems were designed and operated by department technicians for the following events: the Artificial Intelligence Laboratory Conference, Media Lab Wearables Conference, three Enterprise Forum satellite teleconferences, the Innovation Summit, the Technology Review Re-Launch Event, the Industrial Liaison Program conferences, and Commencement and Technology Day.

Direct involvement in audio visual systems design for classrooms and lecture halls expanded this year. Projects include the upgrade of the audio visual system in 1-390 to incorporate distance learning capabilities, the renovation of Kresge Auditorium, the renovation of ten classrooms in Buildings 2, 5 and E51, and in the N42 Demonstration Room for Information Systems.

A computerized database system was developed this year for processing orders, facilitating internal billing through SAP, tracking equipment inventory, and providing business management information. Customers continue to make heavy use of the web-based ordering system which was integrated into the order processing database to facilitate requests for services.

Further information about Audio Visual Services can be found on the World Wide Web at the following URL: http://web.mit.edu/av/www

Louis W. Graham, Jr.

CAMPUS POLICE

The MIT Campus Police continued to commit itself to providing services to the community through partnerships that reduce crime, create a safe environment, build trust, and enhance the quality of life in the academic community. The department remains committed to delivering quality service to the community in an effective, responsive, and professional manner.

The number of crimes against persons during the year dropped to a three-year low of 21 incidents. Although thefts of personal property also dropped during the year, the total number of reported incidents of larcenies from Institute facilities and residence halls rose. There were 196 incidents of theft of Institute-owned property compared to 161 last year. Computers and computer components were, once again, the most frequent type of Institute-owned property stolen. There were 441 incidents of theft of personal property reported at sites other than residences compared with 475 last year. The majority of items stolen were wallets, laptops, and backpacks. There were 112 thefts inside residences reported this year compared with 68 last year and the most frequently stolen items were bicycles and electronic equipment. Motor vehicle thefts on campus decreased substantially. There were 13 motor vehicle thefts this year compared to 24 last year. The theft of bicycles also dropped significantly with a total of 115 bicycles stolen compared to 143 last year.

The Safe Ride safety shuttle service provided 159,207 personal safety escorts during the year. Campus Police also supplemented Safe Ride when early morning operations ceased by providing 708 personal safety escorts to members of the community.

The Campus Police Department provides 24-hour emergency medical services to all members of the MIT community as well as to Draper Laboratory and the Whitehead Institute. The total number of patients transported by the Campus Police rose in 1997 from 2,106 last year to 2,642 this year, an eight year high.

The Rape Aggression Defense (RAD) self-defense program continued to be a popular course. During the year, the total number of individuals trained in the community increased to 357 since the start of the program in 1994.

Cheryl DeJong Vossmer, Campus Police Sergeant in the Crime Prevention Unit, was a recipient of the Gordon Y Billard Award for special service of outstanding merit performed for the Institute at the annual Institute Awards Convocation.

More information about this department, it's services, operations, and campus crime can be found on the World Wide Web at the following URL: http://web.mit.edu/cp/www/

Anne P. Glavin

COPY TECHNOLOGY CENTERS

The goal of the Copy Technology Centers continues to be to provide the MIT community with the highest quality copier and copier-related services. To meet that challenge, we strive to implement creative programs in the areas of efficiency and quality control while at the same time maintaining sound business principles. Implementation of these programs helps ensure that customer satisfaction remains the department's number one priority.

OVERVIEW

One of the main focuses of the department over the past year was to stabilize the organization following the closing of the old Graphic Arts Department. The Copy Technology Centers (CTC) completed their first full fiscal year as an independent department. A great deal of effort went into educating the MIT community about our new identity and services the department provides. The past year also marked the formation of critical partnerships with other internal departments to bring about the structure of a complete document delivery system. It is the development and maintenance of these partnerships that will permit the MIT community and all of its internal partners to achieve their missions and goals.

In an effort to merge the various services the CTCs offer, and to develop a name recognition within the campus community, a program was launched targeting the MIT student population. By participation in numerous student events, utilization of student advertising mediums, and creating a number of activities specifically geared to the student population, the CTC has successfully matched the department's services to the needs of the students. The next phase of this marketing approach will be directed toward the administrative community.

Over the year, sales throughout the Copy Technology Centers rose to $3.3 million, an increase of 9 percent over last year. This financial performance will allow the department to expand it's services by opening a new copy center to be called, "Copy Tech Express". This facility will be located in the Stratton Student Center and will provide copy services in the late evenings and on weekends.

ACCOMPLISHMENTS

The Copyright Clearance and Course Packet Services continue and remain an integral part of production services. During the year, over 18,000 course packets were produced for students and 420 courses submitted packets for student distribution.

In preparation for the expected SAP roll-out next year, all administrative staff participated in extensive training and all relevant computers and peripherals received the necessary upgrades to be in compliance with the SAP functions.

The internal partnerships with the Publishing Services Bureau and Mail Services grew stronger during the year. The department also shared in the design and production of a community brochure outlining the features of each partner and how they relate to each other in the production cycle.

During the year, new equipment was purchased, renovations were completed, and new services were researched in order to meet the demands of the Institute community.

More information about this department can be found on the World Wide Web at the following URL:
http://web.mit.edu/ctc/www/

Steven M. Dimond

ENDICOTT HOUSE

This year's increased business and positive financial results demonstrate the response to recent facility renovations, marketing strategies, and organizational changes. Business volume increased dramatically to a level double that of two years ago and financially, the House closed the year projecting a small positive cash flow.

This turnaround is partially due to a 28 percent increase in MIT-related business throughout the year. A total of 81 overnight conferences, 20 of which were MIT-related, were held at the house during the year. This figure represents a 25 percent growth in total overnight conferences between this year and last year. Day conferences increased 25 percent over last year to 197, 34 of which were MIT groups. Total function bookings increased to 83, up 28 percent from last year. Guest nights also increased by 20 percent to 6,428 this year versus 5,099 last year. We are pleased to report that the total annual occupancy rate for the year was 48 percent, a 27 percent increase over the previous year.

Many of the above increases were achieved through the cooperative efforts of Conference Center Consulting Group, whose sales expertise and marketing strategies positioned the Endicott House as a high quality conference facility. During the year, a number of sales and marketing activities were conducted, including a large client function, direct mail campaigns, print advertising efforts and direct sales calls, an exhibit at the Boston Flower Show, and a presentation to the MIT Conference Planners Group.

In an effort to maintain the beauty and quality of the facility, over $350,000 was spent over the year in renovations and purchases. Although the majority of these expenses were related to bringing meeting areas and sleeping rooms to a higher standard, other expenses included computer equipment and related software, kitchen and service equipment, meeting furniture, general equipment and supplies, and state-of-the-art audio visual equipment.

Several organizational changes during the year focused on improving customer services and increasing quality. With all available positions now filled, the department is undertaking a major training effort to ensure continued customer satisfaction.

In order to maintain the great progress that has been made, the department expects to continue to increase business through targeted marketing programs and to particularly develop stronger relationships with customers within the MIT community. As a result of the training effort, we expect to increase the level of service offered to guests and will continue to reinvest in the facility through capital improvements and renovations.

Michael R. Fitzgerald

INSURANCE AND LEGAL AFFAIRS

The Office of Insurance and Legal Affairs serves the Institute's needs for addressing property and casualty insurance exposures and claims and in responding to a variety of legal issues.

The office continued to work with Physical Plant and MIT's property insurer to resolve two major claims pertaining to the Cogeneration Facility. To date the Institute has recovered $571,575. During the year, the facility ran smoothly and incurred no additional losses.

The Plasma Science and Fusion Generator did suffer two major outages during the year. Total claims exceeded $750,000, for which MIT's insurer has already paid $721,000.

In December, there was a significant fire in Building 20A. Costs incurred to date from this incident are $88,000, including over $28,000 in asbestos abatement costs.

Additional property losses paid by the office during the year totaled $295,000, of which 51 percent were attributed to computer thefts. Heavy rains late in the year caused an estimated $100,000 or more in expenses due to water damage, hazardous waste cleanup, and general cleanup campus wide.

Premiums for all lines of insurance remained level for the year within a budget of $3.3 million.

Mediation efforts to resolve the so-called "Fernald School" case resulted in a settlement of $1,387,500, which MIT paid in order to be released from the lawsuit.

After the Appeals Court affirmed the trial court's decision on a case involving a pole-vaulting injury, MIT decided to settle at $790,000 rather than appeal the matter further. Several other pending lawsuits against the Institute were settled at a total cost of $426,600.

A long-standing claim against the Institute, relating to a violation of a licensing agreement, was settled at no monetary loss to the Institute due to indemnification by other parties also named in the suit. As a result of the settlement, the Institute received certain payments as royalties.

During the year over 100 students were given guidance on a wide spectrum of legal-related problems or questions.

Thomas R. Henneberry

PHYSICAL PLANT

The Physical Plant provides the physical environment, utilities, and support services necessary to promote the educational and research activities of the Institute. To ensure quality service to the MIT community, the department provides strong coordination and communication between multi-functional groups and its customers.

OPERATIONAL UNITS

The first Grounds Services zone was created for the Athletics area of campus. The Athletic/Grounds zone combined Athletic Utility and Grounds staff, working under new job classifications and job descriptions to service both interior and exterior spaces within the Athletic complex, thereby enhancing the academic mission with a reduced workforce. Grounds has also begun to investigate and plan for an integrated central control system for campus irrigation systems. This year, the management of Building Services and Grounds Services was combined to provide better campus-wide customer service. The combined talents and skills of both divisions provide a strong response to an expanding campus as the Institute moves into a time of growth in buildings and land area.

Repair and Maintenance successfully completed the first full fiscal year under the redesign of five local zones and twelve central teams. Under the new design, the Structural/Project Team has performed and managed in-house project work and all projects to date have been completed on time and under budget. The Repair and Maintenance group also successfully demonstrated the department's waste management and spill prevention program during an Environmental Protection Agency Audit this year. Currently, master plans for facilities control systems, fire alarm systems, and infrastructure renewal for the campus are being developed.

The department is pleased to report that over $850,000 was saved through cost-saving initiatives implemented by the Mail Services group. In addition, this group has developed, with Design and Construction Services and SEA Consultants, a long-range plan for materials handling on campus. Over the next year, Mail Services plans to expand the program to reduce unwanted mail from both on- and off-campus sources. Implementation of the Publication, Subscription, and List Management Service (PSALMS) Discovery project will enable MIT community members to both subscribe and cancel campus publications on line, rather than receive unwanted publications. The subscriber will also be able to decide whether he/she wants to receive the publication electronically or on paper.

UTILITIES

The Department of Public Utilities (DPU) order that required MIT to pay exit fees to Cambridge Electric for operation of the new Cogeneration Plant was successfully appealed. The Institute also successfully defended against damaging language in the new Electric Utilities Restructuring legislation enacted this winter.

A new continuous emissions monitoring data acquisition system was installed at the Central Utility Plant, enabling the facility to comply with stringent new environmental regulations. Utilities employees also continue to improve procedures, training, and record keeping to address all aspects of environmental compliance.

DESIGN AND CONSTRUCTION

This year was the busiest in the history of the Design and Construction Section of Physical Plant, due in large part to the relocation of Building 20 occupants. The Building 20 location is the site for the new Stata Complex, which will house five laboratories and departments. This space accommodated 125,502 square feet of diverse users and all were absorbed into locations both on and off campus. Frank Gehry, the internationally recognized architect, was hired to design the new complex.

Departmental staff assisted with the development of scope and budget projections for both construction and landscape master plans to support the anticipated Capital Campaign.

Other highlights of the Design and Construction group include:

- The newly renovated Student Service Center, now located on the first floor of Building 11, opened for business during the year and provides an open and inviting space for one-stop service for a variety of student transactions.

- Ten all purpose classrooms in Building 2 were renovated during the year. In addition to providing all new finishes, furniture, chalkboards, lighting, ventilation and comfort cooling, each of the rooms was equipped with a permanent video projector and two of the rooms were equipped with permanent Athena workstations.

- Renovations to Room 9-150 transformed an outdated lecture hall into a state-of-the-art distance learning facility, the first of its kind at MIT. This sophisticated facility will be the hub for a variety of distance learning initiatives and is capable of studio quality audio and video recording.

- The total renovation of Building 16 was completed during the year and new occupants moved in to office, classroom, and laboratory spaces.

- The newly renovated Music Library in Building 14E received the "Building of the Year" award in the category of Spatial Planning and Interior Furnishings at the Facilities Management Expo.

This year, the Plant took over responsibility from the former Office of Facilities Management Systems for the Insite Space Management system. A facilities audit began to inventory deficiencies in the academic buildings during the year. The capabilities of the database have been expanded to include facilities features such as underground utilities, irrigation systems, campus fire alarms, facility control systems, and the Central Utilities Plant.

MANAGEMENT INFORMATION SYSTEMS

The Management Information Systems (MIS) team continues to support the Physical Plant reengineering efforts by participating in the design and roll out of the new processes. A new SAP Stock Module was implemented, replacing the old system, and planning for and implementation of the transition to SAP for the rest of the department's accounting functions continues to move forward. The team enhanced and continued to provide training and support for Maximo, an I/T system to track work within the reengineered Repair & Maintenance process.

Several enhanced PC and Macintosh programs have been developed for use by Plant employees. The development and maintenance of CAD facility drawings of campus-wide and internal building systems also continues.

The MIS team has continued to deploy desktop computers for use by all members of the organization. There are almost 300 desktop computers in the Plant for use by administrative, support, and hourly staff. Significant I/T training continues to be provided to members of the department. The local area network for Plant was upgraded to support the expanding desktop needs of the department.

HUMAN RESOURCES

The Physical Plant has partnered with the Human Resources Practices Development project team, "Job Design and Classification," to develop competency models for administrative staff positions. Through this modeling process, Plant employees have gained a greater understanding of the concept of competencies. This tool is now being incorporated into current administrative staff search plans and job descriptions.

The Learning and Performance Center implemented a comprehensive training program. One milestone was the publication of a Training Guidelines catalog that lists training requirements for each job classification in Physical Plant. Training is classified in four categories: Legal/Safety Required, Physical Plant Required, Recommended, and Optional courses. The training program was implemented during the year and, after just six months, 757 registrants attended various Learning and Performance training events.

RECYCLING AND REGULATORY MEASURES

Recycling continues to expand throughout the campus. Presently the recycling rate is approximately 12 percent. In order to increase recycling rates and implement waste reduction strategies, the Plant will create a full-time

Waste Management/Recycling position. The Institute is also continuing to abide by the ever changing regulatory requirements of local, state, and federal government agencies.

More information about this department can be found on the World Wide Web at the following URL: http://web.mit.edu/plant/www/index.html

Victoria V. Sirianni

PLANNING OFFICE

This year the Planning Office accomplished a wide range of Institute planning projects. Drawing on years of effort to create reliable data resources on MIT's demographic, financial, and physical resources, as well as access to comparative data from peer institutions, the office has been able to respond to requests for policy analysis, physical planning, land resource requirements, general information, and capital planning needs.

The Planning Office provided information and support to senior officers and Resource Development staff regarding the possible capital campaign, including an analysis and review of capital costs and financing alternatives. In addition, the office is conducting on-going research and analysis, as well as document preparation and production, for use in donor relations.

The Planning Office tracked MIT's campus design issues on a continuing basis as part of its responsibility to help the senior administration chart a course for the future. The major public improvements contemplated around the campus by city, state, and federal agencies and the possibility of a capital campaign all require a clear vision of the future of the campus. In addition, as we anticipate increasing scrutiny at both the local and federal regulatory levels, we have begun to identify the information and design requirements involved, as well as ensuring that up-to-date master plan materials are available.

Based on the pending availability of data from reengineered central administrative systems, the office worked to streamline procedures for accessing data from central sources, including financial expenditures, departmental budgets, personnel statistics, space data, teaching load calculations, enrollments, and majors. An analysis of past requests demonstrated a need to increase the level of detail and the quantity of current and historical information needed for specific studies. This was particularly important for studying a variety of issues including departmental or building space utilization and for projecting demand for diverse physical resources such as academic and research facilities, service access, and off-street parking.

Other activities included design and administration of surveys of the MIT community, including undergraduate and graduate students, faculty, parents, and alumni. The office also served as the central clearinghouse for responses to external surveys as it has for a number of years, completing more than 200 this year which included inquiries from NSF and other federal agencies, Congress (via the MIT Washington Office), national accreditation boards and commissions such as ASEE, peer institutions, national publications, and the press.

MIT currently faces a variety of pressures to increase the supply and quality of on- and near-campus housing and these pressures are expected to increase over the next five years due to the changes in the existing housing supply for students, both undergraduate and graduate, faculty, and staff including the impact of rent decontrol and a reaction to increasing commuter traffic through the city from the suburbs. The Institute's need for additional housing resources has been affected by demographic factors such as increased numbers of women students, increased competition for faculty and students, and general changes in the composition of the faculty, staff, and affiliate populations. These are trends which are expected to continue.

In conjunction with the increased demand on student housing, the office engaged in planning for new undergraduate and graduate residences, modeling the effects of various alternative policies governing student housing and enrollment strategy and developing alternatives which incorporate housing for faculty and distinguished visitors on the campus. The office maintained an inventory of housing sites suitable for both short-term and long-term development and has reserved these locations in the campus master plan to ensure that the land will be available when the program need calls for them.

The issue of land resources continued to be an important one during the year. The Planning Office tracked all MIT-owned land in Cambridge, as well as all other land currently in use or potentially dedicated to academic and research activities. The office also prepared an annual report for the senior officers which included an analysis of anticipated needs and current market opportunities, and which recommended acquisition priorities.

Once again, transportation and parking were of major concern to the Institute. The federal government, the Commonwealth, the MDC, the MBTA, and the City of Cambridge continued the process of making policy decisions

on transportation and development near the campus which have profound implications for the Institute. Further, the office engaged in the planning for new garage facilities, campus shuttle services, and parking fees. Staff members supported the faculty committee on Parking and Transportation, and provided the analytical component of the parking permit allocation process.

The need for generating new and upgraded academic facilities continued in an environment of changing expectations and increased competition for faculty, students, and research funding. In anticipation of these needs, the Planning Office maintained a list of long-range facilities resource needs in an effort to ensure that adequate space resources are available to academic and research activities.

During the year, the office was involved in a number of building projects including the CIIS/Stata Complex, the proposed Teaching and Learning Center, the Media Lab expansion, the Sloan School Design Concours and its associated planning and program definition efforts, planning for a new neuroscience facility, and the ongoing program of classroom renovations.

Throughout the year, the level of demand on MIT's athletic and recreational facilities continued to increase. The quality and availability of these facilities has become a more important factor in recruitment of undergraduate and graduate students, and in demonstrating MIT's commitment to women students under Title IX. The office engaged in projects including the programming of the Central Athletics Facility Phases I and II (pool and additional phases), planning for satellite athletic and recreational facilities (e.g. in the residences), and needs assessments for the Pierce Boathouse expansion and the Sailing Pavilion renovation.

The organizational and operating changes brought about by reengineering have highlighted the Institute's need for identifying and implementing the most appropriate and efficient uses of space for administrative and support purposes. In that regard, the Planning Office continued to work with the Committee for Resource and Space Planning and the Space Administrator. During the year, initiatives included a review of users and priorities in Buildings E18 and E19, support for the space change program within the Office of the Dean for Undergraduate Education (including Bursar, Registrar, and Career Services), site analysis and relocation priorities for materials handling activities, Physical Plant relocation, Information Systems consolidation, and child care facilities.

The importance of appearance and the quality of MIT's physical environment remained an important focus of the Planning Office again this year. The office provided direction on the preparation of an RFP for a landscape master plan, prepared a preliminary plan for renovating Vassar Street, and is working closely with the City on the renovation of Massachusetts Avenue.

O. Robert Simha

PURCHASING

The departmental mission of assisting the MIT community in the procurement of goods and services and providing advice and counsel toward ensuring favorable prices, protective terms and conditions, compliance with MIT policies and procedures and Federal contract and grant regulations, and compliance with the Institute's Government-approved procurement process continued again this year.

MAJOR ACCOMPLISHMENTS

Last year MIT began a pilot program to introduce a Visa Procurement Card (VIP Card) for use by Institute personnel to make small dollar purchases. Based on the success of the pilot program, the VIP Card was introduced to the community this year. At year end, over 350 VIP Cards had been issued to approximately 65 departments and over 2,000 transactions totaling more than $250,000 have been processed. The card should dramatically reduce the number of requests for payment, blanket orders, and petty cash transactions currently processed.

The Subcontracts and other Purchasing personnel assumed a leadership role during the Contractor Purchasing System Review conducted by the Office of Naval Research and DCAA late this spring. The last review was conducted three years ago. Since that time, there has been great turnover in management personnel within the department and there have been significant changes made to the system such as the SAP implementation and the introduction of the Electronic Catalog and the MIT Credit Card programs. Based on this review, approval by the Office of Naval Research is expected shortly.

During the year, the Subcontracts Office maintained and updated a total process system that measures various administrative functions within the department and interfaces with MIT's Management Reporting and Financial Operations project to assist in the development of the necessary reporting and tracking systems required for the Subcontracts/Purchasing operations.

The General Purchasing Office joined with the Management Reporting training team to develop a requisition training program to assist other departments as they convert to SAP, developed new change order and blanket order procedure, and, in conjunction with the Physical Plant, assisted in the redesign of the process for procuring, stocking, and distributing MRO materials.

FUTURE PLANS

The department needs to continue to move forward with the various projects that are already underway and will continue to work closely with the Management Reporting team to assist during the rollout of SAP.

The name of the department will be changed from Purchasing to Procurement and the reporting structure will also be changed. The department's three different spaces will be consolidated into just one large area in E19.

More information about the Purchasing Department can be found on the World Wide Web at the following URL: http://web.mit.edu/purchasing

Diane J. Shea

SAFETY OFFICE

The Safety Office provides advice, counsel, and programs to the MIT community which promote a safe environment in which to learn and work. The office also implements safety-related functions to ensure compliance with Institute policies and government regulations.

Of major note this year was a visit by members of the Environmental Protection Agency (EPA). Staff from the Safety Office worked with members of the EPA inspection teams and inspectors during the enforcement inspection. The Safety Office also directed preparation efforts prior to the site inspection.

Many of the projects that were undertaken last year continued or were completed during the year.

The fire and emergency response systems study that began last year continued this year. The proposal that was submitted for review will be further considered, in a somewhat modified fashion, again next year.

The work that began at Talbot House last year to install an automatic sprinkler system and an enhanced fire alarm and fire protection monitoring system which will report directly to a Cambridge location was completed during the year.

Record levels of chemical waste shipments were experienced this year due to a campus-wide cleanup. The Safety Office disposed of nearly 1,000 hazardous waste lecture bottles during the cleanup effort.

Numerous safety reviews were conducted again this year including design and construction drawing reviews, art and theatrical reviews, and the review of 80 ergonomic computer workstations.

The Safety Office continued their general oversight of safety needs and programs by participating in ongoing reviews, assessments and evaluations, studies, and projects in laboratories, classrooms, and offices. Another continued priority was ensuring that the Institute was in compliance with all legislated safety requirements. The staff in the Safety Office received additional training and development to further ensure that the Institute was adhering to the many requirements and diverse challenges that the Institute must satisfy.

Walter G. Diaz

SECRETARY OF THE CORPORATION

The Secretary of the Corporation serves as the Corporation's Recording Officer and as joint signatory with the President in the awarding of academic degrees. The Office of the Secretary of the Corporation is responsible primarily for providing support to the Institute's governing board and to 27 Corporation visiting committees.

CORPORATION MEETINGS

On September 25, 1997, an orientation program was held for new members of the Corporation. In the evening, new members and their spouses and guests were joined by members of the Executive and Membership Committees for a reception and dinner.

At the annual meeting on September 26, 1997, new members were introduced. The Corporation approved the action of the President in the awarding of September degrees, and voted to approve the list of nominated members of the visiting committees and the Corporation Development Committee. Howard W. Johnson transferred to the status of Life Member Emeritus. Members approved the Annual Report of the President, and heard additional reports from the Treasurer, the Vice President for Resource Development, and from the chairs of the Auditing Committee, Membership Committee, Salary Subcommittee of the Executive Committee, and three visiting committees.

At the meeting on December 5, 1997, it was announced that the new complex to house teaching and research programs in Computing, Information and Intelligence Sciences will be named to honor Life Member Raymond S. Stata and his wife, Maria. Members heard reports from the President, the chairs of the Community Service Fund, Membership Committee, and four visiting committees. Following the meeting, members attended a reception at the Tang Center recognizing Corporation member Elliot K. Wolk for his generous support of the visual arts at MIT.

On March 6, 1998, the Corporation approved the action of the President in the awarding of February degrees. Memorial resolutions were presented honoring Life Member William J. Weisz. Reports were presented by the President, the President of the Association of Alumni and Alumnae, and by the chairs of the Corporation Joint Advisory Committee on Institute-Wide Affairs, Membership Committee, Screening Committee, and four visiting committees.

The final quarterly meeting of the academic year was held on June 5, 1998, prior to Commencement exercises, at which the speakers were The Honorable William Jefferson Clinton, President of the United States, and Dr. David Ho, world-renowned AIDS researcher and graduate of the Harvard/MIT HST program. The Corporation approved the action of the President in the awarding of June degrees, and approved the establishment of a new Master of Engineering degree in Ocean Engineering, and a Master of Science degree in Comparative Media Studies. The Corporation elected new Corporation members, members of the standing committees and committees of annual recurrence, chairs of the visiting committees, and members of the Corporation Development Committee. Resolutions were read to honor five members completing their terms of service on the Corporation. Members heard reports from the President and the chairs of the Membership Committee, Screening Committee, and three visiting committees. Corporation members participated in the academic procession to Killian Court for Commencement exercises, with Dr. Mary Frances Wagley serving as Corporation Marshal.

CORPORATION MEMBERSHIP

Completed Service Effective June 30, 1998: Lawrence A. Hough, Brian G.R. Hughes, John A. Morefield, Kenichi Ohmae, Darcy D. Prather.

Leave Of Absence: Shirley A. Jackson, Life Member, Leave Of Absence For Government Service Continued.

Elected To A Five-Year Term Effective July 1, 1998: Norman R. Augustine, Gerald J. Burnett, Glen V. Dorflinger, John W. Jarve, Ronald A. Kurtz, Robert M. Metcalfe, Leslie Tang Schilling, Anthony Sun, Matthew J. Turner.

Elected Life Member Effective July 1, 1998: William S. Edgerly, David H. Koch, Patrick J. Mcgovern, Robert A. Muh, Richard P. Simmons.

Ex Officio Member For One-Year Term Effective July 1, 1998: John A. Morefield, 1998-99 President Of The Association Of Alumni And Alumnae Of MIT.

Transferred To Life Member Emeritus: Howard W. Johnson (September 1997).

DEATHS
William J. Weisz (December 17, 1997).

CORPORATION COMMITTEES

D. Reid Weedon, Jr., continued as Chair of the Advisory Committee On Shareholder Responsibility, with Vice President and Treasurer Glenn P. Strehle serving as an *ex officio* member. The committee membership included Senior Vice President William R. Dickson as well as faculty and students. Elizabeth T. Harding provided staff support.

The committee met once on April 21, 1998, and conducted telephone polls on February 4, 1998, March 31, 1998, and May 1, 1998. Members voted on 21 resolutions submitted to 13 companies, the stocks of which are held by MIT in its general investments. Issues were spread across a broad spectrum of topics that included the environment, human rights abroad, military contracts, nuclear power, and political contributions. Compared to last year, the number of resolutions increased by four, and the number of companies involved increased by three.

Meetings held on September 25, 1997, and March 5, 1998, were attended by Auditing Committee members; representatives from Coopers & Lybrand, MIT's independent public accountants; and by MIT Audit Division and Finance personnel and other invited members of the MIT administration.

Discussed at the fall meeting were financial statements for Fiscal Year 1997, the auditing inputs from the Institute's internal staff, Coopers & Lybrand, and responsible Government agencies, and the certification and pro-active management letter from Coopers & Lybrand. The spring meeting focused primarily on audit plans, on the progress of continued efforts regarding Year 2000 issues, and on the status of the SAP financial system roll-out.

Corporation Joint Advisory Committee On Institute-Wide Affairs (CJAC)
CJAC held a dinner meeting on December 4, 1997, to which a number of student guests were invited by faculty and student members of the Committee. A roundtable discussion centered on the binge drinking tragedies of the fall of 1997. Other discussion topics included issues of diversity and race relations, residential life, student/faculty relationships, suggestions for the use of the Student Center, and changes in the freshman orientation program.

A second meeting was held on March 6, 1998, to discuss progress in increasing racial and gender diversity in the faculty and student body. Attending the meeting as guests of CJAC were Alex d'Arbeloff, Chairman of the Corporation; Kathryn A. Willmore, Secretary of the Corporation; Professor Ellen T. Harris, Co-Chair of the Committee on Campus Race Relations; and Judy Jackson, Intern in the Office of the Provost.

Development Committee is covered in the annual report of the Vice President for Finance and Treasurer.

During the past year the Executive Committee held ten meetings. Its agenda included such topics as new directions in education and research; student life and the campus environment; external relations and the sponsorship of research; budgeting, financial planning, and the management and enhancement of resources; and changes in the senior administration. One meeting was held at Lincoln Laboratory and provided an opportunity for members to speak with Laboratory leadership and review major ongoing projects.

The Investment Committee held three regularly scheduled meetings during Fiscal Year 1998. The Wellington Management Company of Boston remained the primary investment manager and advisor for publicly traded securities, both domestic and international. The Institute continued the program of equity investments in smaller capitalization companies, managed by four other investment management firms. The program for domestic and international alternative investments to publicly traded securities has been expanded. These alternative investments – including venture capital, private capital, real estate, event arbitrage, and distressed debt – are typically managed by several investment managers through pooled investment funds.

The Membership Committee held three meetings during the academic year to discuss matters concerning membership on the Corporation, and nominations to various Corporation standing committees and committees of annual recurrence.

The Corporation Screening Committee for Nomination of Recent Graduates held an open meeting for students on September 25, 1997. Two teleconferences were held in January and February 1998. The committee selected nine nominees for the ballot from a group of 59 candidates. Matthew J. Turner received the nomination and was elected to serve a five-year term on the Corporation.

Fourteen visiting committees convened during the academic year 1997-98: Aeronautics and Astronautics; Architecture and Media Arts and Sciences; Athletics, Physical Education, and Recreation; Dean of Students and Undergraduate Education; Earth, Atmospheric, and Planetary Sciences; Linguistics and Philosophy; Materials Science and Engineering; Mathematics; Mechanical Engineering; Nuclear Engineering; Sloan School of Management; Sponsored Research; Urban Studies and Planning; and Whitaker College.

In 1997-98, the Institute's 27 visiting committees were comprised of 394 persons and 492 membership positions: 63 Corporation members filled 153 slots; 180 presidential nominees filled 186 slots; 151 alumni nominees filled 153 slots. (Four people each filled both a presidential nominee slot and an alumni nominee slot.)

Women comprised 23 percent of the visiting committee membership, and minorities 15 percent; 68 percent of the members were affiliated with corporations, 31 percent with academia, and one percent with government and foundations.

PERSONNEL CHANGES

Del Ray Cross joined the Corporation Office on February 20, 1998, as Administrative Assistant, and Michelle D. Hinkle was hired on May 1, 1998, as Senior Staff Assistant.

Kathryn A. Willmore

VICE PRESIDENT FOR FINANCE AND TREASURER

In fiscal 1998, revenues and funds of $1,219.3 million were used for operations. Total operating expenses were $1,223.5 million. The resulting need for additional general funds of $4.2 million was met by using Research Reserve investment income and decapitalizing a portion of Reserve principal. Improved operating results relate to growth in research and increased indirect cost recovery.

The Institute continues to tightly control costs and reengineer management reporting and financial systems. These activities impact the Controller's Accounting Office, Audit Division, Office of Sponsored Programs, the Office of Budget and Financial Planning, Purchasing, and the Treasurer's Office . Implementation of the SAP R3 financial accounting system centrally and throughout the departments, laboratories and centers is moving forward. Pilot programs initiated to test functionality have been very effective, including successfully using the SAP system for fiscal year 1998 closing entries. Training of personnel in the departments, laboratories and centers has moved into high gear in anticipation of full utilization of SAP in fiscal 1999.

The staff involved in the SAP project share a sense of pride in their accomplishments during this very challenging process. Their commitment to assuring that the Institute will achieve the goals set for improving our financial systems and simplifying administrative processes is greatly appreciated.

Key accomplishments during the year include : introduction of a comprehensive Budget Book; making steady progress on developing a 10-year budget model and financial strategy; transitioning to SAP for all fiscal 1998 year end journal voucher entries; negotiating an agreement with the government relating to voluntary faculty effort on a sponsored research project and government/university cost sharing; achieving discounted air fares; and concluding IRS audits for past years without significant findings against the Institute.

The following reports by the Audit Division, Controller's Accounting Office, Property Office, Lincoln Fiscal Office, Office of Budget and Financial Planning, Office of Sponsored Programs, and MIT Press will highlight the activities in their respective departments during the year.

Over the past year, each department has addressed its staffing needs to implement SAP, to replace staff through normal turnover, and to bring in staff with the necessary management and systems skills to meet the demands of the new systems and reporting requirements. At year end, women represented more than 57 percent of departmental employees, and minorities 10 percent. We continue our efforts to diversify our workforce and to hire and promote women and minorities, in keeping with our commitment to the Institute's affirmative action program.

Glenn P. Strehle

AUDIT DIVISION

The Audit Division continues to stay closely involved with MIT's rapidly changing environment. As a large effort continues to be invested across the Institute into complex change processes, we have joined in many collaborative efforts to assess impacts of change on existing internal controls, identify opportunities for improving operational effectiveness and efficiency, and recognize potential areas of Institute risk.

Internal Auditing remains an integral part of MIT's internal control structure. We maintain the flexibility to respond to the needs of management by addressing potential audit areas identified by management as well as through assessment of Institute risk. We continue to serve the Institute in accordance with the stated mission of providing reasonable assurance to management that Institute policies are being adhered to as intended, adequate internal controls are being maintained, and assets are properly safeguarded. The last two items are of critical importance during these times of significant organizational and information systems change. We fulfill our role through reviews, both on campus and at Lincoln Laboratory, which encompass the diverse aspects of MIT operations.

Our audit coverage is coordinated with Coopers & Lybrand (now PricewaterhouseCoopers), the Institute's Certified Public Accounting firm, and the Defense Contract Audit Agency (DCAA), MIT's cognizant Federal audit agency.

Internal audits are conducted consistent with the Standards for the Professional Practice of Internal Auditing, which guide us in the discharge of our duties to ensure proper objectivity, independence and audit quality control.

Compliance with governmental regulations continues to be a focus of audit attention. In particular, our departmental audit approach has been effective in verifying proper fiscal responsibility throughout departments, labs and centers. As the new SAP financial system rolls out to the community at large, we will be working with management to determine how financial accountability processes will be impacted, while developing new audit tools and techniques to take full advantage of SAP's functionality. Another area of concern involving regulatory compliance is environmental health and safety. At management's request, we recently conducted a review of the Institute's Hazardous Waste program.

Traditionally, a significant segment of audit work revolves around financial analysis and evaluation of internal controls. While most audits termed "financial" involve aspects of both operations and information systems, the reliability of financial data is of primary concern. Several significant reviews were undertaken this past year in the areas of outsourced services, construction, SAP Accounts Payable, and telecommunications. In all cases, we were able to recommend opportunities for improvements with financial controls and related operational issues. As construction volume is expected to rise over the next several years, we are working closely with the Design and Construction unit of Physical Plant to better protect MIT's interests and help ensure full financial accountability by contractors. Several other upcoming reviews in this category include continued focus on functions utilizing outside service providers, accounting for royalties and licensing income, reviewing MIT Press financial operations, and the increasing use of credit cards to streamline purchasing and accounts payable functions.

Perhaps the highest areas of exposure for MIT and the Audit Division will be related to information technology, with the Year 2000 approaching, a new gifts management system readying for implementation, and the rollout of SAP to the broader MIT community. We continue to be actively involved in each of these efforts to offer our perspectives on internal controls.

Charles A. Shaw

OFFICE OF THE CONTROLLER

CONTROLLER'S ACCOUNTING OFFICE

Fiscal 1998 continued to be a year of change as was fiscal 1997 for the Controller's Accounting Office, (CAO), and the Institute due to the implementation of SAP - Business Process Software.

The second phase of the SAP rollout, to the departments, laboratories and centers, touched all administrative offices with a variety of SAP functionality during fiscal 1998. This trend will continue in fiscal 1999 as additional functionality is made available to the MIT administrative community. A number of other administrative systems, such as Payroll and Telecommunications, will be converting to the financial architecture implemented in SAP in fiscal 1999. We are also supporting the Legacy system until SAP is fully operational.

During fiscal 1998, the CAO introduced SAP Journal Vouchers Documents to the MIT Community. The goal was to have the MIT Community use SAP Journal Voucher Documents by Fiscal Year closing. It was first piloted in the CAO in September of 1997. With an aggressive training program, the MIT Community began using SAP Journal Voucher Documents in March of 1998. As of June 26, 1998, all paper and electronic vouchers were processed in SAP and the classic system was turned off. Also, SAP reports are being used for fiscal 1998, which provide real time access to financial data.

In accounts payable, a software package was purchased from ixos, an sap partner, to allow mit the capability to pay invoices from a scanned image. The accounts payable department started to pay on purchase order invoices and requests for payment from scanned images in march and in early fiscal 1999, purchase order invoices will begin to be paid from scanned images. At some future time it is anticipated that the departments will have access to these images.

During fiscal 1997, MIT joined and took a leadership role with MASCO, (Medical Academic Scientific Community Organization), for a travel consolidation. As a result of newly discounted airfare contracts, during fiscal 1998 MIT has the potential of achieving $1 million in savings.

In October 1997 the Accounts Receivable Department established an SAP Users Group comprised of various MIT departmental personnel who work with the Controller's staff to improve the SAP Accounts Receivable system.

The IRS closed the IRS employment tax audits covering the calendar years 1987 to 1990, inclusive without any findings against the Institute. This closure followed the IRS Appeals Division's earlier decision in favor of the Institute for calendar years 1985 and 1986. This brought to a conclusion the examination activities of the Boston IRS Employment Tax Division, which began over eleven years ago.

The IRS Coordinated Examination Program (CEP) tax agents concluded their examination regarding payroll issues and have identified two minor areas of concern with which the Institute has strongly disagreed. Both parties will continue to move forward to a resolution over, hopefully, the next year.

The Year 2000 Compliance project, which will ensure the compatibility of the payroll system with the issues regarding the Year 2000, has continued during the past year with good progress and results. We expect to complete this project during the final quarter of calendar year 1998.

The project to change the method of recovering the cost of the Research Assistant tuition awards from the employee benefit rate methodology to a direct charge to the specific research project, affected through the Payroll System, was completed after some last minute Institutional policy changes. This project proved to be considerably more involved and time consuming than originally expected.

A project has begun to modify the Payroll System to accommodate the SAP account number and expense classification codes structures. We expect to devote major effort to this project when other critical projects have been completed and anticipate a completion date by the end of calendar year 1998.

Retirement Plans Accounting (RPA) is responsible for the accounting and reporting requirements of the MIT Retirement Plan and Trust. RPA maintains records for over 19,000 members and disburses retirement benefits to former employees. This includes maintaining records for the basic retirement benefit provided by MIT and the Supplemental Plan in which the Institute matches employee contributions on a dollar-for-dollar basis

PROPERTY OFFICE

The Property Office is responsible for the accounting and asset management of more than 100,000 items of equipment which are both MIT-owned as well as sponsor-owned. During the year, 14,600 newly acquired items of moveable equipment were identified and tagged. Over 14,400 financial transactions regarding invoices, purchase orders, requisitions, journal vouchers, and cash vouchers were reviewed resulting in 2,600 corrections, thereby ensuring the integrity of the Property database. The scanning phase of the equipment biennial physical inventory was completed and the reconciliation cycle was begun. Four hundred forty (440) final inventories were submitted as part of closing out contracts, grants, and agreements. There were six hundred eleven (611) financial reports prepared and submitted to various government agencies. Forty-nine (49) items of excess government equipment with an original acquisition cost of $4,805,954 were acquired from government sources at no cost to MIT. Nine hundred eighty-nine (989) items of equipment with an acquisition value of $741,750 were transferred between MIT departments as part of a reutilization program. Equipment unneeded or unusable by the MIT community was sold for $200,017, providing funds for replacement equipment. Three hundred eighty-eight (388) items of equipment with an acquisition value of $3,504,204 were donated to nonprofit organizations.

The annual indirect cost study for the equipment and building pools was conducted in conjunction with the Office of Cost Analysis, which resulted in a recovery of $20.9 million. Thirty-seven (37) capital projects were begun during the year. The costs of capital space changes, major renovations, and new building construction continue to be tracked.

The Office of Naval Research conducted a Property Control System Analysis (PCSA) resulting in the continued approval of MIT's property control system.

LINCOLN FISCAL OFFICE

The Lincoln Fiscal Office (LFO) provides financial support to MIT's Lincoln Laboratory by providing accounting, payroll, cashiers, cash management, and property control services.

1998 continued to see system changes to support the Laboratory operations. The major changes were continued development in the Year 2000 conversion for the General Ledger System which should be completed in the last quarter of 1998, completed version 2.8.5 of Lincoln Executive Information System (LINEIS) with Group 68, implemented access to SAP via the LLEN (Lincoln Lab External Network) for Journal Vouchers to post closing entries, and completed and implemented the new Ship Order system.

Accounting changes made in 1998 were restructuring the Lincoln Laboratory Advance Payment Pool Agreement, as well as reconciling of the "old" pool, and converting from preprinted stock checks to Checkguard, a laser check writing system.

The Property Department of the fiscal office continues to make progress on the reconciliation of property to the Property Control System for the 1996 inventory. This has required effort from all units of the Laboratory as well as from Campus Property Office. We continue efforts to fully comply with the inventory requirements of our sponsors.

More information about this department (CAO) can be found on the World Wide Web at the following URL:http://web.mit.edu/cao/www/

James L. Morgan

OFFICE OF BUDGET AND FINANCIAL PLANNING

The fundamental mission of the Office of Budget and Financial Planning (Budget Office) is to support MIT's goal of continued excellence in education and research by providing senior management with accurate and timely financial information, projections, and recommendations. The Office is responsible for:

- developing and managing the MIT operating and capital budgets and financial planning tools
- monitoring the Institute's financial position and the likely impact of anticipated internal and external changes
- managing the financial information asset as a critical component of the Institute's strategic planning process
- executing operating and capital programs
- providing Institute leadership with all necessary financial knowledge to support strategic planning.

The long-term strategic objectives of the Budget Office continue to be to:

- introduce innovative budgeting and financial planning tools to simplify the collection of financial information, improve its quality, ensure that it meets the needs of the user community, and enhance its accessibility at all management levels
- revise the budget process to shorten its cycle, improve its timeliness and increase its efficiency
- facilitate the implementation of new systems and processes resulting from the re-engineering design study
- continue the development of operating budget models to support the Provost, the Chancellor and senior leadership in the financial planning process
- refine the Budget Office organizational structure to better utilize resources and enhance responsiveness to the changing needs of the Institute community

During fiscal 1998 the Budget Office continued to substantiate its role in providing information to support long range planning and the definition of strategic goals at the Institute level. The financial model of the MIT operating budget, which was introduced in 1997 to project resources and expenses over a ten-year period, has evolved in response to its application during 1998 to support financial deliberations of the Provost and Executive Committee. We will continue to develop this model, which is used to help senior leadership explore the impact of varying needs scenarios on operating results. In addition to the financial model, the Budget Office has focused on the

development of a multi-year Capital Plan. This Plan will be used internally to analyze funding options for capital needs under different marketing scenarios and externally to support the Institute's funding agency requirements.

In January 1998 the Budget Office published a Budget Book for fiscal 1998, the first of a continuing series. In April 1998 the office published the Budget Book for fiscal 1999, establishing the normal annual publication schedule. The Budget Book is the definitive MIT Operating Budget document and includes sections on Research, Tuition, and Individual Schools, as well as an extensive section on Capital planning and operations.

In supporting the Institute's requirements in the immediate future, the Office will be called upon to help revise processes, streamline procedures and introduce new budgeting tools, while at the same time maintaining current functionality and preserving existing controls. To achieve these goals, the office is now fully staffed and is flexibly organized. The Budget Office has a full Budget Officer complement for the first time in over four years and looks forward to providing truly responsive service to its constituencies.

The Budget Office has commenced a project to design, test, and deploy a SAP-integrated budget system to replace and enhance its current system, BEERS, which is not compliant with Year 2000 requirements. In undertaking this significant project, the Office is teamed with the Institute's IT leadership, the Management Reporting function, and the user community. Specifically, a new budget system Advisory Committee, with key representatives from the Institute's academic community and its administration, has been convened. The constituency of this committee will help ensure that the system meets user community requirements as well as provide continuity with previous re-engineering design studies for new budget system development. The Institute should see the first new system application during the budget submission process for fiscal 2000.

Stefano Falconi

OFFICE OF SPONSORED PROGRAMS

For fiscal 1998 the total volume of sponsored research performed on campus was $386,355,000. This represents an almost steady state with the fiscal 1997 volume of $387,880,000. The breakdown by sponsor is shown in the table at the end of this report.

Activities in the Office of Sponsored Programs during 1997-1998 were significantly affected in two distinct areas: externally, by ongoing policy issues related to federal funding of research; internally, by the continued development of a major new emphasis on computerization and automation within the office. Each of these is described below:

FEDERAL INITIATIVES

Adopted in June, 1998, another set of revisions to OMB Circular A-21 (the Federal cost principles applicable to universities), was issued which included provisions that further constrain the ability of institutions to fully recover the costs of performing research for the federal government.

One of the significant changes in 1998 is the adoption of a review process to ensure the reasonableness of facilities costs for research facilities costing over $10 million, of which 40% or more is expected to be used for federal research. There is a requirement for additional documentation for buildings costing greater than $25 million with more than 50% allocated to federal research. These requirements will cause additional administrative efforts to ensure appropriate reimbursement for the Institute's research facilities.

With the implementation of Cost Accounting Standards and more rigid interpretations by federal auditors, issues surrounding cost-sharing are now creating additional areas of audit activity in the research arena. Stated simply, there are serious issues around what constitutes cost sharing and academic year faculty effort and how those activities are documented, reported, and used in the construction of the indirect cost proposal.

RESEARCH ASSISTANT COMPENSATION

OMB decided that MIT and three other major research universities are not permitted to continue charging the tuition of graduate student research assistants to the employee benefit pool but are required to treat it as a direct cost to the individual research projects on which they are employed. The implementing regulations, which appear in OMB

Circular A-21, provided a transition period but require the treatment of tuition as a direct charge beginning in fiscal 1999. Although the Institute decided to support with general funds 30% of the stipend and tuition for each graduate research assistant, the problem remains for NIH awards because that agency is now restricting graduate student compensation (defined as salary plus employee benefits plus tuition charges) to a "reasonable" level and, furthermore, will limit funding from NIH for these costs to $23,000.

INTERNAL INITIATIVES

Significant effort has been devoted toward streamlining some internal processes related to the management of research awards at the Institute. These have provided relief to schools, labs, and departments, as well as to central administrative offices. We have given additional flexibility to principal investigators in the use of federal research grant funds by relaxing many of the internal approvals previously required and have streamlined the Research Proposal Summary form, to reduce the items on the form and make the remaining items more useful.

The major internal effort of the office again this year has been in the area of computerization and automation. In addition to full development and implementation of an OSP computerized database (COEUS™) to capture award and proposal information, efforts have also been devoted to using this database as the initial feed into the Institute's accounting system for research awards. The automated feed from COEUS™ to SAP was activated in March, 1998. Deployment continues to departments, laboratories, and centers of this system, which will permit more effective and efficient management of awards by OSP staff, will permit Institute personnel to access the database, and will provide the capability to produce standard and custom reports quickly and independently. We are currently beginning the testing phase of MIT's electronic proposal system, which is targeted for testing in Summer 1998 and implementation in Fall 1998. This will enable any researcher at MIT using the technology already available in the researcher's office or laboratory to electronically create and submit proposals to federal agencies.

INDUSTRIAL CONTRACTING

In May 1998 OSP added a senior staff member charged with responsibility for heading a team specifically designed to enhance capabilities in the area of negotiation and contracting with industrial concerns on individual research projects. That effort will be enhanced in fiscal 1999.

CAMPUS RESEARCH VOLUME BY SPONSOR - 1990-1998
(in thousands of dollars)

FEDERAL	1990	1991	1992	1993	1994	1995	1996	1997	1998
DHHS	57,915	59,025	60,177	64,882	60,192	61,066	58,211	57,215	58,938
DOE	61,098	60,625	57,355	57,325	63,180	67,114	69,588	70,753	70,281
DOD	51,158	49,104	48,539	66,769	61,601	55,866	59,997	67,858	64,776
NSF	38,093	37,953	36,574	38,008	39,574	38,564	35,837	36,347	36,264
NASA	18,469	22,755	25,889	32,324	37,449	41,291	39,190	36,947	30,227
Other	7,430	8,647	9,773	8,899	8,722	9,641	8,721	7,232	9,115
Subtotal	**234,163**	**238,109**	**238,307**	**268,206**	**270,718**	**273,542**	**271,544**	**276,352**	**269,601**
NON-FEDERAL									
Industry	46,223	48,360	53,578	62,068	59,117	56,120	67,164	75,194	74,062
Nonprofit	25,220	23,751	24,920	25,593	23,666	26,430	25,926	28,952	36,197
Other	5,053	5,599	5,461	5,487	6,173	5,597	5,649	7,382	6,495
Subtotal	**76,496**	**77,710**	**83,959**	**93,148**	**88,956**	**88,147**	**98,739**	**111,528**	**116,754**
TOTAL	**310,660**	**315,819**	**322,267**	**361,354**	**359,674**	**361,689**	**370,283**	**387,880**	**386,355**

More information about this department can be found on the World Wide Web at the following URL:
http://web.mit.edu/org/o/osp/www/

Julie Norris

MIT PRESS

Fiscal 1998 was an excellent year for the book list, sales, program development in journals, and internet/web activity and initiatives. It was also an unusual year. Export sales were down year to year for the first time in memory, domestic backlist sales were up 20%, and internet sales through Amazon.com and Barnes and Noble.com increased from $142,000 to $722,000. This represents continuing turbulence in the distribution side of our business.

At $15.5 million, overall book sales were up $1 million or 7.3% over last year. Journal sales were up 2% at $4.6 million. The operating net for the year was $10,000 compared to a budgeted loss of ($288,000), and ($177,000) for fiscal 1997. There was also an overall charge for RA/TA tuition in the benefit rate of $522,000 which ends this year.

COMPARATIVE OPERATING RESULTS (IN THOUSANDS)

	FY97	FY98
Total Net Book Sales	$14,421	$15,469
Cost of Sales	6,462	6,932
Gross Margin on Sales	7,959	8,537
Other Pub. Income	204	193
Bookstore Net	100	92
Total Income	8,263	8,822
Operating Expenses	8,404	8,915
Net Books Division	(142)	(93)
Journals Net	(250)	103
Net Pub Operations	(167)	10
Add: Investment Income	—	—
Subtotal: Interest Paid MI	—	—
Net Operating Gain (Loss)	$(167)	$ 10

The top five titles experiencing the highest sales were:

Krugman	Age of Diminished Expectations(3rd edition)
Balken	Arthur Dove: A Retrospective
Kluver	A Day with Picasso
Pozen	The Mutual Fund Business
Diffie	Privacy on the Line

Faculty serving on The MIT Press Editorial Boards in 1997-98 were Harold Abelson, Julian Beinart, Olivier Blanchard, Joshua Cohen, Anita Desai, Deborah Fitzgerald, Bengt Holmstrom, Samuel Jay Keyser, Albert Meyer, Gregory McRae, William Mitchell and Donald Prinn. Dean William Mitchell served as Chair. Frank Urbanowski , Glenn Strehle and Ann Wolpert served as ex-officio members.

The MIT Press Management Board met twice during the year. Members of the Board were: Mary Curtis, President of Transaction Publishers; Joseph Esposito, President and CEO of Tribal Voice, Inc.; Jack Goellner, former Director of Johns Hopkins University Press; John Hanley, Chairman and CEO of Scientific American; Steven R. Lerman, Professor, MIT Civil Engineering Department; William J. Mitchell, Dean, MIT School of Architecture and Planning: Dr. Richard Rowe, President RoweCom; Jerome S. Rubin, Group Vice President of Times Mirror; Ann Wolpert, Director of MIT Libraries. William Mitchell and Frank Urbanowski served as ex-officio members of the Management Board; Glenn Strehle served as Chairman of the Board.

Domestic sales this year showed very strong gains, increasing 16.5%, or about $1.4 million. For the first time in many years we saw a decrease in our foreign sales of about 6% from last year. Web booksellers are now becoming a significant customer, and this year accounted for about $350,000 in direct sales. In addition, we sold about $105,000 through our own web site. Amazon.com, the largest web seller, relies heavily on a major wholesaler to supply books for its customers, and when these sales are included, our total internet sales were about $830,000 for

the year. Because several of our major customers have begun to stock virtually all of our in print titles, older books were an important contributor to this year's unit sales increase of about 2%, or 797,400 copies sold.

SUBSIDIARY RIGHTS

Overall, subsidiary rights income in fiscal 1998 decreased by 7% since fiscal 1997. The core of our subsidiary rights program is the sale of translation rights to our books. Since fiscal 1997, income generated by the licensing of foreign rights decreased by 16%. Although we signed a larger number of contracts in fiscal 1998 than previously, the initial advances offered by publishers abroad decreased due to the unstable economic situation especially affecting Asia, and to the disproportionate strength of the dollar. The royalty scales agreed upon, however, remained favorable, so that in the long term these transactions will generate sufficient income to make up for the smaller advances.

Income from our reprint program, which includes permission to photocopy and to publish excerpts from our books, increased by 13% in fiscal 1998. We had several first-serial rights sales, most prominent among them excerpts from Wodiczko's Critical Vehicles, and Bourgeois' Destruction of the Father, both to Grand Street, a publication of the New York Foundation for the Arts.

Book club income decreased by 68% in fiscal 1998, reflecting extensive changes in the book club industry in the past two years. Most sales to book clubs are now in smaller quantities, and are handled as special sales; thus they do not generate subsidiary rights income.

During fiscal 1998, income from the licensing of electronic rights decreased by 5% since fiscal 1997.

MIT PRESS INTERNATIONAL SALES

Following very strong export sales in fiscal 1996 and 1997, MIT Press export sales decreased by 7.3% in fiscal 1998. The downturn was broad-based in terms of geography and appears primarily to result from the growing strength of the U.S. dollar against almost all foreign currencies. In addition, MIT Press books were noticeably more expensive than previously almost everywhere outside the United States, resulting in fewer books being sold. Annual variations in the exportability of the new titles issued by the MIT Press list, along with changes in buying channels brought about by the rise of internet bookselling, will affect export sales results over the coming years. However, these sales will remain broadly depressed until the U.S. dollar weakens against a broad spectrum of foreign currencies.

PROMOTION, PUBLICITY AND DIRECT MARKETING

Fiscal 1998 showed marked improvement for direct mail over last year. Traceable sales through the end of June were $391,601, up 42% . Economics continues to be our strongest direct mail subject area, followed by Cognitive Science, and Computer Science.

Text sales in the U.S. and Canada were $2.4 million, an increase of 1% over last year. Unit sales decreased 12%. Bestsellers in terms of dollars were Barro/Macroeconomics 5E, Kennedy/Macroeconomic Essentials for Media Interpretation, Krugman/Age of Diminished Expectations 3E, and Viscusi/Economics and Regulations of Antitrust 2E.

The MIT Press exhibited books with our own staffed booth or table at more than 55 U.S. academic conferences in fiscal 1998, and displayed books at over 90 others through free and combined exhibits. Sales generated from exhibits are currently at $195,851.

Advertisements for MIT Press books appeared in almost 600 trade and scholarly journals and magazines, as well as conference programs. All of these ads were produced in-house.

Press books and authors continue to be covered by an enormous number of general and scholarly media, including The New York Times Book Review, The Wall Street Journal, Nature, Science, The New Scientist, The Washington Post, The New Yorker, Wired, Foreign Affairs, The Times Literary Supplement, and others. Press authors discussed their books on radio and television programs broadcast by National Public Radio, C-Span, The Bloomberg Business

Network, and others. One of the most widely reviewed titles of the year was Arthur Dove: A Retrospective edited by Debra Balken et al. Another very widely and favorably reviewed title was Billy Kluver's A Day With Picasso, .

Electronic promotion was considerably expanded in fiscal 1998. We posted announcements of all new professional and many new trade titles to e-mail listservs and Usenet newsgroups in the relevant fields; and we negotiated links from many related websites to our own. With the help of our Digital Products Laboratory (DPL), we developed a system to track the number of responses ("hits") generated by each announcement or link.

For the Press's website we prepared a number of substantive promotions in the form of book-of-the-month features. These typically featured a single book in depth, using graphics, author biographies and interviews, author photos, praise from endorsers and published reviews, descriptive copy, excerpts from the books themselves, and further internet resources for readers interested in the subjects covered.

Press books and authors received numerous awards. Among these are City Center to Regional Mall: Architecture, the Automobile, and Retailing in Los Angeles, 1920-1950 by Richard Longstreth - the Lewis Mumford Prize; and Robert Giard's Particular Voices: Portraits of Gay and Lesbian Writers - the prestigious 1998 Lambda Literary Award for Best Book in the Photography and Visual Arts category. The MIT Press author, Torsten Persson, was awarded the 1997 Yrjö Jahnsson Prize sponsored by The Yrjö Jahnsson Foundation and The European Economic Association given to the best young economist active in Europe. Three Press titles were awarded the eighth annual International Architecture Book Awards, sponsored by The American Institute of Architects; the Press received awards for three titles in the 1997 Professional/Scholarly Publishing Division Annual Awards Competition, sponsored by The Association of American Publishers, Inc.; and received awards for ten titles in the 1998 Book, Jacket, and Journal Show, sponsored by The Association of American University Presses.

JOURNALS

In fiscal 1998, the Journals program had gross sales of $4.6 million, a 2% increase over last year. Because of the sale of one of our established journals (International Journal of Robotics Research), only $1,159 was added to the deferred subscription reserve account during the year, making the total reserve essentially flat at $2 million. We also ceased publication of Adaptive Behavior and The Ecologist, and added Real Estate Economics and Videre: Journal of Computer Vision Research to our program. The division ends the year publishing 34 journals.

Frank Urbanowski

VICE PRESIDENT FOR HUMAN RESOURCES AND EQUAL OPPORTUNITY OFFICER

This year has seen heightened activity in most of the groups reporting to me. The Medical Department is implementing a major upgrade to their information system, separate from the overall campus system in order to maintain privacy of patient records.

The Personnel Office, in Benefits and in Services and Employment have focused on ways to take advantage of the Internet. The goal is to eliminate paper transactions as much as is legally possible in benefits administration, resume handling, and other paper-intensive tasks.

The Human Resource Practices Design team (HRPD) delivered reports and recommendations for changes to the classification and compensation system, in training policies and administration, in the reward and recognition program, and in a more comprehensive orientation program. The HRPD team, led by Patricia Brady, has performed a valuable service for the Personnel group and for MIT employees. I want to express my thanks to the team, and to Patricia, for the fine work.

The Performance Consulting and Training group is working to understand and assist us all in achieving the goals of improved performance, and has worked closely with the HRPD Team to that end. The range of program offerings increases each year and feedback from participants is very positive.

We are engaged in a major classification of administrative positions on campus. While there has been constant, careful attention paid to the current system, community feedback indicates some lack of confidence in how jobs are classified. We are grateful to members of the community for their participation in the project.

I am delighted that we were able to bring Ms. Regina Caines on board as Assistant Equal Opportunity Officer. Most of Regina's career has been spent as a research chemist until, in more recent years, she changed her work emphasis into the areas of equal opportunity and diversity.

This has been a difficult year for many as we strive to improve our effectiveness. Thank you all for the support, hard work, humor and encouragement. It all adds up to making MIT the special place we want it to be. I must in closing make special comment to Robert Lewis and David Achenbach for their fine work in negotiating our various union contracts. I also wish to thank Marianne Howard and Philip Lima for their creative work in the redesign of the MIT Pension Plan which, while still in process, looks to be very responsive to community input.

A number of staffing changes took place. Diane Gipson was promoted to Supervisor of Retirement Services, Mary Markel was promoted to Supervisor of Benefits Administration, and Shelly LaVallee and Adrea Surette were promoted to Administrative Staff. Regina Caines joined our staff as Special Assistant to the Vice President for Equal Opportunity and Affirmative Action, and Nora Costa joined us as Manager of Compensation. William Cain had a change in status from temporary assignment to permanent assignment as a Personnel Officer after Sharon Bridburg transferred to the Office of the Dean of Students and Undergraduate Education. Valerie Chu has joined us for a temporary, one-year assignment as a Personnel Officer. Seogae Han, Armando Neves and Nancy Olt left to pursue positions that provided greater interest.

As of June 1, 1998, of the total of 37 administrative staff in the Personnel Office, 11 (30%) are members of minority groups and 26 (70%) are women. (In 1997, of the total of 33 administrative staff in the Personnel Office, 10 (30%) were members of minority groups and 23 (70%) were women. As of June 1, 1998, of the total of 22 support staff in the Personnel Office, 6 (27%) are members of minority groups and 18 (82%) are women. (In 1997, of the total of 20 support staff in the Personnel Office, 3 (16%) were members of minority groups and 15 (75%) were women.

Joan F. Rice

MEDICAL DEPARTMENT

The care of our community, including prevention and treatment of illness, health education and response to the greater MIT community needs remains the major focus of the Department. The integration of new clinical and administrative personnel continues. Our external relationships with Partners HealthCare System (especially the Massachusetts General and Brigham and Women's hospitals) have been improved through enhanced communications via personal and computer interactions. A number of noteworthy accomplishments and initiatives should be mentioned in summary:

- The Department-wide patient service effort, ComMITment to Care, continues and 31 internal focus groups provided a large list of areas and needs that are being prioritized by the multi-disciplinary steering committee. Noteworthy are many objective and subjective changes indicating an increased awareness and sensitivity of interactions among Department members and with patients.

- Upgrading our information systems has resulted in a choice of vendor and increased work to provide improved financial and clinical data.

- Clinical and administrative reorganization of the Dental Service has been completed and a single director, Dr. Gregory Stoute, oversees both the MIT and the Harvard University Dental services. This experience may be a model for selected other clinical, laboratory and administrative collaborations.

- The Health Education Service, medical providers and administrative personnel have made significant contributions to alcohol education on campus during a year of increasing awareness and publicity of drinking problems in the student body.

- Student health issues have taken center stage with the formation of a Student Health Committee and focus group interviews with students to ascertain and understand their special needs.

- The merger of our Psychiatric and Social Work services into a single Mental Health Service has been realized and the Service has upgraded its physical area to facilitate patient flow and confidentiality.

- The Environmental Medical Service completed a strategic plan that addresses continuing education, clinically related activities (in the form of monthly grand rounds exercises) and through a number of task forces, is looking at curriculum development, applied research and expanded training.

- The need for a medical satellite convenient for MIT and Lincoln Laboratory personnel and families has resulted in an exciting plan to renovate space at Lincoln Laboratory for a medical and physical fitness facility. The medical facility would be open to all MIT Health Plan families.

- As part of our commitment to the MIT community, we continue to explore the feasibility of becoming Medicare Part A providers. This would enable us to more seamlessly serve retirees and to offer a Senior Care program tied to an existing one in Eastern Massachusetts.

MEDICAL CARE ACTIVITIES

Dental Service

This year marked the beginning of a new organization of the Dental Service under the leadership of Dr. Gregory A. Stoute who assumed the combined directorship of both the Harvard University Dental Service and the MIT Dental Service. Among the organizational changes that have occurred this past year has been the hiring of a practice manager responsible for daily operations. In addition, a decision was reached to have the Service primarily devoted to routine dental care including dental prophylaxis. With the reorganization, tertiary dental services, at least for the time being, will be referred to the Harvard Dental School or private clinic. As an important part of the reorganization, a staffing model is being put in place which includes a methodology for evaluation and compensation. This methodology has been developed with substantial support from the practice staff. It is anticipated that with these changes, as well as physical renovations and medical/dental record integration, we will see considerable growth and greater acceptance of the Dental Service.

Medical Service
Following last year's major changes in personnel related to early retirement, this year saw no personnel changes. A physician evaluation program has been developed and is instrumental in determining the level of salary support. Benefits for Health Plan members remain stable except that we now are referring patients to the MGH for acupuncture treatment for recalcitrant chronic pain problems. This service is being evaluated carefully and the hope is that it will provide additional help to patients who have an insoluble pain problem. The internal medical service has been intimately involved in alcohol education initiatives in fraternities and in the dormitories, has worked with MedLINKS students at MIT through Health Education services, and special efforts have been made in the development of written information, especially by Dr. William Kettyle and Dr. Mark Goldstein.

Considerable discussion around care of retirees and Medicare-eligible individuals has continued. The potential for offering a Senior Plan along with one of the larger established HMOs is in development. The first stage of such an undertaking will be becoming a Part A Medicare provider and in order to come into compliance with HCFA and present Medicare reimbursement policies, we have made significant changes both in our laboratory forms and in the encounter forms that are used by all providers to comply with standards that are set by the government. Coming into compliance in these areas is vitally important to maintain our position in caring for elderly individuals. As upcoming financial constraints continue to put pressure on the department, internists will continue to strive to deliver the highest quality of personalized care possible. This has as been our tradition and we will continue it while seeking improvements through our commitment to care.

After Hours Service
The After Hours Service, providing 24-hour , 7 day-a-week, on site physician coverage has been busy during this past fiscal year with approximately 8,000 visits. There were 3,500 student visits, amounting to 10% of the total student visits to the Medical Department. It is apparent from surveys and discussions with students that the After Hours clinic is vitally important since students are often tied up during the middle of the day and therefore utilize evenings and weekends to seek help for health problems. Scheduling of appointments in the Urgent Care area on weekends and on holidays has worked very well to decrease waiting time and therefore patient acceptance. Many medications are now stocked in the After Hours area and this allows us to start medications at night or weekends rather than ask patients to seek out pharmacies in the community at odd hours. Finally the student focus groups have included questions about the After Hours service and these are being evaluated and will be used to improve patient satisfaction.

Inpatient Medical Service
During the past year there were 577 admissions made up of students, dependents, affiliates, Health plan members, Medicare individuals, Draper Lab and fee-for-service admissions. The Clinical Research Center accounted for 288 inpatient days. To assist the Clinical Research Center, two inpatient rooms have been renovated to facilitate overnight sleep study research. Other investigations include studies of amino acid metabolism, cardiovascular and neurological regulation, growth and development of adolescents. New computer linkages with the MGH and Partners HealthCare have made clinical care more efficient in communications. In addition, we have brought patients back after procedures without having to stay at a tertiary care hospital. We have provided hospice care for MIT patients and we are looking forward to decisions regarding Medicare Part A.

Obstetrics and Gynecology Service
Statistics for this fiscal year showed a growth in patient care from approximately 7,500 to approximately 8,600 visits and a growth from 166 deliveries to 185 deliveries. We also had a very acceptable Cesarian section rate of 12.3% with less than 10% being primary Cesarian sections. GYN surgeries have been down a bit from 57 last year to 41 this year. The staff has expanded to fill the vacancy left by the retirement of Dr. Charles Eades and the resignation of Dr. James Marquardt. Dr. Chana Wasserman has joined the staff and there has been increased clinical time from nurse clinician Dolores Vidal and this has helped compensate for the retirement of nurse midwife Barbara Merrifield. In attempting to refine patient care standards and better serve our patients, we initiated joint staff and support staff meetings on a quarterly basis to improve communications and benefit from the crosscurrent of ideas generated in these meetings. Communications avenues with Pediatrics, including monthly meetings, have begun and with the help of nurse clinician Pat Bartels in Pediatrics we have developed a system which transfers prenatal information to Pediatrics for inclusion in newborns' records. All practitioners continue to participate in community activities including IAP lectures, premed advising, MedLINKS advising, participating in HST programs, HMS

primary care mentorship program, precepting MGH nurse practitioner students, and supervising residents at Brigham and Women's GYN Clinic.

Pediatrics and Student Health

A variety of activities in addition to traditional pediatric care ensued this past year. A book edited and written by members of the MIT Pediatrics Service titled *Our Baby: The First Year* was published. Drs. Bass, Katz and Goldstein were all involved in that undertaking. This is a book that reviews the care of babies in the first year of life, reflects on the philosophies of the MIT Pediatrics Service, and is being distributed nationally through Barron's Educational Service. The Pediatric Service has also been the site for HMS primary care students as well as residency training for Medical-Pediatric Residents from the Massachusetts General Hospital and a nurse practitioner training program. Nurse clinical coordinator Pat Bartels has served on the long range committee of MIT that has been looking at child care services at the Institute.

As regards student health, a committee was organized with Dr. Goldstein as chair to evaluate the care given to students. The committee arranged for focus group interviews of students. Student ideas, that were in may ways much different from anticipated, have helped us to better define the needs of students, especially nights and weekends. Following the tragic death of Scott Krueger, the Medical Department engaged in a number of responses including living group talks, information pieces in *The Tech,* many conversations with other groups within the Institute, as well as with colleges and universities around the country. Dr. Goldstein was appointed by President Vest to cochair the Working Group on Dangerous Drinking which completed its three-quarter-of-a year's activities recently with a robust report. In addition, a study was done to determine the reason why international students don't seek out mental health services at MIT and the results will be of value here and have also been presented to the American College Health Association. We have been engaged in an epidemiologic and diagnostic study of persistent cough in college students. Funded through the NIH, the study is looking at the increase in whooping cough (pertussis) among various age groups, since a mini epidemic has been occurring over the past 3-4 years. An outbreak of pertussis was documented in a MIT fraternity this past year and the study design allowed rapid diagnosis and treatment of infected students as well as prophylactic preventive measures designed to keep exposed well students well.

Environmental Medical Services

The Environmental Medical Service (EMS) continues to provide consultation activity relating to patient care, to education, and to a variety of professional activities including applied research. Over the past year, the development and beginning implementation of a strategic plan were initiated. The main recommendations, some of which are already in place, include the development of a monthly grand round series dealing with clinical problems relating to environmental medical activities and the appointment of three task forces charged with looking into curriculum development, improvement and training initiatives and applied research appropriate for the EMS. Members of the professional staff have, in addition to the various activities here on campus, been engaged in a variety of professional activities including journal articles and seminar presentations at meetings locally, nationally and internationally. In addition services have been intensified at Lincoln Laboratory and many members of EMS have contributed educational sessions during IAP. Biosafety, Industrial Hygiene and Radiation Safety areas have all been active, pursuing many of the tasks and initiatives that are natural consequences of working in a robust technological and research institution like MIT and Lincoln Lab. Of note, Dr. Robert McCunney has been designated the new President-Elect of the American College of Occupational and Environmental Medicine, an international medical society of 7,000 occupational medical physicians.

Health Education Service

In attractively and efficiently renovated quarters, the Health Education Service has continued to serve as a resource for the entire community. Communication has been enhanced by the development of a new Health Education Service brochure and by signs and literature racks throughout the Department as well as in other areas of the Institute. Health Education prescription pads have been developed and improve department-wide communications. A decision was made to have the Health Education leadership in the hands of a physician, as a liaison function, and to identify a suitable individual to fill a health education position that would be dedicated primarily to the students.

Many workshops and lectures initiated with the help of the Health Education Service were held during the year. IAP featured 77 workshops sponsored by Health Education including two multi- disciplinary open houses focusing

on cancer and diabetes. At Lincoln Lab, 14 workshops were offered this year, a new program developed in response to requests from Lincoln Laboratory. Efforts of the health educators for students centered around alcohol during the fall term. An intensive examination and evaluation of alcohol educational programming were undertaken and expansion of that programming ensued under the leadership of Dr. William Kettyle working with the Health Ed staff, but especially Ms. Tracy Deosvich, health educator for students, and Ronald Fleming, head of the Employee Assistance Program. Written material and many presentations to living groups underscored the potential dangers of excessive drinking.

The MedLINKS program continues to be active and very successful. The MedLINK steering committee has been reorganized by our new Health Educator, Ms. Roseanne Guerriero, and coordinated MedLINKS training in January was then extended to a variety of educational activities including World AIDS Day, campus wide eating disorders campaign, and a major week long "Destress for Success" week before final exams in May. Health Education continues to play a major role in the Residence Orientation week, in IAP, and in the interactive theatre troupe, UpFront, a subgroup of MedLINKS that develops education skits performed in living groups and on campus.

Mental Health Service
The Social Work and Psychiatric services completed their merger to form the Mental Health Service including merging of records. The appointment system was integrated as well and appropriate emergency coverage and clinical rotations were put in place. The Social Work group was brought up to full complement with the hiring of a second individual, Jessica Barton, M.S.W., a superb clinician with special experience in psychotherapy, family counseling and substance abuse. The consolidation of the services was aided by physical renovations of our space, the waiting area was reconfigured for privacy and comfort, and the conference room was resituated. A larger and more secure record room was built to house the consolidated records. The renovations that have been widely praised as being functionally very effective.

New developments this year included the creation of an administrative position, Staff Supervisor in the Mental Health Service. A new and improved encounter form has enhanced data collection A new Mental Health operations group has been formed, meeting weekly to review operational problem of the service as well as recommending new initiatives. The training program was expanded to include an advanced social work student from Simmons and training in other programs has continued. The retirement of Dr. Joseph Brenner, after 32 years of service, led to a reorganization with the assumption of leadership responsibilities by younger members. The Mental Health Service continued to be very active in community outreach, in educational programs and in consultations relating to campus distress and stress.

Dr. Ronald Fleming continues to supervise the Institute Personal Assistance Program, is involved in clinical activities and in supervisor training, in consultation, participation in Institute-wide activities such as substance abuse, and workplace violence. His sensitive role in this area is greatly appreciated in the Mental Health Service, in the Department, and in the MIT and Lincoln Lab. communities.

Surgical Service
A major effort of the Surgical Services this past year has been integration with the Massachusetts General Hospital. The volume of general surgery has increased significantly during this period but it is unclear if this is a blip or a permanent trend. Due to the significant volume of breast disease and breast cancer in the MIT community, and in order to better serve the community in this area, we have written two pamphlets, one on breast cancer and one on patients with new breast problems. The newest initiative is a revisit of the feasibility of a day surgery here on campus.

Nursing Service
In addition to the ambulatory and inpatient unit services provided by registered nurses, physician assistants, and nurse clinicians, community service continues to be a major focus. These activities include Freshman Orientation and new student registration, flu vaccine clinics, participation in IAP activities, and clinical support during graduation ceremonies and other large population activities on campus. Several of the MIT nurse practitioners and physician assistants precepted graduate nursing students for advanced nursing practice from the MGH Institute of Health Professions and Simmons College. The Nursing Continuing Education Committee this year was approved as provider of continuing education in nursing by the Massachusetts Nursing Association. Efforts continue in the

Department to build a collaborative practice among physicians, non physician providers, and the nursing group where the skills and expertise of each discipline can come together to improve patient care and provider communication as well as continuing education.

OTHER ACTIVITIES

Clinical Research Center

Dr. Schwamm replaced William Dietz as Associate Program Director of the CRC and as liaison to the Medical Department serving on the Executive Committee. Studies done at the CRC continue to focus on human nutrition and metabolism, cognitive neuroscience and neuropharmacology, and brain function. The CRC continues to relate clinically to the Medical Department with Dr. Elaine Shiang serving as liaison and the CRC utilizing the Inpatient Unit for 288 days of research subject participation. Representatives of the CRC serve on all of the major committees of the Medical Department.

Lincoln Laboratory Medical Service

The Clinic continues to play an active role in the care of the Lincoln Laboratory employees, visitors, students, subcontractors, and special program participants. Other than routine and usual care, 8 emergency patients were seen who required triage to acute care hospitals. There were a total of over 3,000 patient visits to this modest clinic. Various educational efforts were provided at the Laboratory including a video tape library for patient use and a variety of educational sessions, some during IAP and others during the course of the year. Parenting programs were held at Lincoln Laboratory using medical providers from campus. In addition to other activities, the Lincoln Lab medical service performs a medical assessment review on individuals who have official assignments to the Kwajalein facility. A major undertaking begun during the latter part of this fiscal year has been the evaluation and initial planning for a medical satellite on the Lincoln campus in an unsecured area that would be available for Lincoln Lab employees, their families, and other members of the MIT community who are MIT Health Plan participants. In addition, an expanded facility will allow the walk-in employee benefit to better serve the Lincoln Lab community.

Clinical Operations and Administration

Maintaining and improving quality while minimizing cost continue to be major efforts of our administration. Our affiliation with the Partners HeatlhCare network has allowed us to revise and improve procurement of some professional and hospital-based services for our patients and management of this affiliation continues to require administrative time and effort. We continue to strive to improve the mechanics of patient access to care. Our staff is becoming increasingly integrated with the activities of the Massachusetts General Hospital. In addition to caring for our patients at the MGH, many of our staff members participate in teaching activities at the Hospital.

The Evening Hours program initiated two years ago continues to function in a fashion that improves patient access to care and makes maximal use of our physical plant. A committee chaired by Mark Goldstein, representing several segments of the Department, meets on a regular basis to discuss ways of improving services to this important constituency. In addition, the Pharmacy and Therapeutic Committee continues to provide information and set policy that ensures high quality care at a reasonable cost. A new contractual relationship with our ophthalmologists should result in significant savings, while at the same time ensuring excellent patient access to ophthalmologic surgery and rapidly available coverage nights and weekends for emergency eye problems.

Members of the Medical Department staff continue to play very active roles in activities on campus -- premed advising, MedLINK monitoring, participation in IAP programs are some of these activities.

MIT Health Plans

After several years of declining contracts and membership, the MIT Health Plans showed a net gain in overall contracts as of January 1998 open enrollment. Outreach to all new members by the Marketing Administrator indicates that the new marketing materials have caught the community's attention and that the Health Plans orientation presentations and packets favorably compete with the other plans offered by MIT. More focus groups over the past year provided useful information helping us make decisions about services, including the possible development of a Senior Plan. In response to inquiries from Lincoln Lab, the Department and the Health Plans are in the development phase of providing expanded medical services in a nonsecure area at Lincoln Lab. This new site will offer internal medicine and pediatrics care in the beginning stages of operation and will add other

clinical services as wanted and needed. With this second site available for Health Plan members, it is hoped that additional Lincoln employees as well as MIT employees who live in the Western suburbs will choose one of the two MIT Health Plans for their care. Continued demand for competitive premiums, the ability to hold down costs with rising hospital rates, and new regulatory issues in the managed care industry will challenge the Health Plans Management team throughout the year.

Administrative Operations and Management
Administrative operations and management in the Medical Department continue to work in concert with and in support of clinical activities.

Begun in FY97, the ComMITment to Care program to provide the best possible clinical care and personal attention to patients has become a tangible reality within the department. All staff are familiar with the goals of the program and ComMITment to Care has become part of the "language" of the Department. During the past year, 31 employee focus groups were held within the department. These groups identified almost 900 obstacles to better patient services and staff interactions and made over 1000 recommendations for how to improve them. A ComMITment to Care mission statement was developed by the Steering Committee and signed by all employees. Soon, there will be framed ComMITment to Care mission statements displayed around the department. The Steering Committee has categorized the obstacles to better patient services and staff interaction into six major themes and is in the process of categorizing recommendations for each theme. Many suggestions that are easy to implement have already been implemented. While Arnold Weinberg and Annette Jacobs chair the Steering Committee, the major administrative and managerial work for the ComMITment to Care Program is being done by Tony Rogers, the senior manager for operations, and Gina Vild, a consultant for the department. We are pleased with the progress we have made to date and expect to continue our work on this multi facetted long term project in FY98.

The Management Information System Steering Committee selected a vendor during FY97 and a contract between MIT and IDX, the vendor choice, was negotiated and signed. The department is currently in the process of planning for the implementation of a complete new information system which will meet department administrative, financial, and clinical needs and interface appropriately with relevant MIT information systems. The target date for beginning the actual implementation is the summer of 1999.

Marketing efforts continue. New brochures for student services which follow the same themes of the Health Plan were developed and released within the last year. Materials for both groups have been well received and are being noticed. Health Plan membership and utilization of the department have increased.

Rather then contracting with a community physician group to provide services to MIT and Lincoln Health Plan members and students who live in the western suburbs, we are moving forward in collaboration with Lincoln Laboratory to expand onsite services at the Lincoln Laboratory facility. Administrative staff will be responsible for working with Lincoln Laboratory on renovations, marketing, and for internal planning for staffing and assuring that the myriad of details for successful functioning of the practice and communication with the MIT Medical facility are assured.

Annette Jacobs

Staff Personnel Changes June 1, 1997 through May 31, 1998

Appointments

Jessica Barton, LICSW	9/1/97	Social Worker
Susan Connelly	2/2/98	Supervisor, Mental Health
Gayle DeBay, RPH	11/1/97	Pharmacist
Jeffrey Doucette	7/7/97	Industrial Hygiene Technologist
Grace Gibson, PHD	7/1/97	Psychologist
Rosanne Guerriero	1/1/98	Health Educator
Rita Harding, RN	9/8/97	Nurse, Inpatient Unit
Donna Hayes, RDH	9/8/97	Supervisor, Dental
William McCarthy	8/1/97	Assistant Radiation Protection Officer
Hossein Monzavi, RPH	6/23/97	Pharmacist

Eileen O'Keefe	8/18/97	Manager of Financial Services, MIT Health Plans
Allison Parisi	12/1/97	Financial Analyst
Mark Perkins	5/4/98	Senior Project Manager, Information Systems
Kimberly Schive	2/23/98	Communications Coordinator
Patrick Song	5/4/98	M Programmer/Analyst, Information Systems
Kathleen Sullivan, RDH	11/10/97	Dental Hygienist
Chana Wasserman, MD	8/1/97	Obstetrician/Gynecologist
Terminations		
Joseph Brenner, MD	6/30/97	Psychiatrist
Thomas Crowther	6/30/97	Assistant Industrial Hygiene Officer
Anthony Cavallerano, OD	11/19/97	Optometrist
Dirk Greineder, MD	12/31/97	Allergist
James Marquardt, MD	6/30/97	Obstetrician/Gynecologist
Maureen Rezendes, PHD	6/30/97	Psychologist
Stefan Schatzki, MD	4/30/98	Radiologist
Perry Spearman	11/30/97	Assistant Radiation Protection Officer
Changes		
Robert Edwards	6/1/97	Associate Industrial Hygiene Officer (Promotion)
Pamela Greenley	10/1/97	Associate Industrial Hygiene Officer (Promotion)

CONCLUSION

In the greater than 25 years of existence in its present form, the Medical Department has rarely had as many challenges or as many major efforts under way as currently. The external environment continues to change; quality of care demands documentation and benchmarking; fiscal responsibility and conservation of financial resources are not going to leave us. The Department is blessed by a committed employee group. Everyone has seriously and selflessly joined in the many tasks before us. The loyalty and leadership of Ms. Annette Jacobs, Executive Director, and Dr. William Kettyle, Associate Medical Director, have been instrumental in our planning and progress. I would also like to mention, with appreciation, the special efforts of Mr. Anthony Rogers, Senior Manager for Operations, Ms. Mary Smith, Director of Finance and the MIT Health Plans, Dr. Peter Reich, Chief of Mental Health Services, and Ms. Laureen Gray, Director of Nursing Services.

Arnold N. Weinberg, M.D.

TRAINING AND DEVELOPMENT

Over the last year the Training & Development function has evolved to become Performance Consulting & Training (PC&T). This new entity's mission is to work with departments, laboratories, and centers to enhance their abilities to achieve business goals. Services include needs assessment, planning and measurement, process improvement, team development, custom-designed training, meeting facilitation, resource referrals, and conductive learning environments. As a result, this team not only sponsors a variety of professional development training events for MIT employees, it also serves an internal consultants. In addition, it is responsible for the operation of the MIT Professional Learning Center (W89).

Some constituents who have used the team's consulting services include the Office of the Dean for Students & Undergraduate Education, Physical Plant, the Libraries, the Working Group on Support Staff Issues, the MIT Press, Management Reporting, and the Academic Administrators Network. This work has ranged from facilitating organizational development to developing competency models to creating work plans.

In the training area, the number of courses offered to MIT employees has increased. Over 1400 people attended courses offered either to all employees or to specific departments, laboratories, and centers. Topics include teambuilding, communications, good management practices, coaching skills, decision making tools, and leadership. Even more courses are planned for next year.

In addition, PC&T sponsored two project teams which developed sets of recommendations for senior leadership's consideration. One focused on a program for new employees (in addition to the current benefits orientation). The

other focused on training policies and administration. These recommendations, if accepted, will begin implementation next year.

Margaret Ann Gray

DISABILITIES SERVICES OFFICE

The Disabilities Services Office (DSO) is responsible for providing effective disability services and programs for students, faculty, and employees at MIT. These services include physical and communication access, academic accommodations for students, and the identification and implementation of reasonable accommodations for employees.

Disabilities Services works with the personnel officers, departments heads, immediate supervisors, and outside agencies to provide employees with disabilities an interactive process in identifying appropriate reasonable accommodations. A total of 45 employees identified themselves as individuals with disabilities and requested accommodations. Due to the increase in identified employees and also the types and severity of disabilities, the DSO involvement has increased substantially.

Over the past year, 18 different presentations to the MIT community on their responsibilities during the hiring process to ensure that persons with disabilities are a) provided necessary accommodations when seeking employment; b) that they are treated consistently and fairly; and c) that position descriptions do not impermissibly screen-out persons with disabilities. Work has continued with individual departments developing procedures for rewriting job descriptions to properly identify essential job functions. In addition, the DSO has been working extensively with various departments that have hired employees with disabilities.

In addition to providing academic access to students with disabilities in the form of course material translation, the DSO has focused on the creation of administrative forms and a set of Institute policies and procedures to provide accurate guidelines for students and faculty requesting/receiving services. The DSO has assisted 102 students with disabilities during the past academic year.

With input from numerous people in the MIT community, the DSO has developed a guideline titled "Policies and Procedures For MIT Students with Disabilities." This guide outlines MIT's commitment to individuals with disabilities and the philosophy of the DSO. It clearly defines the processes used by our office for requesting and obtaining reasonable accommodations in order to balance the student's right to access with our obligation to protect the integrity of the Institute programs and services. This booklet has been approved by the Faculty Policy Committee and was sent to all faculty members for review. The guide will be available on the web and published later this year.

In developing this policy, it has unified the entities providing academic access at MIT by defining a more efficient and consistent system for obtaining services. These entities would include the DSO, Adaptive Technology for Information and Computing (ATIC) Lab, the Learning Disabilities Specialist, and the Office of Undergraduate Academic Affairs.

Barbara Roberts

HUMAN RESOURCE PRACTICES DESIGN/DEVELOPMENT TEAM

The Human Resource Practices Design/Development (HRPD) Team, sponsored by the Vice President for Human Resources, was convened in 1996 to support the changing needs of the Institute. HRPD initiatives are shaped by both internal decisions about business processes and forces in the external market. The MIT Human Resource Principles adopted in 1994 provide the foundation for the team's work. The project scope does not include academic or off-campus positions.

Members of the core HRPD team are Patricia Brady, Project Director/Team Leader, Melissa Damon, Margaret Ann Gray, Alyce Johnson, Barbara Peacock-Coady, Mark Snow, and Maureen Wolfe.

The HRPD functions as a temporary, de facto research unit for the Personnel Department and will complete work in January 1999. Its job is to develop, test, and deliver a set of effective "tools" for attracting and retaining the best employees to support MIT's academic and research mission. In the "tool kit" are program outlines, resources, and knowledgeable practitioners.

Core HRPD team members were assisted in FY98 by approximately three dozen employees on campus (administrative and support staff) loaned by their home departments to work on various HRPD projects on a 20% basis for 6 to 8 months.

The final research reports and recommendations delivered to Joan Rice in FY98 concerned: changes to the classification and compensation program; establishing a recognition and rewards program; establishing an orientation to MIT operations program for employees; and changes in training policies and administration.

Under the auspices of the HRPD project, a number of staff are developing expertise in applying new approaches for staff selection, assessment, development and performance management practices. The new approaches were developed in response to needs articulated by the campus community in the design phase of the HRPD project. They are based on understanding the full range of competencies (technical skills, knowledge and behaviors) that lead to successful performance on the job.

In the final phase of the HRPD project, the team will complete the development of the "tool kit" and also propose a 2-year plan for continued evolution of improved human resource practices.

Patricia A. Brady

EMPLOYEE RELATIONS

Employee Relations consists of three areas within the personnel department; Personnel Services and Employment, Labor Relations, and Compensation. Our mission is to serve MIT by providing consulting, advising, strategic planning and administrative services in the areas of employment, employee relations, compensation and labor relations. We are committed to creating a professional work environment where employees are treated fairly in support of MIT's mission of excellence in education and research.

COMPENSATION

In the 97/98 fiscal year, the Compensation Office participated in 39 external salary surveys conducted by universities, associations, and consulting groups from across the country, and responded to over 40 email or phone requests for position-specific salary data. As in previous years, the Office conducted two major surveys with approximately 30 participants each. These MIT survey results continue to provide us with a solid basis in determining our market positions, and in developing our review allocation proposals to the Executive Committee. In addition to using our own surveys to determine market position, this year we expanded our analysis of the Administrative and Support Staff market position by including several external salary surveys.

Nine salary reviews covering approximately 6,800 Campus employees were conducted this year. As part of our continuous effort to increase the efficiency and effectiveness of the annual salary review processes, we continue to use electronic review sheets for the faculty review which were used by the Deans' offices; and for the research, administrative, and support staff reviews, electronic review sheets were provided to the Personnel Officers. All of the electronic review sheets provide meaningful summary statistics which enable management to assess the financial impact of review recommendations. The feedback from users continues to be most favorable. We strive to continue the automation of the salary review process in the coming fiscal year.

A total of 75 administrative positions were classified or re-classified this fiscal year. The total number of active classification positions that currently exist in the Institute's Administrative Staff Classification System is 740, with over 300 inactive position titles eliminated this year.

The Compensation Office, under the sponsorship of the Vice President for Human Resources, has begun a project to redesign the classification and compensation system for Administrative Staff. This project is the first of many

programmatic changes to come from the work of the Human Resource Practices Development (HRPD) Team. The Wilson Group, a compensation consulting firm, has been engaged to provide design and implementation support.

The project has several goals, some of which are to: produce a system which is easy to understand, assess and use; to expand MIT's use of market benchmarks; to enable Managers and Supervisor to creatively compensate and reward their most highly effective employees; and to provide efficiencies in salary administration through the use of new technology.

In order to accomplish this work and have it well-received by the community, four support teams have been formed. The first two teams, staffed mainly by members of the Personnel Office and HRPD team, will be responsible for the actual analysis and design work of the project. The second two teams, comprised of cross-Campus representation from all Administrative Departments and Schools at the Senior Officer, Director, and supervisory levels, will act as advisors for the program's design issues. The project work is anticipated to be completed and ready for implementation by June 1999.

LABOR RELATIONS

The Office of Labor Relations is responsible for negotiation and administering the collective bargaining agreements covering approximately 1,300 MIT employees in five bargaining units. Labor Relations also represents MIT in grievance arbitrations, and in some cases before administrative agencies in employment-related cases.

On November 20, 1997 the Institute signed new agreements expiring June 30, 2000, with Local 254 of the Service Employees International Union (SEIU) for the Campus and Lincoln bargaining units. On December 31, 1997, the Institute signed a new agreement, expiring June 30, 1999 with the Research, Development and Technical Employees Union (RDTEU). The wage increases in the agreements were consistent with MIT budgetary guidelines.

The Institute is still negotiating with the MIT Campus Police association (MITCPA) for a successor agreement to the Agreement that expired June 30, 1997. The prior agreement has been extended through June 30, 1998.

One agreement expires on June 30, 1998, that with the Security Officer's Independent Union (SOIU), the Union that represents the security guards at Lincoln Laboratory. Negotiations for a successor agreement continue as of the date of writing.

The number of grievances rose slightly from the previous year. Three arbitration cases were decided, with a favorable result to the Institute in one case. Three arbitration cases were settled prior to arbitration. Eight grievances have been filed to arbitration and have yet to be heard.

During the year, two cases were filed before the National Labor Relations Board. These cases are in addition to five cases that were pending before the Board. During this same time, two cases were resolved in favor of MIT, and the results confirmed on appeal to the National Board Office in Washington, D. C. One case that had been deferred to arbitration was resolved against MIT at arbitration, one was settled prior to going to the complaint stage, and three remain deferred to arbitration with no arbitration date yet.

In addition this Office provide advice and counsel to departments, centers and laboratories contemplating business design changes that impact collective bargaining issues and continue to work closely in support to various re-engineering efforts.

PERSONNEL SERVICES

This group consists of 7 Personnel Officers, 1 Employment Officer and 5 full-time and one half-time Staff Assistants. We also have temporary authorization for 2 Personnel Offices who are assigned directly to reengineering teams.

In addition to the day to day duties of advertising job openings, providing assistance with staffing including applicant tracking and interviewing, employee job counseling , policy interpretation, performance management assistance, salary administration and conflict resolution, much time was spent this past year supporting the Institute's Reengineering effort and working with the HRPD team.

Staff from this group helped with the reorganization of the student services area and worked collaboratively with HRPD on many of their projects including the rewards and recognition and new employee orientation teams. They also participated in many training activities throughout the year from conducting orientation sessions for new employees and leading classes as part of the Institute's Management Principles Training Program to presenting several sessions during IAP on human resource practices in collaboration with HRPD.

In the employment area we have increased our efforts to establish closer working relationships with minority organizations such as the Urban League in an effort to attract more minority candidates to MIT. We have worked to develope a Diversity Resource Directory which will be an on line directory of minority organizations and publications that will assist hiring managers in their serious searches. The tight job market has also resulted in our working on new advertising styles as well as participation in job fairs and greater utilization of the web to promote opportunities at MIT.

During the past year approximately 8,400 applications for positions were received and processed. 751 were hired for positions listed in the Personnel Office, of whom 180 were MIT internal applicants who were seeking employment alternatives for either promotion opportunities or other reasons. Kenneth Wolff, Employment Officer reviewed 1,498 applications for support staff positions, interviewed 155 candidates and assisted in filling 120 positions.

Some 120 unemployment claims were processed this year for former campus employees. We work closely with the representatives of the Massachusetts Department of Employment and Training to provide timely information to employees who terminate and may be eligible for benefits, including individuals in departments impacted by funding or staff restructuring related to re-engineering efforts. We continue to partner with Manchester Partners International to provide employees with outplacement and career counseling assistance.

Personnel Changes
During this period, Nora Costa was hired as the Manager of Compensation, Valerie Chu as Personnel Officer and Jackie Wood as Staff Assistant. Of the 21 people in the Employee Relations group, 65% were female and 24% were members of a minority group up from 15% a year ago. Employee Relations consists of four areas within the Personnel Office: Personnel Services, Labor Relations, Employment, and Compensation.

Robert J. Lewis

AFFIRMATIVE ACTION/EQUAL OPPORTUNITY & DIVERSITY

The Affirmative Action/Equal Opportunity Office (AA/EO) initiatred activity six months ago at the time of the hiring of the Special Assistant for AA/EO, Regina Caines and Support Staff Assistant, Leona Martin. The office provides assistance to the Institute in the sreas of affirmative action, equal employment opportunity and cultural and racial diversity. The primary responsibilities of this function are to support the Institute's schools and departments by means of a two-pronged effort to 1) assist in recruitment, hiring, advancement, and retention of underrepresented minorities and women; and 2) develop strategies to promote and enhance understanding, sensitivity and acceptance for diversity among students, staff and faculty.

The AA/EO Office initiated activities by beginning within the Personnel to establish contact with the personnel officers and the leadership of each department within Human Resources. The "personnel department" contacts included the heads of Benefits and Systems; Compensation; Disability/Accessibility Services; Team Training and Development; and HR Practices Design/Development.

Additionally, meetings were held with the administrative leadership teams of each Institute School and Department. The personnel officers assisted the AA/EO Office with arrangements for these meetings and their involvement reinforced the office's proposed goal to integrate affirmative action and diversity practices within all personnel functions. In support of this goal, the office has initiated meetings with the HRPD Team to work with them toward the inclusion and integration of AA/EO practices.

The off-shoot of the introductory meetings has been follow-up invitations for the AA?EO Office to conduct affirmative action/diversity discussions with the extended staff of the department leaders visited. The use of the

"Intuitively Obvious" video series, developed by Clarence Williams, have set the stage for lively discussions. Those who have participated have begun to understand the depth and nature of many of the issues and concerns that revolve around race and gender relations at MIT. The administrative departments that have been involved in the office's introductory and diversity sessions to-date include School of Engineering; School of Science; School of Humanities and Social Sciences; Sloan School; Information systems; Libraries; Media Arts and Sciences; and Medical Department.

The AA/EO Office is represented on the Campus Committee on Race Relations and has actively participated in the recent activities, plans, and proposals conducted by the committee. In addition, the office provided mediation support to students and employees who have raised claims based on gender, race or culture-related concerns.

In support of MIT's minority recruitment efforts, the office provided assistance as requested for specific position openings. This support is preliminary to the full-service assistance expected from the Minority Recruitment Program that the AA/EEO Office has initiated together with members of the Personnel Department.

Regina A. Caines

BENEFITS AND SYSTEMS

BENEFITS ADMINISTRATION

The Benefits Office, with the assistance of Faculty and Staff Information Services, developed and implemented the Benefits Self-Service Enrollment System. This system enhances benefits transactions by allowing employees to enroll in benefits using their phone, as in the past, while adding functionality for computer based enrollment over the Internet. The system, which was introduced during the November open enrollment period, also provides direct real time updates to the Personnel database and reduces the need for Benefits Office data entry. During the open enrollment period, approximately 30% of benefit transactions were made using the Internet application.

An Enrollment System module, designed to handle the unique aspects of the new hire enrollment process, is nearing completion. A third module is currently under development. This application will allow for benefit changes resulting from life events, such as marriage or the birth of a child. The development of the Enrollment System necessitated a complete review of administrative procedures and the Benefits Office continues to modify and test new work flows as a result of these changes.

We continue to make progress on eliminating paper transactions to our benefit carriers and to other central MIT departments. We have automated the process of sending enrollment data to Blue Cross, Delta Dental and Harvard Pilgrim Health Care. This project results in the elimination of duplicate data entry and in a streamlined enrollment process for the employee. In addition, we are working on feeding data from other internal systems to our HRIS/Benefits system, facilitating data exchange between MIT departments.

The content and visual aids for the new hire orientation were revised in response to program changes and participant feedback. In addition, benefits information for new employees was added to the Benefits Office web site, providing an opportunity for new and prospective employees to access information about their options and plan provisions.

The Benefits Office implemented changes to the Tuition Assistance Plan which provides reimbursement for courses which assist employees to obtain, maintain or improve skills necessary to develop their careers at MIT. The amount available per calendar year for approved non-MIT academic courses was increase from $3,500 to $5,250.

The Benefits Office continued its efforts to provide retirement planning and investment education services by sponsoring seminars and workshops on investment fundamentals, estate planning, and Social Security in October 1997 and January 1998. These sessions on Campus and at Lincoln Laboratory were attended by 1,600 employees and retirees.

The comprehensive review of the MIT Retirement Plan begun in 1996-97 was completed. Conclusions of the review include recommendations to outsource most services associated with the 401(k) Supplemental Plan, expand 401(k) Plan investment options, and enhance the Plan's early retirement features. These recommendations were presented to

the Trustees of the MIT Retirement Plan, Academic Council and to the Executive Committee of the MIT Corporation.

During the year there were several changes in personnel. Andrea Surette was promoted to administrative staff. Shelly LaVallee from the Office of Disability Services, Charles Ormsbee from the FASIS and Shawn Spencer from Campus Police joined the Benefits Office.

FACULTY AND STAFF INFORMATION SERVICES

Faculty and Staff Information Services (FASIS) has the responsibility to acquire, maintain, and provide employment information about faculty, staff and other persons affiliated with MIT to ensure the currency, privacy, and accuracy of this information. In addition this office serves as the department liaison with computer support groups in the development of long-range computer systems.

The Office continues to process approximately 14,000 transactions for appointments and changes. In addition, the office continues its role in the processing of salary review, in the servicing of data requests received from within the Personnel Office and the MIT Community, in responding to external employment verification requests, and in the production of the staff telephone directory.

There are two main computer systems in the Personnel Office. The Cyborg Human Resource system and the Restrac Employment Management system. There were no major system upgrades this fiscal year. A significant number of changes have been made to Cyborg in preparation for the year 2000. It is anticipated that Cyborg will be Year 2000 compliant by the end of the second quarter in the next fiscal year.

The Office spent a considerable amount of time improving internal processes. A portion of the IPEDS survey was sent electronically to the Department of Higher Education. This automation reduced several days of work to two hours. Several of the department's forms were also added to the FASIS website this fiscal year. The label request form can be completed on the web and sent directly to the FASIS e-mail list. Another form is the personal change notice form that can also be completed on the web and sent directly the FASIS e-mail list for action.

The Office continues to provide technology support to all areas of the Personnel Department. One of the applications requiring our support was the Benefits Office self-service open enrollment application.

Marianne Howard

FAMILY RESOURCE CENTER

The Family Resource Center offers faculty, staff and students a broad range of services to assist with child care and schooling, normal parenting concerns, family relocation, and balancing work and family. In addition, the Center participates in a number of institutional, local and national work/life initiatives and makes available information and research on these issues.

Services offered by the Center include office consultations, informational "briefings", seminars, and discussion groups; the Center maintains and provides access to multiple referral databases, resource packets, and a lending library. This year the Center added 400 new MIT families (including 50 faculty, of whom many were relocating to MIT) to its list of current clients, now totaling roughly 4,000. Twenty eight seminars were offered on topics including stepparenting, adoption, job flexibility, balancing work and family, parenting teenagers, emergency/back-up child care, and schooling. Referral databases, which include child care, schools, camps, and special needs services, were expanded, and the development of on-line access to these databases is underway.

As an internal resource on work/life issues, Center activities this year included contributions to Institute discussions of job flexibility, child care, and faculty work/life issues. Externally, the Center continued to play a leadership role in several national professional organizations, including the National Parenting Education Network, and the Alliance of Work/Life Professionals.

Again this year, MIT work/family programs received national recognition from the Families and Work Institute, which will profile the Family Resource Center in an upcoming report, *Ahead of the Curve: How America's Leading Companies are Meeting the Needs of New and Expectant Parents.*

This March, the Center, staffed by two part-time co-administrators and one full-time senior office assistant, moved to the newly renovated Building 16. Separate offices for each administrator now offer increased client privacy, and reception and conference rooms provide greater access to books and other resources, as well as much needed seminar space.

Malika Bristol joined the Center as Senior Office Assistant in August, following Carolyn Hart's departure to attend graduate school.

This year, the Center has been able to increase minority representation on its staff by 33%.

Kathy Simons, A. Rae Simpson

FACULTY AND ACADEMIC STAFF COUNT

DEPARTMENT	Professors in Administraion	Professor	Associate Professor with Tenure	Associate Professor without Tenure	Assistant Professor	*Subtotal - Tenure Track Faculty*	Adjunct Professor	Senior Research Associate	Senior Research Scientist	Senior Research Engineer	Professor (non-tenure)	Senior Lecturer	Lecturer	Instructor	Technical Instructor	Postdoctoral Associate	Postdoctoral Fellow	Research Fellow	Research Affiliate	Visiting Professor	Visiting Associate Professor	Visiting Assistant Professor	Visiting Lecturer	Visiting Scholar	Visiting Engineer	Visiting Scientist	Coach/Trainer	Other Academic Staff*	GRAND TOTAL	Instructor-G	Teaching Assistant	Research Assistant
PRESIDENT'S OFFICE																																
CHAIRMAN OF THE CORPORATION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1			
SECRETARY OF THE CORPORATION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1			
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2			
PROVOST'S OFFICE																																
CENTER FOR ADVANCED EDUCATIONA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	6			
DIBNER INSTITUTE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	2	0	0	0	0	16	0	0	0	0	25			
INSTITUTE PROFESSORS	0	10	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	19			
OFFICE OF THE PROVOST	1	4	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	1	9			
SUBTOTAL	1	14	0	0	0	15	0	0	1	0	0	0	0	0	0	0	7	0	2	0	0	0	0	17	4	3	0	10	59			
SCHOOL OF ARCHITECTURE AND PLANNING																																
ARCHITECTURE, DEPARTMENT OF	2	8	6	8	5	29	2	0	0	0	6	2	12	0	1	1	1	0	4	2	2	0	0	6	0	0	0	1	69		67	18
CENTER FOR ADVANCED VISUAL STU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	3			
CENTER FOR REAL ESTATE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1			
MEDIA LABORATORY	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	4	0	1	12			
PROGRAM IN MEDIA ARTS AND SCIE	2	2	2	5	7	18	0	0	0	0	2	1	2	0	0	2	0	0	1	1	0	0	0	3	0	0	0	0	30			125
SCHOOL OF ARCHITECTURE AND PLA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2			
URBAN STUDIES & PLANNING, DEPA	2	11	3	1	4	21	1	0	0	0	5	4	6	1	0	1	0	12	2	2	0	0	5	6	0	0	0	4	70		8	31
SUBTOTAL	6	21	11	14	16	68	3	0	1	0	13	7	20	1	1	4	1	13	11	5	2	0	5	22	0	4	0	6	187			
SCHOOL OF ENGINEERING																																
AERONAUTICS AND ASTRONAUTICS,	1	13	3	6	7	30	0	0	0	1	5	12	10	0	2	2	1	0	12	1	1	0	0	0	2	0	0	2	81		5	146
ARTIFICIAL INTELLIGENCE LABORA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6	0	0	10	0	0	0	0	0	0	2	0	0	19			
BIOTECHNOLOGY PROCESS ENGINEER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	4	0	0	0	0	0	0	0	0	0	7			
CENTER FOR INNOVATION IN PRODU	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	6			1
CENTER FOR TECHNOLOGY, POLICY,	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	0	2	0	0	0	0	11	0	0	0	0	18			
CENTER FOR TRANSPORTATION STUD	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2			
CHEMICAL ENGINEERING, DEPARTME	4	15	2	3	4	28	0	0	0	0	1	3	3	0	0	27	11	2	13	2	1	0	0	3	6	16	0	1	117		22	107
CIVIL AND ENVIRONMENTAL ENGINE	6	15	3	1	10	35	0	1	0	1	4	0	2	0	0	11	3	0	1	1	2	0	0	0	6	3	0	0	70		21	154
DEPARTMENT OF ARCHAEOLOGY	0	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2			
ELECTRICAL ENGINEERING & COMPU	13	60	8	12	14	107	3	0	1	1	8	16	11	0	4	1	1	0	3	2	2	1	0	1	0	2	0	0	164		106	425
INTEGRATED STUDIES PROGRAM	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
LAB FOR ELECTROMAGNETIC & ELEC	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	6	0	0	0	0	0	0	1	0	0	9			
LAB FOR MANUFACTURING & PRODUC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2			
LABORATORY FOR COMPUTER SCIENC	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	4	6	0	8	0	0	0	0	9	1	10	0	0	41			
LABORATORY FOR INFORMATION AND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	6	0	0	0	0	0	0	4	0	0	14			
LEADERS FOR MANUFACTURING PROG	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5			
MATERIALS PROCESSING CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	2	0	0	0	0	1	0	6	0	0	13			
MATERIALS SCIENCE AND ENGINEER	5	18	1	6	3	33	1	1	0	0	5	2	3	0	4	20	7	0	4	1	1	0	1	2	4	15	0	3	107		15	98
MECHANICAL ENGINEERING, DEPART	5	26	6	3	13	53	2	0	1	0	18	8	18	0	3	14	1	0	1	2	1	0	1	9	6	3	0	0	141		27	243
MICROSYSTEMS TECHNOLOGY LABORA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	3	0	0	0	0	0	0	3	0	0	10			
NUCLEAR ENGINEERING, DEPARTMEN	1	11	3	1	3	19	0	0	2	0	4	0	0	0	0	3	0	0	9	0	1	0	0	0	4	5	0	2	49		19	68
OCEAN ENGINEERING, DEPARTMENT	1	11	1	1	2	16	0	0	0	0	6	5	7	0	0	4	1	0	5	1	0	0	0	2	3	0	0	1	51		1	44
SCHOOL OF ENGINEERING	0	1	1	0	0	2	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5			
SUBTOTAL	36	171	29	33	56	325	6	3	9	5	52	51	58	0	15	110	33	2	89	10	9	1	2	39	33	70	0	12	934			
SCHOOL OF HUMANITIES AND SOCIAL SCIENCE																																
ANTHROPOLOGY PROGRAM	1	2	0	1	0	4	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	11			
CENTER FOR INTERNATIONAL STUDI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	9	9	0	0	0	0	23	0	0	0	1	44			
ECONOMICS, DEPARTMENT OF	2	16	2	6	6	32	0	0	0	0	1	0	1	0	0	0	0	0	0	1	2	0	0	4	0	0	0	0	41		18	23
FOREIGN LANGUAGES & LITERATURE	1	4	1	1	2	9	0	0	0	0	0	3	18	1	0	1	0	0	0	0	0	0	0	3	0	0	0	0	35			
HISTORY SECTION	2	4	1	4	2	13	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16			

LINGUISTICS AND PHILOSOPHY, DE	1	10	1	0	7	19	0	0	0	0	0	0	1	0	0	4	0	0	1	1	0	0	0	23	0	0	0	0	49		10	16
LITERATURE SECTION	1	6	1	2	2	12	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16			
MUSIC AND THEATER ARTS SECTION	2	4	1	1	3	11	0	0	0	0	1	6	11	0	4	0	0	0	0	0	0	0	0	5	0	0	0	11	49			
POLITICAL SCIENCE, DEPARTMENT	1	7	4	0	7	19	0	0	0	0	2	0	1	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	26		10	25
PROGRAM IN SCIENCE, TECHNOLOGY	1	7	1	1	1	11	0	1	0	0	0	1	1	0	0	0	0	10	0	2	0	0	0	12	0	0	0	0	38		2	12
PROGRAM IN WRITING AND HUMANIS	1	4	1	1	2	9	1	0	0	0	0	1	16	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	35			
SCHOOL OF HUMANITIES AND SOCIA	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	7			
SUBTOTAL	13	64	13	17	32	139	1	1	0	0	4	11	65	1	12	6	1	19	10	7	2	0	0	76	0	0	0	12	367			
SLOAN SCHOOL OF MANAGEMENT																																					
ORGANIZATIONAL LEARNING CENTER	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
SLOAN SCHOOL OF MANAGEMENT	3	44	10	3	24	84	0	0	2	0	4	15	4	0	0	0	1	0	3	7	5	4	0	18	0	1	0	2	150			
SUBTOTAL	3	44	10	3	24	84	0	0	2	0	4	16	4	0	0	0	1	0	3	7	5	4	0	18	0	1	0	2	151		82	71
SCHOOL OF SCIENCE																																					
BIOLOGY, DEPARTMENT OF	3	27	4	3	10	47	0	0	0	0	10	1	0	0	7	30	71	0	51	1	0	1	0	5	0	13	0	2	239			77
BRAIN AND COGNITIVE SCIENCES,	1	15	0	2	5	23	0	0	0	0	1	0	4	0	2	9	22	0	14	0	1	0	1	2	0	5	0	0	84		10	7
CENTER FOR CANCER RESEARCH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	35	2	34	0	0	0	0	3	0	7	0	5	105			
CENTER FOR SPACE RESEARCH	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	6	1	0	4	1	0	0	0	0	0	2	0	0	16			
CHEMISTRY, DEPARTMENT OF	2	19	1	0	4	26	0	0	0	0	4	0	1	0	0	33	44	0	6	1	1	1	0	1	0	13	0	5	136		47	99
EARTH, ATMOSPHERIC, & PLANETAR	2	28	2	3	3	38	0	0	1	0	1	1	0	2	0	22	13	0	10	6	0	1	0	0	0	16	0	1	112		19	81
EXPERIMENTAL STUDY GROUP	0	0	0	0	0	0	0	0	0	0	0	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7			
LABORATORY FOR NUCLEAR SCIENCE	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	18	2	0	5	0	0	0	0	0	0	31	0	6	67			
MATHEMATICS, DEPARTMENT OF	1	33	0	5	10	49	0	0	0	0	0	0	5	34	0	0	10	0	9	1	0	2	0	23	0	3	0	0	136		49	10
PHYSICS, DEPARTMENT OF	10	45	6	3	10	74	0	0	6	0	13	0	1	0	8	8	8	0	2	3	0	0	0	3	0	13	0	0	139		29	180
SCHOOL OF SCIENCE	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1			
SPECTROSCOPY LABORATORY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	20	0	0	21			
SUBTOTAL	19	168	13	16	42	258	0	0	14	0	29	3	16	37	17	146	206	2	135	13	2	5	1	37	0	123	0	19	1063			
VICE PRESIDENT FOR HUMAN RESOURCES																																					
MEDICAL DEPARTMENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	152	152			
SUBTOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	152	152			
VICE PRESIDENT FOR RESEARCH AND DEAN FOR GRAD																																					
CENTER FOR ENVIRONMENTAL HEALT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0	5	0	0	10			
CENTER FOR MATERIALS SCIENCE A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	2	0	0	4			
CLINICAL RESEARCH CENTER	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	11	0	15	0	0	0	0	0	0	27	0	2	56			
DIVISION OF COMPARATIVE MEDICI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	12	0	6	26			
DIVISION OF TOXICOLOGY	1	1	0	1	3	6	0	0	1	0	1	0	1	0	0	8	10	0	3	1	0	0	0	0	0	3	0	0	34		3	14
ENERGY LABORATORY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	5	0	0	0	0	0	6	3	0	1	18			
FRANCIS BITTER MAGNET LABORATO	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	5	5	0	0	0	0	0	0	1	1	18	0	0	31			
HAYSTACK OBSERVATORY	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	0	0	0	0	5			
HRVD-MIT DIVISION OF HEALTH SC	1	3	2	0	0	6	0	0	2	0	1	1	2	1	0	9	17	1	10	0	0	0	0	9	1	8	0	75	143		5	80
NUCLEAR REACTOR LABORATORY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	5	0	0	0	0	0	0	11	0	1	18			
OPERATIONS RESEARCH CENTER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	0	0	5		3	23
PLASMA SCIENCE AND FUSION CENT	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	5	0	0	14	0	0	0	0	2	2	32	0	0	58			
RESEARCH LABORATORY OF ELECTRO	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	10	4	0	71	1	0	0	0	3	0	30	0	0	120			
SEA GRANT COLLEGE PROGRAM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	4	0	0	0	7			
TECHNOLOGY AND DEVELOPMENT PRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	2		3	19
WHITAKER COLLEGE OF HEALTH SCI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1			
SUBTOTAL	2	4	2	1	3	12	0	0	9	0	3	1	3	1	0	52	55	2	127	2	0	0	0	17	14	155	0	85	538			
VICE PRESIDENT, RESOURCE DEVEL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1			
DEAN UNDERGRAD EDUC																																					
AIR FORCE AEROSPACE STUDIES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0	0	0	6			
ATHLETIC DEPARTMENT	0	0	5	3	7	15	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	12	4	39			
CAMPUS ACTIVITIES COMPLEX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4			
MILITARY SCIENCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	1	0	0	0	0	0	0	0	1	7			
NAVAL SCIENCE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	1	0	0	0	0	0	0	0	0	11			
SUBTOTAL	0	0	5	3	7	15	0	0	0	0	0	0	0	8	24	0	0	0	0	3	0	0	0	0	0	0	12	5	67			
ADMINISTRATION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9			
GRAND TOTALS	80	486	83	87	180	916	10	4	36	5	105	89	166	48	69	318	304	38	377	47	20	10	8	226	51	356	12	315	3530	0	581	2197

*Other Academic Staff includes: Institute Professors Emeriti, Honorary Lecturers, Affiliated Artists, Postdoctoral Trainees, Visiting Senior Lecturers, Visiting Instructors

VICE PRESIDENT FOR INFORMATION SYSTEMS

Information Systems (IS) supports MIT's core missions of education, research, and service by ensuring that the Institute's information technology (I/T) resources are effectively, efficiently, and equitably maintained and applied. By partnering with customers to develop and deliver timely business solutions, and by partnering with vendors to influence and adapt their products and services, IS delivers consistent and reliable I/T products and services to the MIT community. IS engages its customers in a dialogue about the substance and rationale of I/T policy, procedures, and standards, and recognizes that IS staff are key resources enabling the delivery of I/T products and services.

Three years after the launch of I/T Transformation (Trans-I/T), it is clear that IS's evolution from a traditional functional organization to a process-centered, team-based one has taken longer than anticipated. However, recent experience has begun to show the benefits of the Trans-I/T design. IS is now seeing more effective application of MIT's I/T resources through increased staff mobility and concentrated team focus on I/T activities and initiatives throughout the Institute. IS is committed to continuing to learn its way into working in the new framework and to ensuring that the new framework works for us, for our customers, and for the Institute.

By the end of fiscal year 1998, IS staff had achieved an impressive range of accomplishments, some of which are highlighted in the reports which follow. This section presents an IS overview.

Work in IS is organized around three explicit elements: IS's customers, its work, and the skills of its staff.

- Leaders of I/T Practices advocate both on behalf of customers to IS and on behalf of IS to customers. The Practice directors promote and enable technology-based work at MIT. They assist the Institute community in identifying information technology needs and opportunities to use technology in education, research, and administration. The Practices also assist in planning for the effective use of I/T resources. Of particular note during the year is Academic Computing's support for the educational computing initiatives outlined in the MIT Educational Technology Council's Report and its work to understand student computer ownership patterns; Office Computing's work to promote a standard cross-platform administrative computing environment; and the Voice, Data, and Image Networking Practice's work to develop improved physical facilities from telephone closets to building cabling.

- As a process-centered organization, the work of developing and operating I/T products and services is the responsibility of five I/T Processes – Discovery, Delivery, Service, Support, and Integration. Highlights here include Institute-wide acceptance of "discovery" as the first step in developing new I/T applications, the delivery of an important set of web-based enterprise applications, the operation of a growing set of services and servers, and support of a larger, more sophisticated community of I/T customers. Use of MIT's I/T resources continues to grow as the I/T infrastructure is improved and expanded. Annually, the MIT community comes to IS with some 100,000 requests for help and service changes, ranging from upgrading telephone service to installing a new office computing environment to assisting faculty in using computers in their teaching.

- The I/T Competency Group concentrates on the skills dimension of Information Systems, working to provide a staff well-qualified to meet future work requirements. Of particular note is work to identify key employee satisfiers and dissatisfiers, to develop a common team staffing process, and to offer a growing selection of workshops that inform and develop staff.

Late in the year, IS was fortunate to add Allison F. Dolan to the I/T Leadership Team. Ms Dolan joined the Institute as Director, I/T Staff Development and Resource Management; in this capacity, she will lead the IS Competency Group.

More information about Information Systems and its work may be found on the World Wide Web at the following URL: http://web.mit.edu/is/

James D. Bruce

ACADEMIC COMPUTING PRACTICE

The Academic Computing Practice seeks to promote and enable MIT education through the effective use of information technology (I/T). Collaborating with I/T Process teams and in partnership with academic departments, the Academic Computing Practice provides widely distributed client-server computing designed to facilitate undergraduate education. This occurs primarily through the Athena Computing Environment, which is used by thousands of faculty, students, and staff each day, with over 10,000 different "logins" on peak days. Academic Computing also provides advocacy, training, documentation, and consulting services to support academic work. During FY 1998:

- The Academic Computing Practice continued its annual renewal of Athena equipment, purchasing workstations and peripherals to replace older equipment. This past year, 132 Sun SPARC5 workstations and seven new Quickstations were deployed to public Athena clusters. Academic Computing also participated in the commissioning of two New Media Center facilities: the Faculty Project Laboratory in Building N42, and the Foreign Language and Literature Satellite Center in Building 16.

- To support educational computing initiatives, the Academic Computing Practice deployed computers to academic department clusters, laboratories, and libraries, including the Hypermedia Teaching Facility. These deployments supported diverse projects: the integration of visualization segments in Chemistry subjects (Professors Christopher Cummins and Larry Stern) for lecture, demonstration, and interaction; work in Optical Astronomy subjects (Professor Stephen Slivan); courses in Civil and Environmental Engineering; advanced instruction in Electromagnetism (Professor Markus Zahn); and courses in Japanese language and Economics.

- As part of an effort by the Office of the Dean of Students and Undergraduate Education (ODSUE) to make instructional support resources visible and readily accessible to faculty, Academic Computing, in conjunction with other departments and offices, set up the Electronic Teaching Toolkit (http://web.mit.edu/faculty/ett), a "one-stop" information point for instructional resources.

- Academic Computing also facilitated several important initiatives. In collaboration with the Dean of Engineering's office, it coordinated the deployment of Intel-granted hardware and organized training for faculty and departments. Academic Computing also facilitated two new initiatives central to the development of a robust educational technology infrastructure, consistent with the recommendations of the MIT Educational Technology Council. The first project focuses on developing and supporting web-based environments for teaching and learning; the second focuses on exploring new networking technology and infrastructure services to facilitate the design and development of next-generation educational computing applications. Within IS, Academic Computing sponsored "Project Pismere" to develop a remotely-manageable, serially-reusable Windows NT environment. To understand the evolving student computing environment, Academic Computing researched peer institutions and surveyed students. This data led to the implementation of an experimental dormitory computing cluster in the McCormick and Burton-Conner houses in the summer 1998.

- During FY 1998, the Academic Computing Practice continued Crosstalk Forums to engage the academic community in issues related to technology and pedagogy. During the past year, Crosstalk topics included: Web-based environments for teaching and learning; the Next Generation Internet; integration of cross-platform technology in curricula; technology/teaching methods; an Instructional Management System (IMS); new models of student computing; and uses of technology in teaching foreign languages.

- Academic Computing hosted visitors from institutions in Malaysia, Singapore, Australia, England, Sweden, Germany, and Japan, as well as the United States. The Practice maintained relationships with external groups such as CAUSE, EDUCOM, the American Association for Higher Education, and IVY+, and with vendor partners such as Microsoft, IBM, SGI, Sun, Intel, and Steelcase. Under the auspices of this Practice, IS collaborated with various MIT agencies involved in delivering and supporting I/T applications for instruction, such as CAES, Media Services, and the MIT Libraries.

M. S. Vijay Kumar

OFFICE COMPUTING PRACTICE

During FY 1998, the Office Computing Practice continued its efforts to ensure that administrative computing customers and providers derive maximum value from MIT's information technology (I/T) resources. Collaborating with I/T Process teams and in partnership with administrative offices and departments, the Office Computing Practice worked to build constructive relationships with individuals and organizational units that share the Institute's administrative responsibilities towards its primary mission of research and education. The work of this Practice relies on a solid and current understanding of office computing needs, opportunities, and priorities. These are essential to discovering, implementing, and supporting the best applications of information technology for the administrative computing environment.

- In keeping with its primary purpose of advocating on behalf of customers to IS and on behalf of IS to customers, the Office Computing Practice devoted a substantial amount of time in FY 1998 to meeting with administrative customers to assess their I/T needs. Throughout the year, Office Computing met with most of the Administrative Officers from each of the Schools. These meetings were opportunities to exchange ideas, to address issues, and to promote a standard, cross-platform administrative computing environment. Discussions spanned work on-campus, off-campus, and between campus and colleagues on other campuses.

- Under the auspices of this Practice, IS collaborated with the MIT Audit Division, Libraries, Sloan School, and Student Services on I/T evaluations, recommendations, and decisions. IS provided knowledgeable resources to support I/T efforts within these offices, and encouraged various training initiatives to meet immediate and ongoing needs.

- Throughout the year, the Office Computing Practice continued to promote the I/T Partners program as a unique opportunity for IS's customers to reach IS and for IS to reach its customers. Participation in this group remained strong throughout the year, and biannual conferences were well attended. Recently, smaller informal luncheons were sponsored to bolster continuity and momentum between I/T Partners meetings, and to provide opportunity for critical announcements. In the future, timely announcements – particularly with regard to software acquisition, evaluation, recommendation, and deployment – will be a focus of this program.

- During FY 1998, the Office Computing Management Group (OCMG) grew as a forum for IS and other administrative I/T staff to meet, share ideas and information, discuss mutual concerns, and plan together for the future. In the coming year, the Office Computing Practice plans to generate greater interest in OCMG across MIT by inviting guests from within the Institute to quarterly meetings.

- To a large extent, MIT's reengineering initiative has meant a reexamination of MIT's business practices. Combined with shifting work demands, this has created a rapidly changing environment for the Institute's administrative processes. In response to the phased implementation of SAP, the Office Computing Practice continued in FY 1998 to emphasize readiness for SAP and other "mission critical" applications. Collaborating with administrative customers and IS teams in Service and Support, the Office Computing Practice participated in readiness-planning for MIT's departments, laboratories, and centers (DLCs), as well as the MIT Professional Learning Center. This effort included the deployment of over 500 new desktop computers, which were delivered by Service teams to DLCs with administrative software and networking installations as needed.

- In close collaboration with Service and Support teams, the Office Computing Practice sustained momentum for full support of the Windows NT operating system. This involved 2,500 negotiated NT License upgrades, as well as NT technical and end-user training.

- With collaboration throughout IS, the Office Computing Practice highlighted Year 2000 issues by raising awareness about hardware retention cycles and advocating software upgrades.

Theresa M. Regan

VOICE, DATA, AND IMAGE NETWORKING PRACTICE

The mission of the Voice, Data, and Image Networking Practice (VDI) is to ensure that the necessary information technology (I/T) systems and services are available to support academic, research, and administrative efforts at MIT. This includes working with IS Process owners and outside vendors to make sure current systems are accessible and have adequate capacity. In addition, this Practice helps identify new communications technologies and facilitates their availability to meet future needs.

During 1997–98, the Voice, Data, and Image Networking Practice focused on four areas:

- During the year, the VDI Practice participated in strategic meetings with both academic and administrative departments to exchange ideas, to address issues, and to assess their I/T needs. Based on meetings with student groups representing the Independent Living Groups (FSILGs) and on-campus residents, the VDI Practice sponsored IS initiatives to improve student services. Specifically, based on student feedback, Service teams upgraded MITnet bandwidth to most FSILGs to support new applications and increased demand. Student long-distance rates were restructured to offer a nine-cent per minute domestic rate during peak calling periods, as well as reduced international rates.

- Discussions continued with other administrative departments such as Physical Plant on how to improve planning and coordination of projects. During the year, IS worked with the Planning Office on a master plan for underground utilities on campus. In the coming year, VDI will also begin addressing the improvements needed in intrabuilding facilities, including wiring closets and cabling distribution systems. Under the auspices of this Practice, efforts continued to evaluate IS's cost recovery models, including the rates charged to individuals, departments, laboratories, and centers.

- During the year, the VDI Practice maintained relationships with external groups such as the Boston Consortium and IVY+, and with vendor partners such as AT&T. Under the auspices of VDI, MIT's AT&T contract was renewed, substantially reducing the Institute's costs for long-distance telephone service. Future contract negotiations will focus on reducing local telephone costs and containing the rising costs of Internet service.

- The VDI Practice continued to focus inward throughout the year to evaluate IS products and services, such as IS's Tether service and "Stopit" program. The VDI Practice also initiated regular staff meetings to parallel those of the Academic and Office Computing Practices, which focus on I/T issues that affect IS's customers.

Dennis Baron

I/T DISCOVERY PROCESS

The I/T Discovery Process promotes a shared vision of information technology (I/T) across the Institute. Discovery focuses on business analysis, best practices, data model and conceptual design, and resource commitments to ensure that projects are properly aligned at their outset. Discovery sets the stage for firmly sponsored commitments and an accelerated path for work in the Delivery, Integration, Service, and Support processes. As an established method for linking I/T to business strategies and customer needs, Discovery seeks to reinforce the shared nature of I/T work across the Institute.

In its third year of work, Discovery has become more visible and familiar to the MIT community. Discovery services have been actively sought by academic, office, and research business units, and the concept and terminology of "discovery" has become understood across campus. During FY 1998, there were over twenty-five projects with a Discovery component:

- As an I/T service provided by IS, Discovery was used by a number of departments across campus, even when the Delivery work was accomplished through local I/T units. Discovery projects, such as the new Web search engine for MIT and a web-based conferencing system for Academic Computing and for Alumni, provided consistent, reliable I/T products and services to the MIT community.

- The essence of Discovery is collaborative partnerships with customers for solutions. During FY 1998, Discovery worked with the Technology Licensing Office to identify approaches for efficient document handling; the Libraries to design an electronic reserves system; the Hypermedia Teaching Facility to define sustainable, supportable web environments; Alumni Networked Services to design and implement an alumni on-line directory; Mail Services to design a publication and mail-list maintenance facility for end-user self-service; MIT Parking to select and implement a new parking application; the MIT Office of Corporate Relations to redesign their knowledge base; and the Communications Office to design an MIT on-line organizational ("Blue Pages") directory and to help envision the MIT Course Catalog of the future.

- To ensure that recommendations result in the effective use of I/T resources, Discovery projects helped improve work processes and align IS efforts with Institute priorities. Some of these projects included: the redesign of the IS software licensing process; planning and assessment for the Year 2000 at MIT; Project Pismere (which is an outgrowth of the Council on Educational Technology Report, in response to growing academic computing requirements to provide Athena services on Windows NT machines); and facilitation of a strategic planning initiative for MIT Physical Plant.

- Discovery work often means working in partnership with vendors for products and services. To complete the Discovery portion of the NECX/ECAT2 project, Discovery worked closely with MIT's preferred desktop-platform provider, NECX, and with MIT's technology partners, Dell, Apple, Sun, and SGI. Throughout the Calendaring/Scheduling project (which is viewed as a key initiative by external I/T organizations, and is an important part of MIT's I/T infrastructure), Discovery worked productively with On Technologies and with Crosswinds Technology. To scope "Project Pismere," Discovery teams partnered with Microsoft to provide secure, scaleable academic computing services in the Windows NT environment.

In FY 1998, Discovery efforts continued to normalize and follow a consistent flow through the IS work processes, ensuring that quality I/T products and services were delivered to MIT.

Greg Anderson

I/T DELIVERY PROCESS

The I/T Delivery Process exists so that MIT and its schools, departments, laboratories, and centers can realize business value as rapidly as possible from the implementation of new information technology (I/T) products and services. Delivery work is organized exclusively into projects. Each Delivery project typically is launched after a Discovery project has qualified the business case and determined a technical approach. Currently, there are sixteen active Delivery projects; eleven others were successfully completed in FY 1998, and one more was terminated due to a reorganization. Highlights of the past year include:

- This past year saw a continuation of the trend toward Web-based applications. The SAPweb effort, which allows web access to SAP purchasing data, was enhanced by the inclusion of accounting data for purchasing transactions. Its use grew past 1,000 accesses per week, while the Purchasing Office saw time-consuming telephone inquiries almost disappear. By fiscal year-end, the secure web-conferencing package "Web Crossing," was being tested for use by the Alumni Office and selected academic departments. A third Electronic Catalog (ECAT) vendor, BOC Gases, was added to MIT's initial web-based electronic commerce system, and Delivery work began on ECAT2, a more sophisticated, standards-based successor to the original ECAT. Working with NECX, the third largest computer retailer in the country, the ECAT2 Delivery team employed industry-standard X.509 Digital Certificates for user identification, the new OBI (Open Buying Interface) specification for "shopping basket" information, and industry-standard EDI transactions for exchange of ordering and invoice data with vendors.

- Much Delivery effort was devoted in FY 1998 to support the rollout of SAP and related activities. IS is deeply involved in sixteen of the "Rollout98" initiatives. Besides the web projects mentioned above, IS contributed to the successful pilot of the MIT credit card and to the initial implementation of the iXOS imaging system, both of which are important to SAP purchasing and processing. The Physical Plant conversion to SAP is now fully underway, with separate conversions planned for each major business area. IS's largest single Rollout98 project

involves expanding the MIT Data Warehouse, which currently stores data from SAP, the Office of Sponsored Programs (OSP), Personnel, and several other MIT areas.

- Delivery teams were involved in several other system deployments during FY 1998. Delivery completed almost all development work on OSP's COEUS system, which will be deployed later in calendar 1998 to research desktops throughout MIT and kindred institutions. IS was also involved in the deployment of the new Adonis system for Alumni, Resource Development, and the Treasurer's Offices.

- Based on a Discovery team's recent assessment of MIT's Year 2000 exposure, a Delivery Team was formed to inform and work with the community to solve the "millennium bug." A significant subset of 143 recently-surveyed legacy computer applications, plus many other MIT forms and procedures, will require modification.

- The Athena infrastructure was significantly improved during FY 1998. Besides the new 8.1 Athena release for all users, the Athena-wide file system was also upgraded, allowing the deployment of a new backup system. Athena code maintenance was standardized and simplified, which will facilitate upcoming Delivery work on Project Pismere. Delivery teams began an on-line pilot thesis submission and access project, drawing on the experience of the almost-concluded Computer Science Technical Report project, which is a collaboration of the Laboratory for Computer Science (LCS), IS, and the MIT Libraries.

- Several new tools and training opportunities were offered to MIT's Delivery developers during FY 1998. Training courses for SAP and Windows NT developers were held on campus. The IS-developed Project Database was introduced to record most I/T project work. Also, MIT is now enrolled as a Corporate Member of the Project Management Institute (PMI), which provides a variety of project resources for interested MIT employees. Despite a very competitive employment market, staffing in Delivery has increased to almost full strength, ensuring that Delivery is certainly "open for business."

Robert V. Ferrara

I/T SERVICE PROCESS

The core mission of the I/T Service Process is to manage MIT's information technology infrastructure reliably and efficiently. This infrastructure includes the data center in W91, MITnet, telephone and related services, the Athena Computing Environment, database services, and desktop maintenance (PC repair) services. During the past year, I/T Service teams in each of these areas reached significant milestones.

- In FY 1998, the number of administrative servers grew by approximately 25% to a total of 60 servers in the data center. The average availability of these servers for the year was 99.76%. Substantial efforts were made to integrate SAP production processing with the legacy production environment, and to provide enhancements to the SAP environment in areas such as web access and electronic data interchange. MIT's data center infrastructure was significantly enhanced this year with the installation of an emergency backup power system.

- This past year saw the rollout of higher-speed access to MITnet from individual buildings and desktops. New building construction facilitated the installation of Fast Ethernet (100Mb/sec) connections to desktops. IS significantly improved Internet access for off-campus living groups. As part of the Internet2 project, Service teams worked with other New England academic institutions to plan a regional high-speed Internet "gigaPoP," and Service teams participated in the "Abilene" high-speed network project. It is expected that MIT will be connected to NSF's "vBNS" high-speed national backbone network early in FY 1999 and to the Abilene network early in calendar 1999.

- The 5ESS Service Team continued to improve the reliability and efficiency of the 5ESS, voice mail, and automatic call distribution (ACD) switches by performing major software upgrades. Resources on the 5ESS were expanded by adding 2,560 ISDN and 384 analog lines. The trunks carrying MIT's local traffic were replaced with a more robust digital service, which also provides Caller ID to the campus. During the past year, Service teams provided MITnet and 5ESS telephone service to newly-constructed or renovated buildings around MIT, including Buildings E60 and N42, 351-355 Massachusetts Avenue, and 864 Main Street.

- The Athena Software Service team continued to transition the Athena software suite and approach to new operating systems and hardware. Supporting new Athena systems has become increasingly difficult as the market has changed so that new hardware may arrive with incompatible operating systems.

- Athena Server Operations (ASO) continued to upgrade older servers and significantly increase AFS disk space to support a growing number of user files, in addition to the space required for MIT's World Wide Web presence. ASO also continues to support SAP by providing the infrastructure for over 450 SAP printers.

- Athena Cluster and PC Services deployed over 340 systems in support of the "Technology for Education 2000" grant from Intel, in addition to deploying SAP-related desktops. Individuals from both Athena Cluster and PC Services were trained and certified to work with Dell platforms. Also, these teams participated in the pilot of dormitory Athena Clusters.

- The Database Services Team worked with the Institute's major administrative departments to maintain over 90 databases supporting SAP, Admissions, Alumni, Payroll, Pension, Personnel, and IS-Telecommunications, among others.

Roger A. Roach

I/T SUPPORT PROCESS

The core mission of the I/T Support Process is the effective and efficient delivery of high-quality support services to the Institute's information technology users. Support is provided by a variety of standing teams: I/T Help Desk; Business Liaison Team; the MIT Computer Connection (MCC); Training and Publications; Desktop Products; Adaptive Technology Support (ATIC Lab); Departmental Computing Support (DCS); Campuswide Information Systems Support (CWIS); Athena Help/Residential Computing Consulting; Academic Computing Support; 5ESS Support; and Support Team Headquarters. Customer support is provided via e-mail and the Web, by telephone, at the customer site (including dormitories and FSILGs), or through walk-in service in several locations.

To better identify and refine support services, Support team members work to improve the help process by listening carefully to customers and balancing customer feedback with Institute goals and resource availability. While focused on different aspects of users' needs, the highly qualified staff on these teams share a common commitment to the I/T Support mission. During 1997–98:

- The MIT Computer Connection (MCC) successfully launched a joint venture with NECX to enable customers to purchase computing and networking hardware and software electronically. This resulted in a significant reduction of MCC staff and marked an important new phase of an ongoing effort to streamline this process. In its first year of operation, this joint venture realized over $8 million in sales, and sales volume continues to increase steadily.

- The Business Liaison Team, composed of staff with both technical and business skills, was formed to focus on providing rapid response and consulting services to administrative customers. In addition to high-priority support for SAP rollout, the Business Liaison Team supports other major systems, such as the Data Warehouse.

- *Casetracker*, a new suite of network-based help tools, was deployed to provide a more integrated approach to tracking customer logs, and to aid in the timely resolution of customer problems.

- Several customer assistance teams relocated to Building N42. A unified location for user accounts, walk-in help for both academic and administrative users, Quickstart training classes, the Athena test cluster, New Media Centers, and CWIS consulting assistance now provides "one-stop shopping" for many customer needs.

William F. Hogue

I/T INTEGRATION PROCESS

The mission of I/T Integration is to implement an information technology infrastructure that has high levels of reliability, availability, and serviceability; provides excellent price/performance; meets current MIT needs and can quickly adapt to meet future needs; and enables the effective performance of the other I/T processes. During the past year, teams working in the Integration Process made progress on several fronts:

- The Integration Team worked to educate software designers about MIT's current and new I/T infrastructure and new directions. The lunch seminar series begun in FY 1996, which draws 30–80 MIT developers per session, continued with topics including: Java and Java Script; electronic data interchange (EDI); database web access; MIT ID server; "Roles" database; server security; MIT Data Warehouse design; and SAPweb interface.

- Integration standing teams also acted as consultants for designers and developers. Over the past year, Data Administrators helped with data modeling for new systems, and Integration team members reviewed and advised on designs for new systems. This year, significant progress was made in increasing usage of current infrastructure applications such as Kerberos V5 and MIT certificates for authentication, the MIT Data Warehouse to share and access data, the MIT ID server to check for people who already have MIT ID numbers, and additional uses of Oracle databases. Strategies like shared training, web pages aimed at MIT's software developer community, seminars on I/T infrastructure and security issues, consulting with MIT developers and outside contractors, and project reviews exemplify Integration's ongoing education efforts.

- Integration project teams worked both to update current I/T infrastructure components and to build new ones. This year the Brio Query tool, selected primarily to view data in the MIT Data Warehouse, was deployed to the MIT community. Software and user support to allow a registered MITnet user to access MITnet easily from a portable desktop in different locations (called "dynamic IP addressing" or DHCP) was provided to the community. Last fall, a team composed of staff from IS and Student Services altered the registration process for new students to protect sensitive student data available on-line during registration. The "Roles" database, a new infrastructure service, was built and deployed to allow distributed access and maintenance of authorizations for multiple applications to appropriate staff in DLCs. Working with two Delivery teams, Roles was deployed for both graduate awards and SAP during FY 1998.

- One goal of the Integration process is to propagate MIT technology strategically to vendors of commercial products and to other users outside MIT. By exerting influence in strategic areas, such as network security in open-network environments, MIT has the opportunity in the future to buy (rather than build) its preferred I/T infrastructure components and applications. To encourage a standard for network security, the Integration Process continued to make Kerberos Version 5 freely available beyond MIT in FY 1998, worked with commercial vendors to ensure that products incorporating Kerberos would interoperate, and helped organizations outside MIT learn about and use Kerberos. MIT developers continue to attempt to influence Microsoft into incorporating a version of Kerberos into their next operating system, Windows NT 5. Similarly, Integration team members are working to influence Apple to incorporate MIT's requirements in their next operating system, Oracle to continue to support secure access to databases from the Macintosh desktop, and SAP AG to support the use of strong authentication and encryption using X.509 certificates in the design of their Internet Transaction Server (ITS).

- The "I/T watch" subprocess is designed to track technology directions. During FY 1998, Integration team members tracked changes in web development tools, object-oriented technology, and Corba developments. Integration staff also examined Java as a possible new piece of MIT's I/T infrastructure, as well as Apple's new Rhapsody operating system.

Susan S. Minai-Azary

I/T COMPETENCY GROUPS

The I/T Competency Group (CG) is responsible for ensuring that IS has the right people in the right jobs, with the right technical and behavioral competencies, at the right time.

Due to personnel departures in late FY 1997, IS did not have a Competency Group Director for most of FY 1998. Greg Anderson, interim CG director, led the Competency Group Planning Team, which was chartered to develop a direction for the competency concept and to provide staffing recommendations for the CG Team leadership. Based on the planning team's recommendations, IS posted the position of Director, I/T Staff Development and Resource Management, in November 1997. Over 100 resumes were received in response to general advertising and a targeted mailing to the participants of an "HR for IS" Conference. Three candidates were screened via telephone interviews, and two candidates were invited to interview on campus. Based on a competency-based interview process, each candidate met with the I/T Leadership Team as a group, the two current members of the CG Team, several IS team leaders, and IS staff, as well as an Human Resources Practice Development (HRPD) team representative. The selected candidate had a strong I/T background, as well as the requisite behavioral competencies. The new Director, Allison F. Dolan, arrived in IS on April 6, 1998.

Although they lacked a full-time director for much of the year, CG maintained a number of processes and programs focused on recruiting, retention, training and development, and performance management. In addition, CG continued to be an interface to Personnel and an internal focal point for IS employee relations.

- During FY 1998, IS experienced a 9% attrition rate, with the loss of several key personnel. The most common reason for leaving was pay inequity; the I/T industry has experienced significant average pay increases (5–8% average; upwards of 10% for scarce skills). To retain staff, IS employed a number of tactics, including several off-cycle pay increases, and hired new staff at higher salary levels. In addition, IS participated in a "Hot Technologies Survey." Combined with other data, the results of this survey will be used to review IS compensation more systematically. Since recruiting and retention is not limited to pay, CG also conducted current-staff interviews and staff-exit interviews to understand why people stay in IS and why they leave.

- Late in FY 1998, CG designed and implemented a "Team Staffing" process – a highly collaborative process involving I/T Process directors (who provide technical details) and CG (who provide input and process facilitation). First used in staffing the MIT-wide Year 2000 (Y2K) team, this documented process has been received positively because it encourages wide involvement, a diverse candidate pool, and a relatively short cycle-time.

- CG sponsored or participated in a number of activities designed to inform and/or develop skills in IS. These included: an MIT-wide SAPWeb Knowledge Transfer Seminar; an Intel-sponsored, MIT-wide, three-day Windows NT training course; a series of one-hour Coaching Brown Bag Luncheons; a follow-up Coaching workshop for IS staff; seminars for sharing conference learnings and understanding networking; an MIT-wide, three-day course on *Usability Testing of Computer User Interfaces and Documentation*; and Oracle training for IS staff. With IS's Personnel Officer, CG continued to promote competency-based interviewing by presenting two workshops to non-IS departments, as well as designing and piloting the process and instrument to support individual behavioral and technical competency self-assessment. CG also contributed 20% of an EFT to the HRPD Performance Management and Coaching sub-team.

- Also, a modified Performance Appraisal process was introduced in FY 1998, in which the 5-point rating scale was simplified to three levels: "exceeds expectations," "meets expectations," and "below expectations." Staff who rated "below expectations" were expected to document a development plan. Focus groups were used at the end of the performance review process to solicit input for modifications to the FY 1999 process.

Allison F. Dolan

VICE PRESIDENT FOR RESOURCE DEVELOPMENT

For the third consecutive year, private support to the Institute set new records. Built on a tradition of partnership with all of MIT's donor constituencies, this past year's dramatic growth in gifts from alumni and friends, and continued support from corporations and foundations, provided a strong beginning for the first year of the silent phase of a new capital campaign.

The capital campaign planned for the years ahead will be the fifth in MIT's history. Following past practice, the campaign will encompass a two year quiet phase of planning and fund raising, followed by a five year public effort. In general, the keys to the success of such initiatives are built on the strength of principal giving, defined at MIT as gifts from individuals, corporations and foundations of $1M or more, as well as broad based support from alumni and friends at all levels of participation. Campaigns serve as a vehicle to help institutions articulate goals and secure funding for critically important priorities, and in so doing, raise the philanthropic sights of the donors.

Several internal efforts helped lay the groundwork for this first campaign year. With the completion of the academic priority setting process by the Provost, the deans, the department heads and the faculty, Resource Development moved ahead on several fronts with regard to structure and organization of a campaign. Fund raising counsel from Marts and Lundy was retained to help advise Resource Development in the early preparatory stages; the position of Director of Resource Development was created to oversee development operations; and the conversion of the database neared completion. Working groups developed key strategic recommendations regarding campaign timing, goal, size of the nucleus fund, potential of the prospect pool, volunteer structure, and the critical next steps to complete in the twelve to eighteen months remaining before the public announcement. As the work in each of these areas continues into FY 99, the final timeline, goal and size of the nucleus fund will be determined in collaboration with the Alumni/ae Association, and with the guidance of the senior officers, the Executive Committee and the Corporation.

During the year, there were 13 promotions in Resource Development (6 men and 7 women, including 1 Asian American woman). In addition, 11 open staff positions were filled including 6 women and 1 Asian American. Resource Development continued its effort to fill positions with qualified women and minority candidates by working closely with Personnel and others to identify new resources of applicants. Once again, Resource Development hosted a minority intern from CASE (Council for the Advancement and Support of Education) which will continue into FY 99.

Private support for Fiscal Year 1998 totaled $143.9 million, including the following: $137.1 million in gifts, grants, and bequests, and $6.8 million in support through membership in the Industrial Liaison Program. The total compares with $133.6 million in 1997, $130.9 million in 1996, $108.9 million in 1995, and $94.5 million in 1994. Gifts-in-kind for the past year (principally gifts of equipment) were valued at $8.3 million.

Sources of gifts for Fiscal Year 1998 were: alumni, $42 million; non-alumni friends, $38 million; corporations, corporate foundations, and trade associations, $30 million; foundations and charitable trusts, $25.9 million; and others, $1.2 million.

Donors designated expendable and endowed funds as follows: unrestricted, $16.8 million; departments, $49.7 million; faculty salaries, $9.8 million; graduate student aid, $7.3 million; undergraduate student aid, $14 million; building construction funds, $31 million; and other funds $8.5 million.

More information about giving opportunities at MIT can be found on the World Wide Web at the following URL: http://web.mit.edu/giving

Barbara G. Stowe

OFFICE OF INDIVIDUAL GIVING

Directed by H.E. (George) Ramonat, the Office of Individual Giving, in partnership with the senior officers, the Corporation Development Committee, key volunteers, faculty, and the reunion gift program, continued to cultivate, solicit, and steward individual prospects and donors of the Institute.

The Corporation Development Committee assisted the senior officers and staffs of Resource Development and the Alumni Association in developing an overall campaign strategy and timetable at its annual meeting in November 1997 and at the Advisory Group meeting in April 1998.

The field officers, in addition to working to increase the individual gift stream, also engaged in activities to better prepare the Institute to execute a major campaign over the next six years. The entire fund raising staff participated in task forces dedicated to campaign planning. Of greatest importance were efforts undertaken to increase the compliment of working volunteers, analyze the potential of the prospect pool, and create development opportunities enabling individuals to contribute approximately $1 billion to MIT during the course of the campaign.

H. E. Ramonat

OFFICE OF PRINCIPAL GIFTS

Directed by Lucy Miller, this year the efforts of the Office of Principal Gifts were dedicated to deepening and broadening the pool of donors at the principal gift level in preparation for a campaign. The office continued to support the President's Council, which was established last year by President Vest to gather the perspectives of a small group of close alumni/ae and friends on the directions MIT is taking as it moves into the next century. Two meetings of the President's Council took place in this fiscal year.

With the support of this office and the Office of Individual Giving, the President visited over 80 alumni/ae and friends to share his views on the need for a capital campaign and to seek their reactions to the probable priorities for a campaign. This gathered important perspectives for Resource Development and the President about shaping campaign themes and priorities.

The staff of the office made a concerted effort to increase the number of prospects for gifts of over $1M during a campaign and succeeded in increasing the qualified prospect pool by almost 20%.

Several important multi-million dollar commitments were received this year in support of the Computing, Information and Intelligence Sciences building, as well as the Department of Materials Science and Engineering.

Lucy V. Miller

OFFICE OF COMMUNICATIONS AND DONOR RELATIONS

This office, known as COMDOR, is headed by Elizabeth Harding. It provides editorial and event planning support for the fund raising staff and coordinates major gift stewardship at MIT.

In a year long partnership with the President, COMDOR laid the groundwork for developing a draft campaign prospectus. Through an analysis of Institute-wide speeches, articles, publications and internal reports, key thematic messages were identified and discussed with senior officers, the faculty, key alumni and volunteers.

COMDOR continued to publish *Spectrum*, a 16-page tabloid newspaper with a circulation of over 30,000 MIT donors, faculty and staff. A World Wide Web site titled, *Giving to MIT*, went on-line in the fall of 1997. The staff once again produced eight full-page advertisements in *Technology Review* profiling alumni/ae who have established life income funds.

Stewardship activities included the coordination of letters of appreciation from the President and the Chairman to major donors to the Institute. In addition, the staff continued to serve as a clearinghouse for the approval and

production of all plaques mounted within MIT to commemorate either gifts or the special service of faculty and staff.

COMDOR continued to refine and expand systematic stewardship programs for scholarships and UROP and to facilitate fund raising for financial aid. An overall assessment of the desirability and effectiveness of a donor recognition program for major donors was initiated.

The Office of Events within COMDOR helped to organize 60 Resource Development events, including spring and fall Campus Visits, a series that introduces donors and prospective donors to current research and educational programs in two-day visits to campus.

Elizabeth T. Harding

OFFICE OF DEVELOPMENT RESEARCH AND SYSTEMS

Under the direction of Shelley Brown, the Office of Development Research and Systems continued to provide research and information systems support to Resource Development.

The office focused on several major objectives for this fiscal year: a successful conversion to a new alumni database, scheduled for implementation at the start of Fiscal Year 1999; a comprehensive research effort to expand and refine the pool of potential major donors to the Institute; an analysis of the Institute's fund raising potential for the next seven years; and, a technology strategy for the department. These objectives were accomplished as part of a multi-year strategy to ready the department for the upcoming capital campaign.

Along with the initiatives geared toward campaign readiness, work as usual continued in support of ongoing fund raising efforts. The staff prepared over 260 research backups for senior officer development activity, and provided research support to the staff of the Office of Individual Giving. They also developed several new reports documenting MIT's impact on particular geographic areas and industries, including a comprehensive analysis of the role played by the research university in the development of the Internet. The programming staff divided their time between conversion activity and maintaining the current database, with particular responsibility for the gift and prospect systems.

Shelley Brown

OFFICE OF FOUNDATION RELATIONS AND SCHOOL DEVELOPMENT SERVICES

Under the direction of John S. Wilson, gifts from private foundations for this fiscal year totaled more than $27M million, up 9% from FY 97, and continued to provide significant support for MIT's educational and research programs. Major grants or pledges were received in support of the Starr Asian Internship Program, the W.M. Keck Foundation Neural Prosthesis Research Center, the Lemelson-MIT Awards Program, Howard Hughes Institute Biomedical Research Program, a Whitaker Foundation Biomedical Engineering Special Opportunities Award, the V. Kann Rasmussen Energy Choices Fund, and the Museum Art Loan Project.

The Office of School Development Services (OSDS) provided research and support for the fund raising efforts of the five schools and the Office of Academic Development, while continuing to maintain and update the full series of academic department profiles for each school and running an FYI series for Resource Development. Additional selected efforts included: supporting the annual meeting of the Alliance for Global Sustainability; helping to oversee the inauguration of the Dean's Council for the School of Humanities and Social Sciences and organizing the School's first telethon and mailing to benefit the Chinese Language and Culture Program; managing the fund raising program for the Teaching Laboratory for Complex Systems of the Department of Aeronautics and Astronautics in the School of Engineering; managing an event to honor the corporate donor and inaugural recipients of a new fellowship in Mathematics for the School of Science; soliciting four alumni on behalf of the Sloan School of Management and coordinating a staff of eight volunteers for the fall 1997 Campus Visit; and researching and

qualifying corporate prospects to participate in the first brainstorming session for the House_*n* (house of the future) consortium for the School of Architecture.

John S. Wilson, Jr.

OFFICE OF CORPORATE RELATIONS

Under the direction of Acting Director Karl F. Koster, the Office of Corporate Relations (OCR) supported efforts of the faculty and senior administrators to forge new, corporate partnerships; staffed Institute and international initiatives; identified and pursued corporate support for discrete MIT research and educational programs; and maintained the health of the Industrial Liaison Program (ILP) which will celebrate its fiftieth anniversary in FY 99. OCR continued to benchmark the competition and assess internal strengths and weaknesses as part of a formal strategic planning process. In FY98, corporate cash gifts totaled $30 million; ILP revenues were $6.8 million; and OCR staff helped raise an additional $30 million in revenues for the Institute.

Through support of senior faculty and administrative leaders, the development of strategic partnerships with key corporations continued. Ford Motor Company signed a major, 5-year agreement to fund the establishment of an environmental consortium and various research activities. NTT signed a multi-year, multi-million dollar research agreement to support innovative research in artificial intelligence and computer science. Earlier partnership agreements with Amgen and Merck showed growing levels of commitment, while a number of other partnership agreements were explored and negotiated.

OCR also continued to support Institute initiatives on the environment, for product development, in support of buildings, etc. As a result, Norsk Hydro joined the Environmental Challenges Consortium at $500,000 per year; three new member companies committed $1.5 million over 5 years to the Center for Innovation and Product Development; Lockheed-Martin pledged $1 million for the CIIS building; and support for multi-million dollar programs in Argentina, Brazil, Singapore, Spain, Taiwan, and Thailand was provided.

On behalf of MIT consortia and faculty, OCR worked to establish collaborative relationships with corporations. Selected results include: a $1 million commitment from TDK to sponsor 3DP Technology research over the next 2 years; two agreements between Saudi Aramco and the Earth Resources Laboratory totaling $1.5 million; and Telia's five year commitment to the Media Lab's Digital Life Consortium. OCR also worked to develop contacts and programs with smaller, local, high-tech companies, although developing financially self-supporting programs that provide perceived value to this market segment over the short-term remain problematic.

The Industrial Liaison Program (ILP) remains a mechanism for companies, at a reasonable fee, to participate broadly in the MIT community while allowing the faculty to access and leverage these relationships on behalf of MIT. With a focus on customer service and increasing the membership base, fourteen new companies from around the world joined the ILP in FY 98. Industry sectors ranged from telecommunications and electronics to specialty chemicals and materials.

More information about the Office of Corporate Relations/ILP can be found on the World Wide Web at the following URL: http://ilp.mit.edu/

Karl F. Koster

ASSOCIATION OF ALUMNI AND ALUMNAE OF MIT

At the close of FY 98 the Alumni Association has much to celebrate. This year will be remembered the best Alumni Fund year to date. Highlights include total dollars of $28.7 million, $2.1 million ahead of FY97; total donors of 30,815, for the fifth consecutive year of increased donor numbers; and a 48% increase in parent donors. On a world tour, Robert M. Metcalfe '68, Association president, visited cities from Hong Kong to Chicago to Oslo, speaking before nearly 4,000 alumni and guests. Our Alumni Network Services program reports a one-year 130% increase – 15,000 at year end – in number of registered users of E-mail Forwarding for Life. The Association magazine was re-launched with the May/June issue as *Technology Review, MIT's Magazine of Innovation.* We initiated a successful MIT On The Road program with seminars in Sanibel, Florida, and New York City. Three pilot programs involving alumni with faculty and students in MIT's classrooms were conducted. And our alumni and staff met the challenges of Tech Week and reunions with President Clinton as commencement speaker. Altogether, nearly 18,000 alumni, parents, students and their guests attended Association-sponsored activities this year.

During FY 98, alumni volunteers and staff have worked together toward achieving results in each of these strategic priority areas: the Alumni Fund and its goals; *Technology Review* and its objectives for growth; alumni services, especially alumni network services; alumni, student and faculty partnerships in teaching and research; and alumni database client-server conversion. Outcomes in each of these areas will be elaborated upon in the report, which follows. The first section documents the successful volunteer partnership and support which is the hallmark of the Association's work. The report continues with more detail on Alumni Fund results, on the *Technology Review* re-launch, on Alumni Network Services and the Association's increasing use of the Internet to meet objectives, on alumni programs and services at MIT and worldwide, and finally on the important support functions including Alumni Information Services and other Association print publications.

VOLUNTEER PARTNERSHIPS

Led by Robert M. Metcalfe '68, Association president, more than 3,800 volunteers worked on behalf of MIT this year including nearly 300 alumni serving as members of the Corporation and its visiting committees, more than 400 working on a successful Tech Week/reunions program, and 700 serving as officers in 94 clubs and five affinity groups worldwide.

The most essential partnership is the shared leadership between the chief volunteer and the executive vice president. This year it has been a rare opportunity to be able to work with such an accomplished individual as Robert M. Metcalfe '68, inventor of ethernet, founder of 3Com and renowned technology pundit. His contributions to the success of the Association this year have ranged from his suggestion to bring more alumni into the classroom, to his visits to cities around the world talking with MIT groups about his professional expertise, the future of the Internet, and encouraging alumni to become involved with MIT. The impact of his participation in the *Technology Review* Board during this key year in which the magazine has been reinvented cannot be exaggerated. Perhaps it goes without saying that the staff benefited greatly from his personal contributions. Like each MIT volunteer, Metcalfe has brought to the table unique skills and exceptional talent, and through the thoughtful exercise of each, he brought even this excellent staff to new levels of accomplishment.

Metcalfe chose to focus the Alumni Leadership Conference (ALC) on the theme of alumni involvement in teaching and learning at MIT. Held on September 20, the program "Enriching the MIT Experience: Alumni, Faculty and Student Partnerships" was introduced by Metcalfe. He asserted that MIT must use more effectively the tremendous resource of its alumni to add value to an MIT education. Metcalfe carried this theme around the world during the year to very favorable reaction. Speakers for the plenary session included Provost Joel Moses MA '67, Professors Woodie Flowers ME '73, Arthur Steinberg, Glen Urban, Dean of the MIT Sloan School of Management, and Rosalind Williams, Dean of Students and Undergraduate Education.

An annual feature at the luncheon during the ALC is the presentation of the Association awards for outstanding volunteer leadership and performance. Honorary memberships were presented at the Technology Day luncheon on June 7, 1997 and recognized again at the ALC awards luncheon.

Bronze Beaver Award for distinguished service to MIT, the highest Association recognition honor: Albert M. Bottoms MT '62, Alexander W. Dreyfoos, Jr. '54, William L. Maini '51, Hyun-A C. Park '83

Harold E. Lobdell '17 Distinguished Service Award for sustained alumni relations service of special depth: Bruce A. Blomstrom '59, M. William Dix, Jr. '67, Richard R. Lowe CP'61, Martha A. Margowsky SL '78, Royal Sterling '23

George B. Morgan '20 Award for excellence in service to the Educational Council: Donald S. Callahan '58, Charles W. Johnson CE '55, Harry G. Jones '48, Jill J. Wittels '70

Henry B. Kane '24 Award for exceptional fundraising service and accomplishment: W. Gordon Bowie '29, Brian G. R. Hughes '77, George P. Palo '28, Richard F. Shea '24

Presidential Citation Award given to alumni volunteer groups for distinguished service: AMITA/Maragaret L. MacVicar '65 Oral History Project, Committee on Alumni Online Communications, MIT Club of Washington Seminar Series, MIT Club of New York

Honorary Membership: Samuel Jay Keyser, Barbara Gunderson Stowe, Kathryn Adams Willmore

The National Selection Committee (NSC), chaired by Richard A. Jacobs '56, named the following alumni to MIT and Association governance positions.

MIT Corporation for five-year terms: Glen V. Dorflinger '46, John W. Jarve, Jr. '78, Robert M. Metcalfe '68

Association president-select to serve as president FY99: John A. Morefield '56

Association vice presidents for two-year terms: Bradford Bates '59, Jorge Rodriguez '60

Association district directors for two-year terms: James A. Moody '75, Donald Reynerson ME '75, Raymond A. Grammer, Jr. '45, Cordelia M. Price '78, Joel E. Schindall '63

Seventy-four alumni served on Association national boards and committees, including as chairs of standing committees: Noel S. Bartlett '60, Audit and Budget Committee; Brian G. R. Hughes '77, Alumni Fund Board; Christian J. Matthew '43, *Technology Review* Board; Wendyl A. Reis, Jr. '56, Enterprise Forum Board; and Hyun-A C. Park '83, Technology Day Committee.

Afternoon breakout sessions featured a session titled "Staying in Touch – Enriching Communications with Fellow Alumni" and included roundtables with morning speakers for alumni interested in volunteering for classroom related activities; a report from the Task Force on Student Life and Learning; an Educational Council workshop; and an Enterprise Forum workshop.

Pre-ALC activities on Friday, September 19 saw a record attendance at the club leaders workshop which offered opportunities to learn about new programs and policies for supporting alumni activities in the field. The annual solicitor training workshop gave participants tips on successful solicitations and the opportunity to discuss the case for MIT support with senior officers of the Institute.

Following the ALC, three pilot alumni involvement initiatives were guided by Association staff. Working with Professor Woodie Flowers and other Mechanical Engineering Department faculty, alumni volunteered to advise the student teams in the department senior design course. Other alumni agreed to be interviewed by students in a pilot course being developed for the faculty's new communications requirement. And for the first Freshman/Alumni Summer Internship Program, alumni were asked to serve as mentors and industry employers. Altogether, more than 80 alumni volunteered to participate in these new activities, and each of these initiatives has been evaluated by faculty who intend to continue them in the coming academic year.

A service to current students which called on the greater involvement of our alumni was a set of internship and externship programs held in FY 98. Nineteen undergraduates were chosen from 23 who applied to take part in

internships during the Independent Activities Period with alumni in their fields around the country; a Washington DC externship program successfully linked 12 graduate students with alumni in that area for a week in January. Each of these will certainly be repeated in the coming year.

The first European club leaders workshop was held in Paris on November 1, 1997, with representatives from ten of thirteen clubs present. This workshop will be held every two years in a European city. In December, the Association approved the creation of a new committee for Alumni Network Services (ANS); the twelve member ANS Advisory Council, chaired by Michael J. Greata '63, includes two alumni faculty and two Corporation members. Other volunteer highlights of the year included the creation of a Parent Connections volunteer corps, a new ad hoc committee on clubs to evaluate the health of the club system and recommend improvements, and the growth of the Institute Career Assistance Network mentor group by 300 over last year.

ALUMNI FUND

This was yet another record-setting year for the Alumni Fund, not just in total dollar amount - which is impressive - but in the Fund's various component parts as well. The total of $28.7 million outstripped last year's record by $2.1 million and exceeded the goal by $1.2 million. The chart below tells the story, including these highlights: an all-time high number of donors; a record number of graduate alumni donors; and a near-doubling of the number of non-alumni parent donors to the Parents Fund.

FY 98 Alumni Fund Goals and Measurements

CRITERIA	FY97 Results	FY97/FY98 Goals	FY98 Goals	FY98 Year End Projection	FY98 FINAL RESULTS
Total Alumni Fund	$26.6M	+$900k	$27.5M	$27.5M	$28.7M
Undergraduate					
#Donors to Fund	19,576	+224	19,800	19,600	19,638
#Donors ≥ $500	2,920	+180	3,100	3,000	3,140
% Donors ≥ $500	14.9%	+.8%	15.7%	15.3%	16%
#First-time donors	750	+50	800	825	821
Graduate Students Exclusively					
# Donors to Fund	11,001	+199	11,200	11,050	11,177
# Donors ≥ $500	919	+81	1,000	950	957
% Donors ≥ $500	8.4%	+.5%	8.9%	8.5%	8.5%
# First-time donors	688	+62	750	775	696
TOTAL					
# Donors to Fund	30,577	+423	31,000	30,650	30,815
# First-time donors	1,438	+112	1,550	1,600	1,517
Total Giving ≥ $2k					
#Donors ≥ $2,000	1,080	+120	1,200	1,125	1,155
% Donors ≥ $2,000	3.5%	+.4%	3.9%	3.7%	3.7%
Parents Fund					
Total $	$378k	+$22k	$400k	$250k	$227k
# Donors	568	+32	600	850	838

Graduate alumni only (GSE) results continued strong with 31% participation for the eighth consecutive year of increased donors. Dollars from graduate alumni increased by ten percent, ahead of the overall dollar increase for the Fund.

Undergraduate annual fund participation is used as the sole indicator of alumni satisfaction in the *US News and World Report* university rankings. Last year MIT was eighth in annual giving participation among its peer institutions in this annual survey. This year's result of 43% participation puts MIT in a strong position for next year's rankings. Exceeding the goal for donors of $500 or more, sixteen percent of undergraduate donors made a gift at this level, a one-year increase of eight percent.

Led by record-breaking 50th, 20th and 15th reunion gifts, class reunion giving totaled $46.4 million in gifts and pledges. More than half the reunion gift donors increased the level of their previous gift with very strong participation rates in each reunion class, exceeding the undergraduate average by at least four points in all but the two youngest classes. See chart below:

CLASS YEAR	*Gift Total*	Participation
1998*	$28,515	10%
1993	$59,315	24%
1988	$50,906	39%
1983	$479,733	48%
1978	$2,697,455	47%
1973*	$2,306,383	67%
1968	$631,198	50%
1963	$998,326	49%
1958*	$6,758,230	62%
1953	$772,029	51%
1948*	$13,285,770	65%
1943	$724,486	57%
1938	$3,426,908	76%
1933*	$3,193,085	85%
1928*	$11,002,896	86%
Total	$46,415,235	

* five-year campaigns

Telethons continue to account for nearly one-third of all Alumni Fund donors. More than 1,000 caller nights produced outstanding results again this year. Dollars pledged in volunteer student telethons ($240,000) increase by nearly 60% over last year; academic department telethons continued strong with a 71% pledge rate, reporting $262,000 in pledges to department needs; and Tech Callers increased contacts by 24% and pledges by 16%.

The Alumni Fund Board recommendation to raise the minimum gift amount for receipt of *Technology Review* from $35 to $50 was approved by the Association Board of Directors. Recent graduates of less than five years will continue to receive the magazine for a minimum gift of $25. In another action the Fund Board recommended a new brochure on making gifts of appreciated securities which showed positive results. Other Alumni Fund initiatives this year included increases in life income fund lunches, a telethon in February for gift upgrading among donors who had previously given more than $500, and the initiation of a campaign for support of Baker House restoration.

All these factors, along with strong volunteer efforts, combine to make it clear that MIT alumni continue to take enormous pride in their alma mater, to value the education it provided them, and to reflect that pride and appreciation in generous contributions of money, time, energy and good will.

TECHNOLOGY REVIEW

This was a year of great change for *Technology Review*. The magazine underwent numerous staffing changes, editorial redesign and repositioning, and the implementation of a business plan designed to transform the magazine into a profitable, respected, and highly visible magazine focusing on technology and innovation. R. Bruce Journey, Publisher and CEO, and the management team conducted an in-depth analysis of the magazine including focus groups with readers and interviews with major advertisers. *Technology Review's* Board approved a $2.5 million multi-year investment plan, which was subsequently endorsed by the parent Association Board of Directors and President Vest. With these endorsements, the staff began the task of circulation development, operational re-alignment, and editorial redesign and repositioning. A portion of the $2.5 million was released in fiscal year 1998 to support these important efforts. At the end the growth plan's first year, we are happy to report that the magazine is on target financially and that the market and audience reaction so far has exceeded expectations.

Beginning in June, 1997, a volunteer committee conducted a nation-wide search for a new editor and a fresh editorial focus. The unanimous selection for Editor-in-Chief was John Benditt. Before coming to *Technology Review*, Benditt spent nine years at *Scientific American* and seven years at *Science* magazine. Benditt joined Journey in developing a new vision for the 100-year-old publication. Their vision can be summed up in one word – innovation. The new leadership believes the time is ripe for a magazine that focuses on the subject of innovation, one of the most vigorous and dynamic aspects of our society. The new magazine was launched in May of 1998 with great editorial success.

The MIT News section was no less a part of the magazine's re-design, acquiring new voices in Senior Editor Mary Tamer, who came to MIT from Harvard's Kennedy School and Concord Academy, and Associate Editor Abigail Vargus '97. They worked closely with Alumni Activities staff to completely revamp the MIT News, by developing new sections, highlighting the accomplishments and the writing of MIT alumni, faculty, and friends, and generally diversifying the content of the news being reported from the campus. The magazine staff also partnered effectively with Christine Tempesta of the Geographic Programs staff, who has served as editor of the Alumni Volunteer News component of the MIT News, to further recognize the contributions of the Alumni Association's 3,800+ loyal volunteers.

ON THE INTERNET

As is the case in much of the private sector, the Internet has become the fastest growing area of Association work. The Internet and especially the World Wide Web present an opportunity to extend the MIT community and to advance the Association's dual goals of service to MIT and its alumni. The centerpiece of our online activity is the Alumni Network Services (ANS) program, which is leading the Association staff and volunteers to develop information and services on the Web.

In March we learned that the Association web site comprised the second largest set of pages on the web.mit.edu server, second only to MIT's IS pages. Even when *Technology Review* moved its pages to a commercial server the Association remained in the top six MIT web sites. These pages include sites maintained by 56 volunteer webmasters representing classes, clubs and other alumni groups. Online volunteer support includes server access, support by ANS staff, and a club volunteers "tool-kit" posted online.

Many Association activities are promoted online as well as with traditional print publications. Event registrations are available online and increasing rapidly, with ten percent of reunion attendees using the secure transaction online registration process. The Association promoted the Institute commencement webcast to 28,000 alumni whose email addresses are on record and received favorable notice from most of the nearly 400 alumni who commented. Nearly 13,000 people took advantage of the webcast.

During the past year accomplishments include the growth of our first ANS service, E-mail Forwarding for Life (EFL) by 130% over FY 97 to 15,000 registered alumni. We are seeing an even more dramatic increase in use, with more than 10,000 messages forwarded each day. Version 1.0 of the online directory has been available since November 1997, with more than 25,000 records holding searchable data; alumni can update their own directory record which will save Alumni Records staff time when the new client-server system is in place. In cooperation with Resource Development staff, a Giving at MIT site was launched in the fall with secure credit card gift options to be promoted more vigorously during FY99.

The original Alumni Association web site, launched in June of 1995, was completely redesigned and re-launched in March 1998 with an emphasis on customer service. The user interface for the ANS secure alumni-only site was revised to reflect the more than 300 weekly customer suggestions and questions.

With the leadership of the ANS Advisory Council, led by Michael Greata '63, the FY99 ANS budget and operational plan were submitted to MIT and funded, allowing the addition of two more staff bringing full time staff on this program to five people in the coming year. Priorities in FY98, to continue into FY99, have been on customer service, improved EFL performance, expanded directory services, the addition of web forums, and integration with the Alumni Information Services database and services.

In addition to the above web services, the Association supports and maintains 120 email lists with volunteer editors. Clubs send event notices, classes solicit and distribute class notes and reunion notices, and volunteer groups including club presidents and the Association board of directors receives regular updates from MIT staff.

As this mode for communication and service delivery has become more robust, it has presented challenges for the Association and its volunteers. We are learning new ways of operating and are finding new needs for collaboration inside and outside the Institute. An already agile staff and volunteer cohort are being required to become even more opportunistic and more than ever to be responsive to our alumni, who are using the Internet more and more frequently and expect MIT to be there with the best service.

PROGRAMS FOR ALUMNI AT MIT

One of the Association's overarching objectives is to keep alumni linked with the institution by bringing them back to take part in the life of the campus. As ever, the centerpiece of this effort was the annual Tech Week and reunion programs. These events were a tremendous success, with nearly 3,000 alumni and guests returning to MIT. Nine of the 13 reunion classes had reunion attendance above the forecast, with strong turnout from the other classes. Despite the logistical demands imposed by the participation of President Clinton in Commencement, the third year of a combined reunions/Commencement weekend worked relatively smoothly.

Highlights of class events included a Class of '48 dinner dance organized by Harold Ottobrini '48, featuring an appearance by the MIT Ballroom Dance Team who stayed for lively dancing with the 200 class members and their guests. Jonathan Goldstein '83 recruited astronaut Cady Coleman '83 to share her experiences in the space program. Norman Leventhal '38 invited his classmates to view the Normal Leventhal '38 Map Collection in the Compton Gallery and then to attend a reception in his home at Rowes Wharf. The Class of 1963 won the second annual Reunion Row and the class of 1988 won the Tech Challenge Games. All planning was ably led by Amy Seybold-Burke, newly-appointed Director of Reunions and Events, who joined the staff in December, from the University of Massachusetts, Lowell, where she had created the alumni relations office.

The Technology Day program was entitled "Creating Wealth: Knowledge, Skills, Capital, Resources" and included welcoming remarks by Charles M. Vest HM, followed by a plenary session which featured Tony K. Tan PH '52, Deputy Prime Minister of Singapore and Minister for Defense; Judith C. Lewent GM '72, Senior Vice President and Chief Financial Officer, Merck & Co., Inc.; David H. Marks, Professor and Director, Program in Environmental Engineering and Research, MIT; and Lester C. Thurow HM, Jerome and Dorothy Lemelson Professor of Management and Economics. President Vest moderated a lively question and answer period with many more questions than time allowed. There were also three outstanding afternoon sessions. Karen W. Arenson '70, former Association president and currently a reporter for *The New York Times*, moderated a discussion on the return on philanthropic investment. Lotte Bailyn, T. Wilson Professor of Management and current chair of the MIT faculty, moderated a discussion on maximizing human capital in organizations. Robert Metcalfe '68 moderated a group of very distinguished reunion alumni in discussing entrepreneurship to a packed 10-250. Hyun-A Park '83 chaired the Technology Day Committee, which planned this extraordinary day.

The Alumni Association continued its tradition of strong dedication to the senior class. Senior Dinners, hosted by President Vest and his wife, Rebecca, and organized by the Alumni Association, were well attended by 442 seniors as well as alumni volunteers. For the second year, the Alumni Association worked with the senior class not only on the senior gift but also on planning for senior week. Senior Week involved 300 seniors in ten events. The welcome

reception for graduating seniors and their families during reunions was a colossal success, with approximately 1,000 students, alumni, and family members participating.

Family Weekend, with an attendance of 1,500, built on its well-earned reputation for opening the lives of students on campus with their parents, grandparents, siblings and friends. Falling as it did just weeks after the tragic death of Scott Krueger '01, the planned program was successfully re-arranged to allow senior faculty and administration to address the urgent and legitimate concerns of family members which arose from the incident. Feedback from families was extremely positive, under the circumstances, with gratitude expressed for the opportunity to make themselves heard on this important and sensitive issue. In May, the second annual Student/Alumni Expo was held in Lobby 10, with staff and Student Ambassadors on hand to personally introduce soon-to-depart seniors to the Association's events and services, including on-site registration for Alumni Network Services and E-mail Forwarding for Life in the Bush Room. Student Ambassadors, who numbered 20, were instrumental in the success of the more than 30 events held on campus through the year.

The Enterprise Forum strives to combine the goals of bringing alumni to campus with the goal of sharing the wealth on campus with alumni around the country. This goal was achieved in 1998 through delivery of two very well received satellite broadcasts featuring leading academic lights of MIT. January's featured speaker was Edward B. Roberts '57, David Sarnoff Professor of the Management of Technology at the Sloan School, with a talk on "Building High-Tech Enterprises: The Next Twenty Years;" the moderator was Dennis R. Costello '81, Chief Investment Officer for Advent International in Boston. About 500 people in the Wong Auditorium and another 1,500 people in Colorado, Connecticut, Delaware Valley, Northeast Ohio, Palm Beach, Oregon Beach, Houston, Toronto, and Washington, DC attended this program.

A broadcast in May was moderated by Lita Nelsen '64, Director of MIT's Technology Licensing Office, with the talk given by her frequent collaborator Robert S. Langer CE '74, Germeshausen Professor of Chemical and Biomedical Engineering at MIT. Titled "Creating and Implementing Breakthrough Technologies," the talk was enjoyed by roughly 500 attendees in Kresge Auditorium, who were joined by another 1,500 in Central Ohio, Cincinnati, Connecticut, Delaware Valley, Northeast Ohio, Oregon, Toronto, and Washington, DC.

Through this set of programs, a significant number of alumni were involved in receiving important, current information from the Institute. In addition, a number of the receiving sites involved the cooperative effort of a Forum chapter and a regional Alumni Association club. The building and strengthening of these ties is a long-term goal for the Forum.

March saw a celebration of the end of an era, as MIT's Building 20, "The Magical Incubator," was feted with a weekend-long series of events. The Association supported the Department of Electrical Engineering and Computer Science with representation on the planning committee, and by welcoming the many alumni who have returned for one last tour of the building before its demise. In June, AMITA celebrated the 125th anniversary of the graduation of Ellen Swallow Richards, Class of 1873, MIT's first woman graduate; the centerpiece of this celebration was a popular exhibit at the entrance to the Infinite Corridor, detailing the history and accomplishments of women at the Institute.

SERVICES TO ALUMNI WORLDWIDE

The Association truly surpassed itself in its ongoing mission of bringing the spirit of MIT to its alumni "where they live." The newly re-constituted MIT On The Road program combined with class mini-reunions; the tour of Association president Bob Metcalfe '68, who played to sell-out audiences around the world; the first club officers workshop in Europe; the satellite broadcasts produced by the Enterprise Forum; record-breaking participation in the Alumni Travel Program – all these and many other events combined to mean that well over 10,000 alumni worldwide were linked to the Institute in unique and important ways.

The Association was given a unique and exciting opportunity with the presidency of Robert M. Metcalfe '68, VP for Technology at the International Data Group, Inc. and a world-renowned technology pundit, completely fitting, as he invented ethernet while at Xerox Palo Alto Research Center in 1973, and subsequently founded 3Com Corporation. Metcalfe is also a recipient of the Medal of Honor from the Institute of Electrical and Electronics Engineers. Before he even began his term as president, plans were underway to allow Metcalfe to reach the broadest possible audience

of alumni with his thought-provoking messages on everything from the state of the Internet to alumni involvement in undergraduate education.

Eventually, the "Metcalfe Tour" was hatched, centered around Metcalfe's talk on "Internet Futures;" this provocative speech explores how (in his own words) "the Internet has managed to grow so rapidly, despite bogging down and intermittently collapsing. New technologies will help but the most promising of Internet futures will require that Internet service providers cooperate more and that telephone monopolies be broken. Then, the Internet will bring us global electronic commerce, telepresence (so we can stay home more), and immortality." Dates and locations were chosen, with many events co-sponsored and with attendees from IDG, Inc., and eventually Metcalfe gave his talk to enthusiastic audiences in 11 domestic and eight international cities, traveling everywhere from San Francisco to Munich to Kuala Lumpur.

The MIT On The Road program reintroduced and revitalized a program that had been attempted in the past, an effort to bring some of the Technology Day experience to alumni in a variety of locations worldwide. The kick-off MOTR was held in Sanibel, Florida, in January, and was organized to coincide with mini-reunions of the classes of 1940 and 1950, whose participation greatly enhanced the eventual success of the program. The theme was "Renaissance Thinking in the 21st Century," and included seminars exploring cutting-edge fields such as artificial intelligence, climate, genetics, the Internet, and urban development. Speakers included Kerry Emanuel '76, Professor of Meteorology, David Housman, Novartis Professor of Biology, Samuel Jay Keyser HM, de Florez Professor of Linguistics, and William J. Mitchell, Dean of the School of Architecture and Planning. The first evening's keynote address was given by Robert M. Metcalfe '68, who gave his "Internet Futures" talk; the second night, a talk entitled "Around MIT in 180 Days" was presented by Alexander V. d'Arbeloff '49, Chairman of the MIT Corporation and Chairman and co-founder of Teradyne, Inc. Overall reaction of participants indicated that MOTR was off to a roaring start.

New York City was the next site, with another forward-looking theme titled "MIT Perspectives on Trends Shaping the 21st Century." Seminar topics ranged from brain plasticity to the Middle East to finance, and Metcalfe once more delivered his by-now famous "Internet Futures" speech. Other speakers included Dr. Emilio Bizzi, Eugene McDermott Professor in the Brain Sciences and Human Behavior, Philip S. Khoury, Dean of the School of Humanities and Social Science, and Dr. Andrew Lo, Harris and Harris Group Professor at the Sloan School of Management. Again, the response to this lifelong learning program was enthusiastic and the stage was set for the continued development of the program in the coming year. Events were planned in Lisbon, Portugal, timed to coincide with EXPO '98 and offering a specially designed Alumni Travel Program; Washington, DC, San Francisco, and Boston. These successful first steps in breathing new life into a valuable but underdeveloped program will surely serve as the cornerstone of the Association's lifelong learning efforts in the future.

A variety of other events and programs were held on a diversity of subjects and areas of interest to alumni. The MIT Club of Boston held a gala in October at Boston's Top of the Hub restaurant, to welcome incoming Corporation chairman Alex d'Arbeloff '49 and his wife Brit d'Arbeloff ME '61 to their new posts as leaders of the community. MIT's oldest club, the MIT Club of Chicago, celebrated its centennial with a major event where Robert M. Metcalfe '68 and MIT President Charles M. Vest HM addressed attendees. This was among a number of visits made by Dr. Vest on behalf of the Association, other locations including northern California and Seattle. Alumni are always pleased to hear from, and discuss the current state of the Institute with our president, and he is generous with his time and energy in their regard. Besides Dr. Vest, 82 faculty and senior administrators were recruited as part of a new Speakers Bureau in the Association, in an effort to create a robust body of interested faculty who will share their areas of expertise with alumni throughout the U.S. and the world; they may be called upon to address one of 94 regional clubs, join an MIT On The Road roster, or take part in an Alumni Travel Program trip, and wherever they go, they are very well received by the alumni in attendance.

The Alumni Travel Program achieved record attendance in 1997-98, with 567 alumni and guests taking part in one (or more) of 27 trips to locations on almost every continent, including Asia, Africa and South America. Five trips took place in the U.S., including a train trip aboard the American Orient Express, which traveled from New Orleans to Chicago to the accompaniment of Professor Samuel Jay Keyser HM and his New Liberty Jazz Band. Continuing an increasingly successful trend, 80 alumni and guests traveled to Ireland for an Alumni College Abroad program,

featuring less travel, but an increased lifelong learning component of seminars and guided tours; we plan to continue with the ACA component in FY 99 with trips to Burgundy and Spain.

PUBLICATIONS

The Association continued to produce a wide selection of high-quality publications to promote and support its ongoing activities. The promotional materials for the Tech Week and reunion activities were redesigned and mailing strategies improved, and it is clear from tracking attendance that we are attracting an increasingly broad audience to these events, including many alumni who had never before participated in their reunions.

A first-rate brochure detailing the history of this active outpost of the Institute accompanied the centennial celebration of MIT's oldest regional club, the MIT Club of Chicago. The renewed MIT On The Road program was supported by an elegantly uniform set of materials, designed to work for all locations. The successful launch of a series of planned giving luncheons was accompanied by a clear and concise brochure on giving securities to MIT; this brochure was singled out by the Council for the Advancement of Secondary Education as a model for success in delivering a sometimes complicated message.

Students and parents were not neglected, as the Association continued to pursue its goal of reaching out to our "future alumni" and their families. The Guide for recent graduates was completely redesigned to more fully reflect the range of services available to alumni from the very moment they graduate. The *Parents News*, published three times per year, played its role in expanding the MIT family by keeping parents up to date on their concerns: a recent issue included an interview with the newly-appointed director of the Career Services Office; a "Campus Round-Up" with updates on tuition costs; commencement planning; and a save-the-date briefing on October's Family Weekend plans. The Enterprise Forum used its *Forum Focus* to highlight its extensive programming features by publishing the question-and-answer portions of its satellite broadcast events, as well as keeping its nationwide network of volunteers well briefed on best practices from a variety of chapters. The Alumni Travel Program published its second annual edition of the *MIT Explorer* newsletter; this featured information on all trips scheduled for 1998, along with articles written by faculty members planning to accompany those trips, as well as MIT On The Road previews.

SUPPORTING FUNCTIONS

The areas of information services, personnel and operations continued to provide strong support to the many activities of the Association, including *Technology Review*. Information services staff were active on a number of fronts, preparing for conversion of the alumni database from a mainframe to client/server environment. The data entry staff were trained early as "power users," in order to be able to test and verify the new system; the entire Alumni Information Services staff migrated to an NT platform, and Macintosh servers were replaced with an NT server, which simplifies maintenance, and assures that on-line reporting from the new system will be easy and efficient. Hundreds of vital reports were converted to the new programming language and printing issues were examined and resolved in a timely fashion. Policies, procedures and training guidelines were created for the new system, and will be used by staff members in the Association, as well as by staff in our partner offices of Resource Development and the Office of the Recording Secretary to ensure operational consistency among the owners of the new database.

Staffing issues were more challenging than usual, with the redesign and re-launch of *Technology Review* accompanied by a significant reorganization of the editorial staff. Ultimately, seven staff left as a result of the reorganization and others for their own reasons, while the business staff of the magazine was expanded. In all, 14 new editors, circulation, marketing and advertising sales staff were added to the masthead in support of the magazine's bold new venture. There were 15 new hires throughout the rest of the Association, and 14 staff members were recognized for exceptional contribution through promotions.

More information about the Association of Alumni and Alumnae of MIT can be found on the World Wide Web at the following URL: http://web.mit.edu/alum/

William J. Hecht

INDEX

A

B

C

R

S

T

U

V

W