Massachusetts Institute of Technology

TECH TALK

September 8, 1976
Volume 21
Number 5

Scientists Complete Synthesis of Man-Made Gene

MIT Scientists have completed the synthesis of the first man-made gene that is fully functional in a living cell.

"Chemically synthesized genes will now be available for the controlled, systematic study of how the structure of a gene influences its function," said Nobel laureate Har Gobind Khorana, who directed the research.

Dr. Khorana and his co-workers announced in 1973 the synthesis of the structural part of the gene, which produces tyrosine transfer RNA. Now they have synthesized the start and stop signals for the gene, which is found naturally in *E. coli* bacteria.

Dr. Khorana, who is the Alfred P. Sloan Professor of Biology and Chemistry at MIT, said that the gene and its controls have functioned correctly in test-tube experiments as well as in a bacterium.

It was impossible to conduct such a test of the first man-made gene, a yeast gene completed by Dr. Khorana and his co-workers—then at the University of Wisconsin—in 1970. Not enough was known about the controls of the biochemistry of that gene, Dr. Khorana said.

But the bacterial tyrosine transfer RNA gene is much better understood. Moreover, it contains information that corrects a harmful mutation that can occur in natural genes. Genes afflicted with that mutation create nonfunctional, incomplete proteins. The synthetic gene enables such mutants to produce functional proteins.

The scientists announced their results at the national meeting of the American Chemical Society in San Francisco, in papers presented by senior research associate Dr. Ramamoorthy Balagaje and researcher Dr. Hans-Joachim Fritz, Monday morning, August 30.

Their co-workers include Dr. Eugene L. Brown, Professor Robert G. Lees, Dr. Takao Sekiya, Dr. Tatsuo Takeya, Dr. Michael J. Ryan and Dr. Hans Kupper, of MIT; and Dr. Michael J. Gait from England, Dr. Kjeld E. Norris from Denmark, and Dr. Roland Contreras from Belgium.

The work was funded by the National Institutes of Health, the National Science Foundation, the American Cancer Society and the

(Continued on page 5)

MIT Welcomes '80

A freshman class of 1,065 students from 48 states and 34 foreign countries arrived on campus for the start of Residence/Orientation week on Friday, September 3.

According to Peter H. Richardson, director of admissions at MIT, the entering Class of 1980, selected from more than 5,000 applicants, includes 170 women, 61 blacks, 17 Mexican Americans, seven Puerto Ricans, and 61 foreign students.

"The entering black student population is as large as it has ever been in a freshman class," Mr. Richardson said. "We've had some success this year, but the problem of increasing the number of minority students at MIT is far from solved," he said.

Every state but Alaska and Wyoming is represented in the freshman class. Massachusetts, New York, New Jersey, Pennsylvania and California are the most popular home states with at least 50 students each. Eleven students come from Canada, six from Malaysia, five from Greece, and 39 other foreign students from 31 different countries.

Also new to MIT this September are 147 transfer students—who have completed one or two years of college elsewhere. They will begin their sophomore or junior years at MIT.

Members of the Class of 1980 graduated from 695 public high schools, 74 private schools, and 73 church-related schools. Schools sending the largest delegations are four public high schools—the Bronx High School of Science, New York City, with nine students, Boston Latin, Boston, with eight; Stuyvesant High School, New York City, with seven, and Walt Whitman High School outside Washington D.C., with five. The students range in age from 15 to 21, and 29 of them enter MIT after completing four years of high school in three years.

The freshmen were officially introduced to MIT Residence/Orientation Week Friday afternoon, September 3, with a picnic in MIT's Killian Court. Academic counselling and social activities continue through Sunday, September 12, closing with the President's Reception for parents and freshmen, from 3:30-5:30pm at the President's House on Memorial Drive.

The freshmen will join about 3,400 other MIT undergraduates for registration on Monday, September 13. Classes begin Tuesday, September 14.

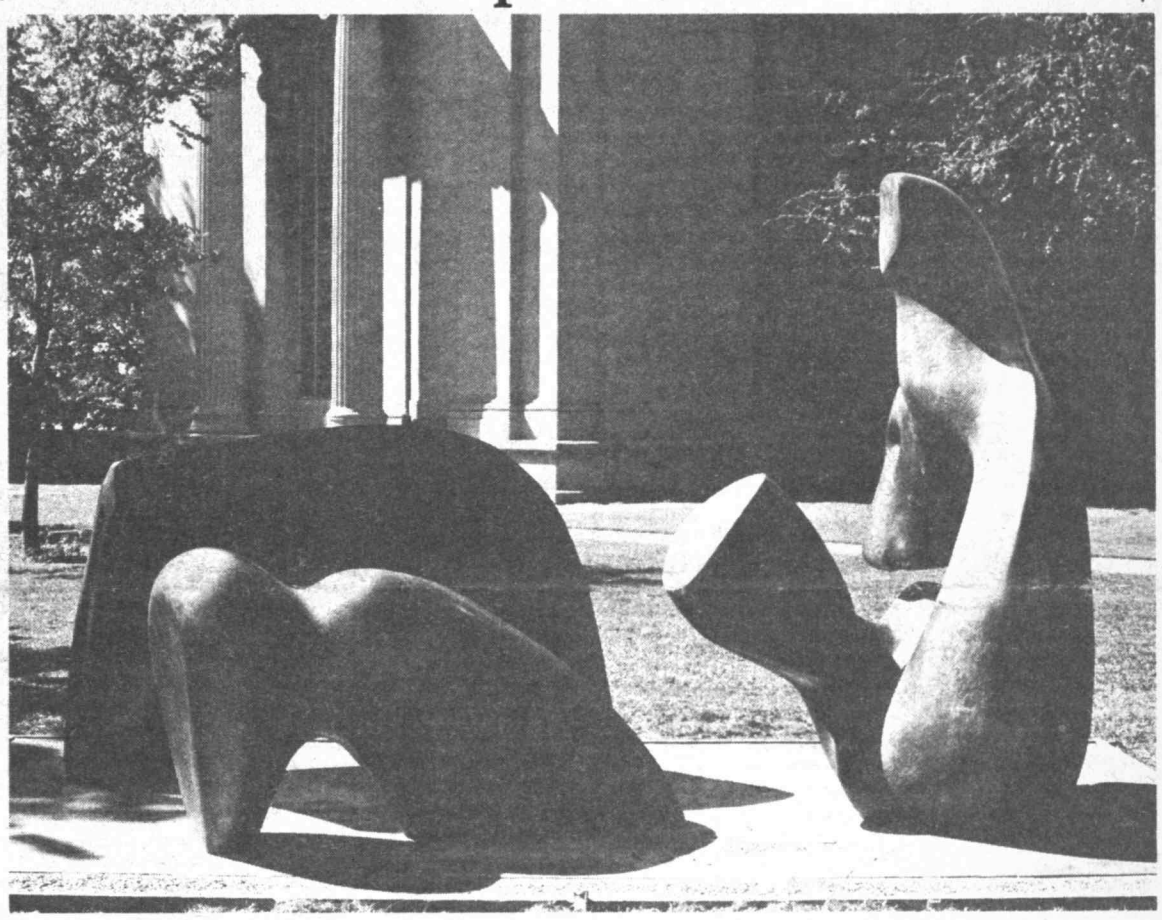
The size of the freshman class turned out to be somewhat smaller than anticipated. Academic Council earlier this year authorized admission of a class of up to 1,100. Of those offered admission, the number (the "yield") who indicated last spring that they would register turned out to be just about the target 1,100. Then, the number of acceptees who changed their minds over the summer and decided not to come (the "summer melt") turned out to be larger than in previous years. The result is a final class of 1,065. Admissions officers are conducting a study to determine why the "yield" and the "summer melt" were different from previous years, but thus far have found no generally applicable explanation.

Tech Talk Resumes Weekly Schedule

Effective with this issue, *Tech Talk* resumes regular weekly publication until Christmas vacation.

***Tech Talk* is distributed to offices and laboratories through Institute mail, and bulk allotments are delivered to the desks in residence halls. Additional copies are available in the Information Center (Rm 7-111) and the News Office (Rm 5-111).**

Moore Sculpture Installed



Henry Moore's *Three Piece Reclining Figure, Draped* in Killian Court.

By KATHARINE S. C. JONES
Staff Writer

An important sculpture by the internationally celebrated British sculptor Henry Moore was installed in the du Pont Court side of MIT's Killian Court on Friday, August 27.

The 16-foot-long bronze sculpture, *Three Piece Reclining Figure, Draped*, is the first of Moore's monumental works to come to the New England area.

The sculpture is a gift to the Institute from several generous donors. A dedication ceremony is planned for the fall.

No more than six casts of any of Moore's works can ever be made. So far three casts of the reclining figure have been made and two have been sited, one in Moore's own sculpture garden in Hertfordshire, England, and a second at MIT. Moore's estate, with many of his monumental sculptures in place, will be bequeathed to the Tate Gallery in London.

The possibility of placing a sculpture in Killian Court was a major factor in Moore's enthusiastic endorsement of one of his masterpieces for MIT. The tranquil setting in an "urbanscape" impressed Moore when he visited MIT in May, 1974. To him Killian Court is a handsome environment for his work.

Moore believes, "Sculpture is an art of the open air. Daylight, sunlight is necessary to it, and for me its best setting and complement is nature." Moore feels strongly that his sculpture should be placed in a landscape . . . "rather than in the most beautiful building I know."

Efforts to obtain a monumental

Robot Joins Frosh Luggage Parade

Along with the backpacks, trunks, musical instruments, and assorted luggage that arrived at MIT with the freshman Class of 1980 came Christopher, a 50-pound robot.

Christopher is the invention of Jay Dunnington, a freshman from Ridgefield, Connecticut, who aspires to be an inventor.

Mr. Dunnington began building Christopher in late 1974 during his senior year at Loomis-Chaffee School in Windsor, Conn. Building the robot is a learning project for him.

"I've never had a master plan. I just apply what I've learned and see if it works. The more I learn, the more I modify Christopher," he said. "Now that I'm at MIT I hope to learn why it works the way it does."

When he began the robot, Mr. Dunnington was beginning to learn about electricity.

"At first everything was coils, then everything was relays, then transistors. A year ago I found integrated circuits easier to work with," he said.

Most recently Mr. Dunnington has learned about computer technology and has applied what he's learned to Christopher. He first realized the potential of computers last December while at MIT for an interview in the Admissions Office. A professor in the Laboratory for Computer Science talked with Mr. Dunnington who then realized how much a computer would improve his robot.

Knowing nothing about computers, Mr. Dunnington bought some manuals. He soon discovered it would be too difficult to build a computer from scratch, so in early July he bought an

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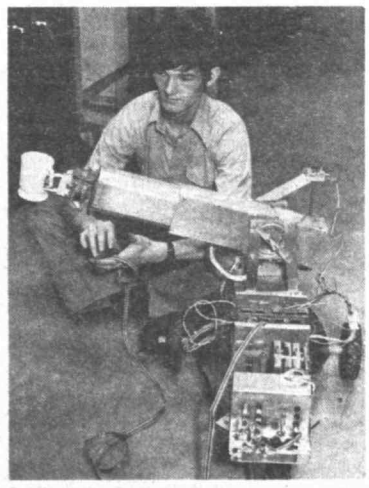

CHRISTOPHER THE ROBOT serves a morning mug of coffee to inventor Jay Dunnington, a freshman from Ridgefield, Conn.

Microprobe Scans Legionnaires' Hair

By ROBERT M. BYERS
Staff Writer

A scanning proton microprobe under development by a team of scientists from MIT, Harvard and MIT's Lincoln Laboratory as a potential future tool in the analysis of biological tissues is being used to scan single hair strands taken from survivors of the mysterious Legionnaires' disease.

Investigators want to know if there are present in the hair strands excessive amounts of any specific elements. Such information could be a clue to the cause of the mystery disease.

The Harvard-MIT team includes Dr. Lee Grodzins, MIT professor of physics; Dr. Paul Horowitz, professor of physics at Harvard University; Dr. Jean Ryan, who directs the 4-million volt Van de Graaff accelerator facility at MIT's Lincoln Laboratory in Lexington, Mass.; and several present and former students at MIT and Harvard.

Legionnaires' disease is the name given by officials of the Pennsylvania state health department to an influenza-like illness that broke out among persons who attended an American Legion convention in Philadelphia in late July. The same illness broke out also among a smaller number of persons who attended a Eucharistic congress in Philadelphia a few days later. Both meetings used the same Philadelphia hotel for headquarters. All told, there have been 177 reported cases and, of these, 28 persons have died.

No infectious agent has been identified as the cause. Some investigators have suggested that a toxic substance might have been inadver-

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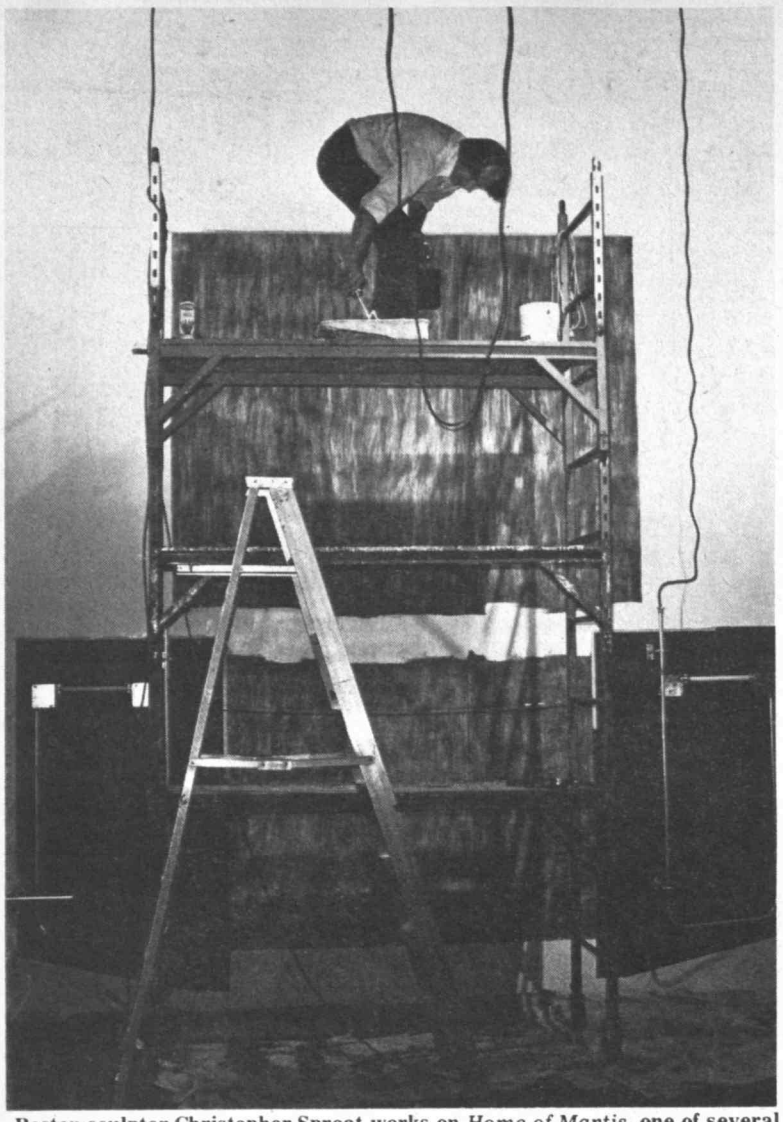

Boston sculptor Christopher Sproat works on *Home of Mantis*, one of several light sculptures he constructed on site in Hayden Gallery at MIT. "Chris Sproat: Made in Hayden" will be on view from September 3 through October 2, Monday through Saturday, 10am to 4pm. The public is invited to a reception for Sproat in the gallery, located at 160 Memorial Drive in Cambridge, on Friday, September 10, from 8-10pm. *Photo by Christopher Barnes*

Moore Sculpture Installed in Court

work by Henry Moore began in 1971 with a proposal by Professor Wayne Andersen, chairman of the MIT Committee on the Visual Arts, for one of Moore's marble pieces. Since that time the Committee has discussed several alternate sculptures for the Court.

When Professor Andersen visited Moore in the summer of 1975, he saw a large plaster maquette of a reclining figure Moore had just conceived for the prime site on his grounds. Both Moore and Andersen judged the piece a superb choice for MIT, calling it a "bicentennial gift to *New* England of a cast of a work chosen as a special bequest to England." Professor Andersen reported back to the Committee and others at MIT, showing slides and photographs taken during his visit, and the work was unanimously approved.

Henry Moore's art remains intrinsically within centuries-old sculptural traditions. His materials—stone, bronze, and often wood; his reverence for shapes and forms and their solid physicality; and his recurrent interest in sculpture's major theme, the human figure, all confirm an undeniable orthodoxy. A brilliant reinvestment of the past with modern concerns has been his decisive contribution to 20th century expression.

Three Piece Reclining Figure, Draped, is the last in a series of variations on the theme of the recumbent nude that Moore has imbued with his sculptural ideals for the past 40 years. Moore's figures look as if they have been shaped as much by the forces of nature as by the artist. Particularly in the reclining pieces, there is the embodiment of landscape.

At first Moore presented the notion of void as mass by breaking into solid form to allow space to take on equal proportions within the sculpture itself. The tensions he created led him to begin to sever the connections between the parts of his works, a device he has repeatedly used since 1969. In the MIT piece, Moore uses drapery as a separate, enveloping, protective element with classical reference, as well as evoking the strong folds common to some mountainous terrain.

Large scale outdoor sculpture has become a pivotal element in MIT's public art program. Precedents were set with the placement of Theodore Roszak's bell tower on the MIT Chapel and Alexander Calder's *The Big Sail* in McDermott Court. The Committee on the Visual Arts has had a particularly active year with the acquisition of the Moore, Louise Nevelson's *Transparent Horizon* and a piece by Tony Smith that will be installed later this fall.

Rio University Honors Rosenblith

Professor Walter A. Rosenblith, MIT Provost, received an honorary doctor's degree from the Federal University of Rio de Janeiro in Brazil on August 23.

While in South America, Professor Rosenblith met with alumni groups in Bogota, Colombia, and in Rio de Janeiro. He also gave lectures in Rio de Janeiro on "Some Contemporary Problems in the Structure of Scientific Knowledge."

Musical Groups Schedule Instrumental Choral Auditions

Musicians at MIT—students, faculty, and employees alike—are invited to audition for a variety of instrumental and choral groups at MIT.

The MIT Symphony Orchestra under the direction of David Epstein will hold auditions Tuesday, September 14, at 7pm on the main stage of Kresge Auditorium.

The MIT Chamber Music Society, directed by Marcus Thompson, will hold auditions Wednesday, September 15, at 8pm in Rehearsal Room A of Kresge Auditorium.

The MIT Brass Ensemble under the direction of Robert Pettipaw will hold sight reading rehearsals to which new members are invited on Tuesday, September 14, and Tuesday, September 21, at 5:30pm in Kresge Auditorium. Auditions for the Brass Ensemble and for smaller groups—brass trios, quartets, and quintets organized under the auspices of the MIT Chamber Music Society—will be held from 7-8:30pm on Tuesday, September 21, in Rehearsal Room A and on Wednesday, September 22, in Rehearsal Room B. New members may sign up for auditions at the Brass Ensemble rehearsals on September 14 and 21. The group regularly rehearses on Tuesdays from 5:30-7pm and plans to present programs both on and off campus during the year.

Auditions for the Concert Band, directed by John Corley, will be on Monday, September 20, in the Student Center Sala de Puerto Rico at 7pm.

The Concert Jazz Band, directed by Everett Longstreth, and the Festival Jazz Band, directed by Herbert Pomeroy, will hold their first rehearsals on Sunday, September 12, on the main stage in Kresge; the Concert Jazz Band at 10am and the Festival Jazz Band at 6pm.

The Choral Society under the direction of John Oliver has scheduled auditions for Monday, September 13, at 7:30pm in Room 10-250.

For further information, call the Music Section Office, x3-3210.

Student Art Association Lists Variety of Classes

Classes in drawing, pottery, photography and other arts open to all members of the MIT community are being sponsored this fall by the MIT Student Art Association (SAA).

Classes meet weekly beginning Monday, September 20. Registration will be held September 13-17 in the SAA office located in the Student Center, Rm W20-429. Hours for registration are 1-5pm, Monday through Friday, and 5-8pm Wednesday evening.

Class fees range from $15 to $50, depending on materials provided. Students are charged reduced rates and receive preference when class size is limited.

The following classes are scheduled for fall:

Drawing from Life, taught by Maria Vitagliano; Drawing from Still Life and the Model, taught by Malka Kutnick; Tuesday Night Open Life; Basic Claywork, taught by Linda Melamed; Intermediate Claywork, taught by David Judelson; Advanced Claywork, taught by Ellen Saslaw; Non-Class Clay.

Also, Stained Glass, taught by Mark Van Note; Basic Photography, taught by Lee Parks; Special Projects in Photography, taught by Linda Wasko; Non-Class Photography; Printmaking, taught by Thery Mislick; Silk Screen Printing, taught by Agusta Agustsson; Jewelry, taught by Sheela Gladwell, and Other Non-Class Use.

For more information on classes and a registration form, call x3-7019 in the afternoons or stop by the SAA office, W20-429.

Dean Brown Honored

Gordon S. Brown, Institute Professor Emeritus of Electrical Engineering and former dean of the MIT School of Engineering, has received the 1976 Robert Fletcher Award of the Thayer School of Engineering, Dartmouth College. Presentation was made during the recent annual awards banquet of the Dartmouth Society of Engineers.

INSTITUTE NOTICES

Announcements

Students Interested in the Legal Profession—J.D. Nyhart, chairman of Prelaw Advisory Council, will speak Wed, Sept 15, 4pm, Rm 4-153. Sponsored by Preprofessional Advising & Education Office, Rm 10-186, x3-4158.

Undesignated Sophomore Program—The program is being run by Dean Robert L. Halfman. Students with questions or problems should contact his secretary, Jane Brandford, in Rm 5-104, x3-4861.

English Conversation Classes—For wives of visiting faculty and staff, and wives of students from foreign countries. Sponsored by MIT Women's League. Registration: Thurs, Sept 16, 10am-12n, Rm 10-340. Classes: Tues & Thurs, 9:15-11am. Fee: $20. Babysitting provided for additional $5/family. Info: Mrs. Pinson, x3-3656.

Family Day Care Program—Child Care Office is currently accepting applications for Family Day Care Program. If you are interested in caring for infants or toddlers in your own home, pls call Child Care Office, x3-1592, Rm 4-144.

New UROP Listings

Welcome Freshmen and Other Newcomers

UROP invites and encourages you to participate with MIT faculty members in a wide range of research activities both on and off campus. The 1976/77 UROP Directory is now available in the Information Office, Rm 7-111. To get started, *first* read the "How to Participate" section of the directory then talk with coordinators and faculty members; check with the UROP office, Rm 20B-141, x3-5049 if you have specific questions. Current project offerings will be listed in this weekly column and on the UROP bulletin board in the main corridor of the Institute. You are also invited to hear five undergraduates give presentations of their research at a UROP Symposium, Saturday, Sept. 18 in Room 26-100.

Department of Nutrition and Food Science

An undergraduate with interest in clinical application of computer science is encouraged to participate in a multidisciplinary research project aimed at evaluating the role of nutrition support in the treatment of obesity, malnutrition and cystic fibrosis. The student will be involved in computerization and tabulation of the data obtained in several of the joint MIT-Children's Hospital research projects. Credit. Contact Dr. Robert M. Suskind, Rm 18-479, x3-6303.

Urban Physical Patterns and Change

Undergraduates are invited to participate in an ongoing research project dealing with urban form and change of two neighborhoods in San Francisco. The project concentrates on the description of the physical aspects of these urban environments and their development over time. Students should have a design background. Opportunities are given to collaborate with graduate students. Contact Prof. Anne Vernez-Moudon, Rm 10-303A, x3-7644.

Department of Nutrition and Food Science

An opportunity is available to carry out research involved with hormonal control of cellular metabolism (beginning Sept. 1976). The model system under study is the regulation of thyroid cell function and cell division by thyrotropin. Experience gained from work on this project should acquaint the student with numerous analytical techniques in biochemistry and cell biology. Previous laboratory experience essential. Contact Dr. John Stanbury, Rm 56-237, x3-6737.

Foreign Studies

Fulbright-Hays Grants

The Fulbright-Hays grants support predoctoral graduate study or research abroad for one academic year. Applicants must be US citizens and must hold the BA degree or an equivalent before the beginning date of the grant. Language proficiency sufficient to communicate with the people of the host country and to carry out the proposed study is also required. Contact the Graduate School Office, Rm 3-136, for further information.
Deadline: September 20.

Marshall Scholarships

The Marshall Scholarship Program awards approximately 30 scholarships each year to citizens of the US who are graduates of US colleges and universities to study for a degree of a university in the United Kingdom for a period of at least two academic years. Applicants may not have reached their 26th birthday on October 1, 1977. Information and application forms: Graduate School Office, Rm 3-136.
Deadline: October 22.

Churchill Scholarships

The Winston Churchill Scholarship program provides support for outstanding American students to do graduate work in engineering, mathematics and science at Churchill College, Cambridge University. Approximately 10 scholarships are awarded annually; the majority of the scholarships are for one year, and permit a student to work for a Certificate of Diploma. A few scholarships are for three years and permit a student to work for a PhD. Applicants for the Churchill Scholarships must be citizens of the US, must hold a bachelor's degree or its equivalent from a US college, and must be between the ages of 19 and 26 upon taking up a scholarship. Applicants must also have taken the GRE (aptitude and advanced tests) no later than October 16, 1976. Information: Graduate School Office, Rm 3-136.
Deadline: November 1.

Graduate Studies

Fannie and John Hertz Foundation Fellowships

The Fannie and John Hertz Foundation offers graduate fellowships to outstanding students in the applied physical sciences. Applicants must be US citizens or show documented proof of intent to acquire it, must have received a bachelor's degree by the time they propose to commence fellowship tenure, and are expected to have at least an A- average for their last two years of undergraduate work. The proposed field of graduate study must be concerned with applications of the physical sciences to human problems, broadly construed. The fellowships are tenable at 14 institutions within the US, including MIT. They provide tuition, fees, and a stipend of $5,500 for single Fellows and $6,500 for married Fellows. Information: Graduate School Office. Rm 3-136.
Deadline: November 1.

Amelia Earhart Fellowships

Grants of $4,000 to women for graduate work in aerospace related science and engineering are being offered by Zonta International, a service organization of executive women in business and the professions. A bachelor of science degree preparatory for graduate work in some field of aerospace related science and engineering, plus evidence of exceptional ability and potential are required. Application forms may be requested from: Zonta International, 59 East Van Buren Street, Chicago, Ill. 60605.
Deadline: January 1, 1977.

Other Opportunities

Luce Fellows Program

The 1977-78 program offers a year of work, study and travel in Asia to graduate students, seniors, faculty, staff and recent graduates. Candidates must be US citizens, under 30, and be non-Asian specialists. Application deadline: October 1. Details and applications: Prof. Skolnikoff, Rm E53-473, x3-3140.

New Subjects

Editors note: The following are new courses in literature for the fall term, pending approval by the Committee on Curricula. For further information, contact Humanities Office, Rm 14N-409, x3-4441, or the instructor.

21.127 MAJOR ENGLISH NOVELS
Prereq: None
Year: U
6-0-3
Tues & Thurs, 11am-12:30pm, Rm 14E-304, Professor Irene Taylor (Rm 14N-423, x3-4448).

21.131 LITERATURE AND POPULAR CULTURE
Prereq: None
Year: U
6-0-3
Tues & Thurs, 12:30-2pm, Rm 14E-304, Professor David Thorburn (Rm 14N-306, x3-6950).

21.132 AUTOBIOGRAPHY
Prereq: None
Year: U
6-0-3
Tues & Thurs, 1:30-3pm, Rm 4-156, Professor Barry Spacks (Rm 14N-420, x3-4452).

Club Notes

MIT Bridge Club*—Open pairs duplicate bridge. Thurs, 7pm, Stu Ctr Rm 473.

MIT Chess Club**—Chess and speed chess. Meetings Sat, 12n-7pm, Stu Ctr Rm 491. Info: x5-8156 Dorm.

MIT Goju Karate Club**—Mon, Wed & Fri, 7-9pm, Stu Ctr Rm 407. Info: Shawn x3-2018.

Student International Meditation Society*—Transcendental Meditation introductory presentation. Wed, Sept 15 & Wed, Sept 22, 3 & 7pm, Rm 4-145. Attend any session.

WTBS: All-Volunteer Radio Station—Open House wine & cheese recruitment party. Come if you're interested in broadcasting & broadcast journalism or radio electronics. We'll train if you've no experience. Entire community, especially freshmen, welcome. Sat, Sept 11, 4-6pm, Walker bsmnt.

Religious Activities

The Chapel is open for private meditation 7am-11pm daily.

Hillel Services*—Fri: Traditional, 7pm, Rm 50-005; Reform, 7pm, Chapel. Sat: Traditional 9:30am, Chapel; Reform, 11am, NW corner Killian Court (2nd fl Bldg W2A, if rain). **General Hillel meeting:** Tues, Sept. 14, 7pm, Stu Ctr Rm 400.

Prayer Time**—Lunch hour Bible classes led by Miriam R. Eccles. Fri, 1-2pm, Rm 20E-225. All are welcome.

Tech Catholic Community*—Masses Sun, Sept 12: 9:15am, 12:15pm & 5:15pm, Chapel.

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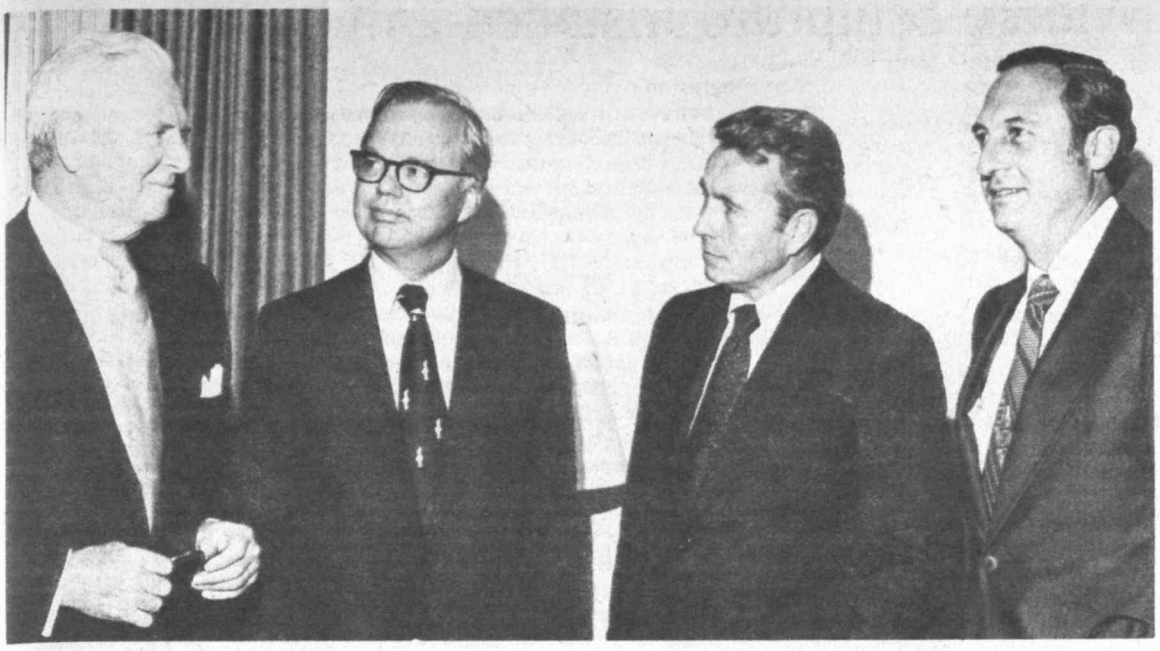


NEWEST ILO MEMBER—The most recent company to join MIT's Industrial Liaison Program is the Chrysler Corporation, and shown above on a visit to MIT to make the enrollment official are (left to right): Thomas F. Morrow, who until his recent retirement, was Chrysler group vice president-international; Howard W. Johnson, chairman of the MIT Corporation; Richard A. Vining, Chrysler group vice president-engineering, product development and purchasing, and Sidney D. Jeffe, Chrysler vice president for engineering. Mr. Morrow is a 1935 graduate of MIT and a member of the Corporation Development Committee. Chrysler's enrollment brings to 135 the number of companies that are members of the Industrial Liaison Program. The Program is one mechanism through which MIT is able to strengthen its relationships with industry and through which industry is able to provide support for MIT's programs in education and research.

Synthetic Fuels Subsidy Unwise, Researchers Say

Synthetic fuels and alternative sources such as solar and nuclear energy will not be realistic substitutes unless petroleum and natural gas become so inaccessible that the cost of recovering them equals or exceeds the cost of developing the alternatives, according to two chemical engineers at MIT's Energy Laboratory.

There is no shortage of energy, Dr. Ogden H. Hammond and Robert E. Baron state in the July-August issue of *American Scientist*, "but it is clear that there is a drastic shortage of energy at the prices to which we have become accustomed."

These conclusions have been developed in an article which focuses primarily on the historical development of synthetic fuels and the raw materials used in their production. The article traces the history of fuels and synthetics from the ancient Chinese to the present day and also examines and explains various synthetic fuels technologies, including hydrogenation, coal gasification, coal liquefaction and the use of oil shale and tar sands. Several diagrams illustrate many of the synthetic fuels processes.

The House of Representatives is currently considering a bill, already passed by the Senate, which would provide approximately $2 billion in loan guarantees and other subsidies to a variety of expensive energy supply technologies, particularly coal gasification and shale oil.

"A massive development of a synthetic fuels industry by means of some sort of subsidy appears unwise," Hammond and Baron write. "If synthetic fuels are subsidized, there will be less incentive to use capital and labor to reduce consumption..."

Hammond and Baron indicate that the extremely high cost of present synthetic fuel technologies makes them a questionable investment, particularly with current fuel prices.

"The part synthetic fuels will play in the future cannot yet be determined," they state. "It appears certain that there will again be a U.S. synthetic fuels industry of some sort, but how large that industry ought to be and how soon it should develop is unclear."

Whatever course of action is followed, Hammond and Baron predict that "the costs to the nation will be high" and the U.S. standard of living may be significantly affected.

Exam Reminder

Members of the faculty are reminded by Winston E. Flynn, assistant registrar, to fill out the questionnaire they received through interdepartmental mail recently concerning the scheduling of first term final examinations. Information is being solicited from the faculty earlier than usual this year, in an attempt to investigate alternatives to the presently scheduled examination dates.

Biologists to Hear Kennedy

Sen. Edward M. Kennedy (D., Mass.) will be opening speaker in a program, "The Biological Revolution: Cell Biology and Public Welfare," at 7:30pm today, Wednesday, Sept. 8, in Kresge Auditorium.

The evening program on science and public policy, which will include a panel of leading biomedical scientists, is a session of the First International Congress on Cell Biology being held Sept. 5-10 in Boston. Information on tickets for the program may be obtained by calling 734-3300, ext. 619.

Dr. Eugene Bell, MIT professor of biology, is a member of the local committee for the conference. Other MIT participants in the conference include Dr. Mary Lou Pardue, associate professor of biology; Dr. Uttam Lal RajBhandary, professor of biochemistry; Dr. Sheldon Penman, professor of cell biology; Dr. John M. Buchanan, John and Dorothy Wilson Professor of Biochemistry; Dr. Thomas R. Cech, postdoctoral fellow; Dr. Raymond E. Lockard, postdoctoral fellow, and James J. Bonner, a graduate student, all from the MIT Department of Biology; and Dr. Nicholas Catsimpoolas, associate professor of food biochemistry, and Dr. Ann L. Griffith, research associate, both of the MIT Department of Nutrition and Food Science.

Environmental Studies Brochure

The office of the Provost has published its sixth annual "Environmental Studies at MIT" brochure which contains a collection of information focusing primarily on environmental education and research activities at MIT.

An increasing number of academic departments and research laboratories are offering environmental programs for MIT students. These include the graduate professional degree, Environmental Engineer, in the School of Engineering, and undergraduate concentrations in environmental design offered by the Department of Urban Studies and Planning and in transportation offered jointly by the Departments of Urban Studies and Planning and Civil Engineering.

The brochure lists the names of the ed by the various departments as well as others at the Institute who would be sources of information for environmental studies. In addition, the brochure contains a partial list of the various subjects offered at MIT that relate to the environment. Copies of the brochure are available in the office of the Special Assistant to the Provost, Louis Menand III, Room 4-246 or in the Information Center, Room 7-111.

Pyschologists Resolve Question on Vision

MIT psychologists studying the development of vision have resolved one aspect of the debate on the relative influence of environment and heredity.

They have found that people see horizontal and vertical edges better than diagonals because they are born that way—not because they are "brainwashed" by seeing so many perpendicular buildings and square objects.

The argument that the trait is acquired had gained support several years ago when it was found that Canadian Indians living in tepee villages see diagonals better than the average city-dweller.

But the MIT researchers found a preference for vertical and horizontal lines in infants as young as two weeks old—too short a time to acquire the trait, especially while lying on one's back in a crib.

Other scientist have found that Chinese see diagonals better than Caucasians. Since Canadian Indians and Chinese are both of Mongolian descent, this suggests that the Indians' vision is determined by their genes, not by the sloping walls of their tents. Studies by other researchers support this interpretation.

The research was carried out by Dr. Richard M. Held, professor of experimental psychology; graduate student Susan C. Leehey; staff researcher Sarah L. Brill; postdoctoral fellow Jane Gwiazda; research associate, Joseph A. Bauer, Jr., and former postdoctoral fellow Anne Maskowitz-Cook. Pat Worthen is secretary to the group.

The research is funded by the National Institutes of Health, the National Aeronautics and Space Administration, and the Spencer Foundation.

The technique the researchers used was based on the premise that a baby would rather look at a pattern he or she can see, than at one that is fuzzy or undistinguished.

The baby was held by his mother or father in a darkened room, in front of a wooden partition with two circular screens. One screen showed vertical or horizontal stripes; the other showed diagonal stripes. (Which screen showed which pattern changed during the session.)

An observer watching through a peep-hole—but unable to see the screens—decided whether the infant looked for longer periods or more frequently at one screen than the other.

In one study of 24 infants from six to 50 weeks old, the researchers found that the infants preferred vertical and horizontal stripes except when the stripes were so wide that the child could see both patterns clearly, or when the stripes were so thin that the child could see neither pattern. The results have now been confirmed with infants as young as two weeks.

The researchers are now using the same techniques to study a defect of vision similar to the inherited preference for horizontal and vertical exes: astigmatism, or blurred vision along one axis.

They hope to determine whether it is possible to prevent some damage to vision by giving corrective glasses to children in early childhood.

Studies with kittens, both at MIT and elsewhere, indicate that visual neurons responsive to certain stimuli may atrophy, or fail to develop, if the stimuli are absent.

For example, when kittens were raised with goggles showing them only vertical lines, and then the goggles were removed, their visual neurons were at first considerably less reactive when a horizontal object came into view.

This suggests, Dr. Held said, that visual neurons might be desensitized not only by the absence of certain stimuli, but also by prolonged inability to see stimuli because of defects in the eye. In fact, he said, many adults with astigmatism do show "markedly lower acuity" even when the defect is corrected optically.

"The implication is that the neural damage has occurred—perhaps because the astigmatism was not optically corrected soon enough.

To test that theory, Dr. Held and his colleagues are studying astigmatic infants. First, an optometrist diagnoses astigmatism by studying light refraction in the eyes; then the vision of the child is tested with and without corrective glasses. So far they have studied children up to one year old.

The results suggest that with optical correction, an infant astigmat doesn't seem to show neural loss," Dr. Held said. "This appears to mean that when loss of vision is detected even with optical correction, it will be found only after the first year. But this is so far a tentative conclusion."

The researchers are now continuing their studies of astigmatic children.Children less than a year old are tested in the same way as the infants tested for diagonal vision. But children more that a year old don't respond to that method.

Apparently the older babies no longer find a simple pattern of stripes so enthralling that they will sit still and stare at them.

For the older babies, another method is used. Electrodes placed on the child's skull measure electrical response of the brain to visual stimuli of different orientations—vertical, horizontal and oblique—as the child watches a circular screen with a slowly rotating striped pattern.

To keep the child's interest, a color cartoon is superimposed on the pattern. The researchers have found that giving the very young children a bottle also keeps them calm enough to work with.

Wulff Book Issued

An Introduction to Materials Science and Engineering, written by Dr. John Wulff, professor of metallurgy, emeritus, in the Departmen of Materials Science and Engineering at MIT, has been published by John Wiley & Sons.

Co-authors of the college text with Dr. Wulff are Dr. Kenneth M. Ralls of the University of Texas at Austin, and Dr. Thomas H. Courtney of the Michigan Technological University.

Urban Studies Graduates Find Variety of Careers

Urban studies majors in the Department of Urban Studies and Planning are highly employable and have gone on to a wide variety of careers since their graduation from MIT, a survey has shown. The career fields most heavily represented are urban planning, law, management and medicine.

The survey was undertaken to learn about the employment and education experiences of the 83 students graduating from the time the departmental major was established in 1970-71 through 1975.

Dr. Langley C. Keyes, professor of city and regional planning and the head of the department, said the research results will be used to guide curriculum improvements and to broaden the base of information available to MIT students considering majoring in urban studies.

The survey was conducted by Dr. Robert Hollister, assistant professor of urban studies and the department's undergraduate officer, assisted by Ruth Kolodney, administrative assistant.

These were the major findings:

—Most of the department's majors have done graduate work either immediately after getting their SB or after working for a period. Eighty percent of the respondents have an advanced degree or are enrolled in an advanced degree program.

—The most striking fact with respect to graduates' schooling beyond the SB is the variety of fields in which they have sought advanced training (although in recent years increasing proportions have gone on in urban planning). Among those who have received or are presently working toward advanced degrees are 14 in urban and regional planning and urban affairs (this figure would almost double if it included students presently enrolled in the department's five year SB/MCP program); 10 in law, five in management and business, five in medicine, three in education and two in architecture and urban design. Other fields are sociology, computer science, engineering, systems dynamics, religion, philosophy and public affairs.

—Graduates with and without advanced degrees have landed responsible and interesting jobs in both the public and private sectors. A few examples: law assistant, House of Representatives, Washington; senior environmental engineer, Waldon Research, Cambridge; transportation planner, Barton-Aschman Associates, Washington; deputy director, Massachusetts Energy Policy Office; planner, Candeub, Fleissig and Associates, Newark, N.J.

—Graduates have secured decent salaries in their first full-time employment. The Urban Studies program is too new to have much data on salary increases over time, but the experiences of graduates in 1971 and 1972 indicate healthy advancement in both responsibility and salary levels.

The average starting salary for 1971-75 graduates with an SB (making no correction for inflation) is $10,250; the average for graduates with an advanced degree is $13,600. The high and low first full-time salaries for those without an advanced degree were $16,500 and $5,500; for those with an advanced degree, $21,700 and $9,600.

The average present salaries for the classes of 1971, 1972 and 1973 are, respectively, $15,400, $13,000 and $16,300. The high salaries for the same three classes are $19,000, $24,000 and $21,700 and the lows $10,700, $5,500 and $13,000.

—While a number of graduates have experienced brief periods of unemployment, their rate of unemployment is relatively low compared with recipients of bachelor's degrees in other fields, including the sciences and liberal arts.

THE INSTITUTE CALENDAR

September 8 through September 19

Events of Special Interest

International Open House for Newcomers from Abroad — "Here's Boston" slide show by Gregory Smith, UROP staff, member of MIT Corporation. Wed, Sept 8, 7-8pm, Rm 10-105. **Open House** continues through Thurs, 9:30am-5pm, Rm 10-105.

Graduate Orientation '76 — Sponsored by Graduate Student Council. **Thurs, Sept 9**: Welcoming in Kresge Auditorium, followed by coffee & donuts (Kresge Lobby) and videotaped workshops on key offices (Kresge Little Theatre & Sala), 9:30am. Graduate Activities Midway, including taking of graduate *only* ID pictures (avoid Registration Day lines), 10:30am. Picnic in Killian Court with departmental representatives. Tickets $1.50, in Rm 3-136 or GSC Office, Rm 50-110. Followed by Departmental Open Houses, 2-4pm. **Fri, Sept 10:** Videotaped workshops shown all day (11am-6pm) in Muddy Charles Pub (Rm 50-110). Faculty Club Gala Dance 8pm-1am, 6th fl Bldg E52. Music by Disco Sounds, cocktails served (2 at 50¢/ea). Information Center all week, Rm 3-136, Graduate School Office.

Seminars and Lectures

Wednesday, September 8

Nonlinear Estimation Theory and Phase-Lock Loops* — John Eterno, G. Aero/Astro Thesis Presentation. 2pm, Rm 37-252.

Thursday, September 9

Mapping *Gag* and *Pol* Regions on the RSV Genome — Dr. Peter Duesberg, molecular biology & Virus Laboratory, University of California at Berkeley. Nutrition & and Food Science Seminar. 4:30pm, M&D 404, Tufts University. Tea 4pm, M&D 406, Tufts.

Friday, September 10

Active Control of High Speed Rail Vehicles — Prasun K. Sinha**,** G. Aero/Astro Thesis Presentation. 2pm, Rm 33-206.

The Spectrum of Resonance Fluorescence Induced by a Monochromatic Field ** — Frederick Y. Wu, G. Aero/Astro Thesis Presentation. 4:30pm, Rm 33-206.

Monday, September 13

Science Library Open House — New graduate students and staff members especially welcome. 2:30-4:30pm, Rm 14S-100. Refreshments.

Tuesday, September 14

Two-Photon Spectrum of Benzene* — John R. Lombardi, chemistry, CUNY. Seminar in Physical Chemistry. 4pm, Rm 4-370. Coffee 3:45pm, Rm 6-321.

The End of Objectivity: An Introduction to Existential Philosophy, Part I: The Heritage of Rationalism* — Gian-Carlo Rota, applied mathematics and philosophy. Concourse Lecture. 7pm, Rm 2-390.

Wednesday, September 15

Lecture on Transcendental Meditation** — Sponsored by Student International Meditation Society (SIMS). 3 & 7:30pm, Rm 4-145. Info: Terry King, x3-6821.

Community Meetings

MIT Women's Forum** — Meetings Mon, 12n, Rm 10-105. **Mon, Sept 13**: Social meeting with punch, cheese & crackers. All MIT women invited, especially students. Nominations for 3 Forum representatives to Women's Advisory Group (elections following week).

Student Art Association Classes** — Fall program offers a variety of 10 week classes, ranging from drawing to photography to jewelry making (complete list available Stu Ctr Rm 429.) Open to entire community, preference given to students. Classes begin Mon, Sept 20. Registration: Mon, Sept 13-Fri, Sept 17, (also 5-8pm on Wed), Stu Ctr Rm 429. Payment due at registration.

Technology Wives Organization Welcoming Party* — Everyone invited to TWO's welcoming party, especially newcomers and their families. Sun, Sept 12, 2pm, patio in front of Kresge. Fresh watermelon, apples, homemade bread. We'll be happy to answer your questions about MIT & Boston area.

Regisration Day Ice Cream Party** — Sponsored by Association for Women Students (AWS). Mon, Sept 13, 2-4pm, Stu Ctr Mezzanine Lge.

MIT Women's League Mushroom Walks*** — Margaret H. Lewis will conduct walks Tues, Sept 14, Wed. Sept 22, Wed, Sept 29 & Tues, Oct 5, 10am-12n, at different sites. Will learn to collect and identify a few mushrooms with confidence. Limited to 50. Mary Pinson, x3-3656 or Terry Palty, 334-4810.

Association for Women Students** — Steering Committee meeting Tues, Sept 14, 4pm, Rm 3-310. Please come share our suggestions for future meetings & projects, new ideas. New members always welcome, men and women invited.

Technology Nursery School — Now accepting applications for new school year from MIT children, ages 2 years, 9 mos. to 4 years, 9 mos. There are 2-day, 3-day and 5-day progarms. Eastgate: 9am-1pm weekdays (bring lunch); Westgate: 9am-12n weekdays (no lunch). Info: x3-5907.

Social Events

Hillel Social Events* — Wed, Sept 8: Cocktail party (free) 9pm, Senior House. Note change in day. **Sat, Sept 11:** Coffee house with felafel & live entertainment, 9:30pm, bsmnt of 312 Memorial Dr. **Sun, Sept 12:** Lox & bagel brunch for students & parents, 11am, Rm 10-105. Speaker.

Faculty Club Special Dinners*** — Thurs, Sept 9:** Lobster Nite. Baked or Broiled, salad bar, dessert cart, $7.95 + tax. **Thurs, Sept 16:**Rib Nite. Complete dinner $6.50 +tax. RSVP for all, x3-4896.

Movies

Sleeper** — LSC. Fri, Sept 10, 7 & 9:30pm, Kresge. Admission 75¢, MIT or Wellesley ID required. Free for freshmen!

Dr. Strangelove** — LSC. Sat, Sept 11, 7 & 9:30pm, Rm 26-100. Admission 75¢, MIT or Wellesley ID required.

LSC Registration Day Movie** — To be announced. Kresge.

Wind from the East* — MIT Film Society. Fri, Sept 17, 7:30 & 9:30pm, Rm 6-120. Admission $1.

Music

Festival Jazz Band & Concert Jazz Band** — Auditions Sun, Sept 12, Kresge. Jazz Band 10am, Festival Jazz Band 6pm.

Choral Society** — Auditions Mon, Sept 13, 7:30pm, Rm 10-250.

MIT Brass Ensemble** — Sight reading rehearsals Tues, Sept 14 & Tues, Sept 21, 5:30pm, Kresge.

MIT Symphony Orchestra Auditions — Auditions begin Tues, Sept 14, 7:30pm, Kresge (open rehearsal). There are vacancies in almost every section and all members of MIT community are welcome to audition. Stop at Activities Midway or call Jim Heeger, x5-9454 Dorm, with questions.

MIT Chamber Music society** — Auditions Wed, Sept 15, 8pm, Kresge Rehearsal Rm B.

Dance

MIT Folk Dance Club — International: Sun, 7:30-11pm, Sala. **Balkan**: Tues, 7:30-11pm, Stu Ctr Rm 491. **Informal:** Fri, 12n-2pm, Kresge Oval (in good weather). **Israeli**: Thurs, 7:30-11pm, Sala.

Exhibitions

Photographs 1970-1976* — Exhibition of photographs by Jonathan Green. Thurs, Sept 2-Wed, Sept 29, Hayden Corridor Gallery. Sponsored by MIT Committee on the Visual Arts.

MIT Faculty Club Exhibit* — Susan E. Schur paintings on exhibit during Sept.

Chris Sproat: Made in Hayden* — Exhibitions of works constructed in Hayden Gallery space. Sponsored by MIT Committee on Visual Arts. Fri, Sept 3-Sat, Oct 2, Hayden Gallery. Hours: Mon-Sat, 10am-4pm. Reception: Fri, Sept 10, 8-10pm.

Strobe Alley* — High speed photographs by Harold E. Edgerton, Institute Professor and Profeesor of Electrical Measurement, Emeritus. Bldg 4, 4th fl.

Music of the Celestial Dieties* — Music Library exhibit of manuscript facsimiles & pictures. Daily, Bldg 14E.

Hart Nautical Museum* — Permanent exhibit of rigged merchant and naval ship models of yachts and engine models. Bicentennial exhibit: "1776-1976" — a frigate, 2 schooners, a gondola, and the Durham boat of the American Revolution. Open daily in Bldg 5, 1st floor.

MIT Historical Collections* — Permanent exhibition Mon-Fri, 9am-5pm, Bldg N52, 2nd floor. **Bicentennial Exhibits**: Karl Taylor Compton; and Norbert Wiener, 1876 exhibit, Bldg 4 corridor. **The New Technology Exhibit** and **Energy Exhibit**: 2nd floor balcony.

Freshmen are encouraged to attend departmental lectures and seminars. Even when these are highly technical they provide students one means to learn more about professional work in a department and field.

***Open to the public**
****Open to the MIT community only**
*****Open to members only**
Send notices for July 28 through Aug 15 to the Calendar Editor, Room 5-111, ext. 3-3279, before noon Friday, July 23.

MIT's Viking 2 Experimenters Pleased With Initial Data

By WILLIAM T. STRUBLE
Staff Writer

Viking 2 lander is sending back first data from the Utopia Plains on Mars and one group of MIT scientists involved in the mission to the Red Planet is more than usually pleased with the results to date.

Dr. M. Nafi Toksoz, MIT professor of geophysics and a member of the Viking seismology investigation team, reported Tuesday (Sept. 7) from the Jet Propulsion Laboratory in California that the Viking 2 seismometer was operating and producing data.

"Tomorrow we will get into the full-scale monitoring mode," Dr. Toksoz said. In three days' of data gathered to date "we have not seen any large Mars quakes, but we had not expected to," he said.

That the Viking 2 seismometer is working to some extent assuages the keen disappointment felt by the seismology team when an identical instrument on Viking 1 was left inoperable because its protective mechanisms failed to release. The mechanisms were designed to cage and protect the instrument's sensing elements during launch and landing shocks.

With Dr. Toksoz at JPL were Dr. Anton Dainty, research associate in the MIT Department of Earth and Planetary Sciences, and Kenneth R. Anderson, a graduate student. Dr. Toksoz is a member of the faculty of the department and director of MIT's George R. Wallace Geophysical Laboratory.

In the molecular analysis experiment, Dr. Klaus Biemann, MIT professor of chemistry and leader of the team, also reported on Tuesday from JPL that the gas chromatograph-mass spectrometer (GCMS) had been checked out for mechanical problems and the first sample oven had been moved into loading position.

The team will run a few atmospheric analyses in the next two or three days, repeating the measurements made on Lander 1, Dr. Biemann said.

"Now we are in the midst of deciding where to pick the sample," he said. Dr. Biemann referred to the lander's telescopic arm, which is scheduled to reach out and scoop up soil samples—on Saturday—for the biology experiments, and on Sunday, for the GCMS. If the samples are successfully retrieved, a variety of soil tests will then begin, with emphasis on the search for organic compounds of either biological or non-biological origin. "We will try our best to find even small organic compounds this time," Dr. Biemann said.

To do so, changes will be made in the sequence of the gas flow through the sample while it is heated up in the GCMS, he said. This time, the soil sample will not be flushed with C^{13}-labeled CO_2, which obscures the early part of the gas chromatogram, Dr. Biemann said. Hydrogen will be used instead, thus eliminating the obscuring effect, he said.

The soil tests will also repeat the analyses of the active biology investigation team, a member of which is Dr. Alexander Rich, Sedgwick Professor of Biology at MIT.

Three of the MIT Viking scientists are co-authors of two of 13 reports on Viking 1 that appeared in the Aug. 27, 1976, issue of *Science*, magazine, published by the American Association for the Advancement of Science.

Dr. Biemann is co-author of a report, "Composition of the Atmosphere at the Surface of Mars: Detection of Argon -36 and Preliminary Analysis." Co-authors of the report, "Viking Lander Location and Spin Axis of Mars: Determination from Radio Tracking Data," are Dr. Irwin I. Shapiro, professor of geophysics in the MIT Department of Earth and Planetary Sciences and a member of the Viking radio science team, and his associate, Dr. Robert Reasenberg, staff member in the department.

In addition, the Scientific and Technical Information Office of the National Aeronautics and Space Administration (NASA) has published an 80-page book, "Viking 1 Early Results," the first formal report of early scientific results from the mission.

Black Graduate Student Directory Issued

A directory of black graduate students has been published for the first time at MIT as an aid for students who will be starting their studies in September.

"Because black graduate students are only about four percent of the total graduate student body at MIT, they often suffer from loneliness and feelings of isolation," John B. Turner, assistant dean of the Graduate School, said. "The directory may help reduce the problem."

In addition to listing the names and departments of continuing and new students, the directory also includes the names of black faculty members and key black staff members who may be of help to incoming students.

Also included are brief descriptions of on-campus resources such as the Housing Office, the Medical Department and the Black Student Union Tutorial Program. A listing of selected off-campus facilities ranging from barbershops to churches and the Museum of Afro American History completes the tabular section of the directory.

An introduction to the 25-page brochure includes brief statements by present black graduate students on how they view MIT from their personal experiences and a section on "Random Thoughts" by various other graduate students.

The booklet is part of an orientation program that includes a two day program for minority graduate students on September 10 and 11. New students will be given briefings by department heads and student support staff members, meet present graduate students, and be entertained at a social bazaar.

ADP-VIII Announced

The Office of Personnel Development is now accepting applications for the next Administrative Development Program, ADP-VIII.

The program, which is open to all faculty, staff, and exempt employees of the Institute, provides professional development for those with administrative and management responsibilities at MIT. More than 200 people have participated in the program thus far.

Those interested in participating in ADP will be asked to attend a counseling panel session. In these sessions, former ADP participants will discuss course structure and content, share their own ADP experiences, and answer questions. Course descriptions and application forms for ADP VIII will be available at the counseling sessions, which will be scheduled through September 21st. Applicants may call Ellen O'Hara on ext. 3-4276 to sign up for a counseling session.

Applications for the ADP VIII must be received in the Office of Personnel Development, E18-320, by September 28. A selection committee comprised of a sub-group of the Academic Council will choose participants according to criteria designed to achieve a heterogeneous group from Institute departments, laboratories, and centers.

The first class of the Organizational Psychology section will be held on Wednesday, October 13, from 1:30 to 5:00 in E18-320. This section will meet every Wednesday for 10 weeks. The schedule for the Financial Management section, to be held in Spring 1977, will be announced at a later date.

Women's Forum Lists Programs

The Women's Forum—a community-wide group representing women at MIT—will launch its fifth year with an Open House Monday, Sept. 13, in the Bush Room (10-105) from noon to 1pm, with punch and crackers and cheese.

Meetings of the Forum are held every Monday (except for holidays) and are open to all members of the community, including men. The format is a bring-your-own-lunch lecture or discussion of topics of interest to women.

Programs for the upcoming weeks include an introduction to the various other MIT women's groups on Sept. 20, films of skits by the Lincoln Lab Women's Forum on Sept. 27, and the premiere of "Women's Work: Management," on Oct. 4 in the Little Theatre.

Scientists Complete Synthesis of Man-Made Gene

(Continued from page 1)

Alfred P. Sloan Foundation.

Dr. Khorana said that the work differs from all other test-tube syntheses of genes in that the natural gene was not used as a template. The strategy he and his co-workers have developed "allows completely controlled manipulation of gene structure," he said.

"Starting with natural nucleic acids you can only replicate what exists in nature," he said. "With chemical synthesis we can alter specific parts of the gene, carrying out deliberate 'mutations' of all kinds to study their influence on the gene function."

Interactions with Protein

He is particularly interested in studying the interactions between the genetic material (DNA) and proteins. Only a small portion of genetic material serves as the blueprints for making RNA, which then makes proteins, he said. The majority of genetic material controls the function of genes, by interacting with proteins that act as enzymes.

The MIT scientists used the naturally occuring gene only to derive the sequence of the four building blocks (the nucleotides adenine, thymine, guanine and cytosine) making up the gene and its control signals.

They constructed the gene in several steps, using the principles of subassembly.

First they developed chemical methods to hook together commercially synthesized nucleotides in the correct order, to make gene segments 10 to 15 nucleotides long. Each segment was a portion of one of the two complementary strands of DNA forming the gene.

Forty such segments were synthesized, an effort spanning nine years and involving the participation of 24 postdoctoral fellows.

After each segment was made, the scientists had to purify it. Dr. Khorana said the particularly dramatic progess has been made with a rapid, high-pressure liquid chromatography method developed by Dr. Fritz.

In the final phase, enzymes were used to link the 40 single-stranded segments into the entire double-stranded DNA, forming the structural gene and its control signals.

Dr. Khorana said that the scope of the chemical synthesis of genes is very different from the more rapid, controversial techniques known as "recombinant DNA," in which DNA from different organisms are joined together to study their expression.

He said that his work on the tyrosine transfer RNA gene does not present "any risk whatsoever," in relation to the recent debate on recombinant DNA.

"We are dealing with a completely defined system, containing a single transfer RNA gene which is already present in, and absolutely necessary to, all living cells," he said.

Background on the Gene

The gene is the basic unit of all heredity. It consists primarily of a long, double-stranded molecule of deoxyribonucleic acid (DNA). The two strands twist into a double helix, often described as resembling a spiral staircase.

The individual units of DNA are called nucleotides. The most commonly found nucleotides are adenine, thymine, guanine and cytosine—abbreviated "A," "T," "G," and "C."

In the double-stranded DNA molecule, each adenine on one strand pairs with a thymine on the other strand, and each cytosine on one strand pairs with a guanine on the other strand. One nucleotide is, thus, complementary to the other—naturally bonded to it because of its mutually attractive chemical form.

This complementary pairing of nucleotides (and, thus, DNA strands) is extremely valuable for biologists building genes and determining their sequences.

When information from the genes is to be transmitted into functioning protein molecules in the cell, special enzymes begin transcribing information by building a complementary strand of ribonucleic acid (RNA) along one strand of the DNA.

Like DNA, RNA consists of a string of nucleotides, each of which pairs with a nucleotide on the DNA strand. When the enzymes have completed their synthesis of the strand of RNA, the RNA strand breaks from the DNA and is used to synthesize protein molecules.

There are three types of RNA synthesized on DNA strands.

One type, called messenger RNA, represents the cell's method of translating information from the gene into proteins. These proteins will be the workers of the cells, chiefly as enzymes which aid the cell's chemical reactions.

Another kind of RNA is ribosomal RNA. This RNA folds up after leaving the gene, to form ribosomes. These ribosomes provide a "holder" which messenger RNA uses to translate its information into protein.

But some method is need to grab amino acids, the building blocks of proteins, and carry them to the ribosomes, where they can be incorporated into proteins specified by messenger RNA. This is the function of the third kind of RNA—transfer RNA.

Professor Khorana and his colleagues have synthesized the gene that codes for a particular kind of transfer RNA—the kind that grabs the amino acid tyrosine, brings it to the ribosome, and allows it to be incorporated into a protein. Hence, the name of their gene is the "tyrosine transfer RNA gene."

Start and Stop Signals

Start and stop signals at either end of the gene direct the enzymes that asemble nucleotides along one strand of DNA, to form a strand of RNA. These signals consist of additional sequences of nucleotides.

The start signal for the tyrosine transfer RNA gene, as determined by the MIT scientists, consists of 59 nucleotides. Particularly interesting to the scientists are the regions of symmetry, in which a number of bases in one part of the strand are complementary to another group of bases, read backward, farther down the strand.

For instance, one region of the start signal has the sequence TCAT, while further down the strand, reading backwards, is the complementary sequence AGTA.

Professor Khorana and his colleagues theorize that this indicates that the start signal may fold in some three-dimensional manner to offer a recognizable shape to the transcription enzyme.

Similar, though less extensive elements of symmetry were found in the 23-unit stop signal.

History of the Gene Synthesis

Professor Khorana and his colleagues began work on the tyrosine transfer RNA gene nine years ago, while still at the University of Wisconsin, Madison. In 1970 Professor Khorana announced synthesis of the first artificial gene, the gene for alanine transfer RNA from yeast. By construction of this gene, Professor Khorana proved that chemical and enzymatic techniques could be applied to such syntheses.

The 77-unit gene, however, could not be used for further studies, because its functioning in a living cell could not have been detected.

Also, the scientists did not know the nature of the start and stop signals for the gene. These are vital for the cell machinery to recognize the gene and utilize its information in cell processes.

The *E. coli* gene for tyrosine transfer RNA was much easier to work with. Researchers in Cambridge, England, had determined the sequence of the gene, and had done extensive work with it, giving the MIT researchers a base on which to build.

Dr. Khorana and his colleagues also decided to synthesize the tyrosine transfer RNA gene because of a development which would enable them to detect the gene's functioning in a living cell.

In *E. coli* most of the genes are used for the synthesis of proteins. Occasionally a certain mutation in such a gene can result in a stop signal within a gene.

The result is a nonfunctional protein which is shorter than normal. This mutation, scientists have found, can be suppressed by a second mutation in another gene of *E. coli*. The English scientists discovered that this second mutation was within the gene for a tyrosine transfer RNA. For this reason the second gene, which was the one synthesized by Dr. Khorana, is often called "tyrosine suppressor transfer RNA gene."

This suppressor transfer RNA cancels out the stop signal and introduces the amino acid tyrosine instead. This results in a protein of normal length which in many cases is fully functional. Dr. Khorana and his colleagues can, thus, test the operation of their man-made gene by introducing it into the mutant bacterium, using a virus to carry it into the bacterium. If the gene works, the *E. coli* proteins are normal.

The MIT team originally began synthesizing only an 85-unit tyrosine transfer RNA gene, which they believed coded for the entire product transfer RNA. In 1970, however, the Cambridge, England, scientists, Drs. Sidney Altman and John Smith, found that there was an additional 41-unit segment of the gene. This total 126-unit gene coded for what was called a "precursor" transfer RNA, which was longer than a functioning transfer RNA. For some unknown reason, after the long "precursor" transfer RNA chain is synthesized, the extra 41-unit protein is enzymatically split off, creating functioning transfer RNA. Dr. Khorana then began work on the longer 126-unit gene, with an additional aim of finding the function of the extra 41-unit portion.

Synthesizing Small Units

Professor Khorana and his colleagues build the gene and control signals by synthesizing small ten-to-fifteen unit segments of the gene from individual nucleotides. Each segment consists of a complementary portion of two opposing segments of the two-stranded molecule. Thus, each segment acted as a "splint" to attract and hold together two opposing segments, which could then be tied together by an enzyme called DNA ligase. The scientists design each part of the synthesis so that the joined segments still have a leftover single-stranded segment extending beyond the double-stranded segment. This leftover segment can be used as a splint to attach more segments of the gene.

The MIT scientists point out that their synthesis is but a beginning step in the investigations of the gene. Their gene, plus control signals, is only about 200 units long, as compared with the typical human gene which measures in millions of units.

Members of the MIT team that completed the synthesis of the first man-made gene get together with their leader, Nobel laureate Dr. Har Gobind Khorana, who directed the research. The group synthesized the bacterial tyrosine transfer RNA gene and implanted it in a living cell, where it proved to be fully functional. Here the group views photo slides that accompanied the presentation of papers announcing the work on Aug. 30 at the national meeting of the American Chemical Society in San Francisco. In the group, left to right, are Dr. Robert G. Lees, Dr. Michael J. Ryan, Dr. Khorana (seated, holding papers), Dr. Ramamoorthy Belagaje, Dr. Hans-Joachim Fritz, and Dr. Eugene L. Brown.

Synthetic Tyrosine tRNA Gene

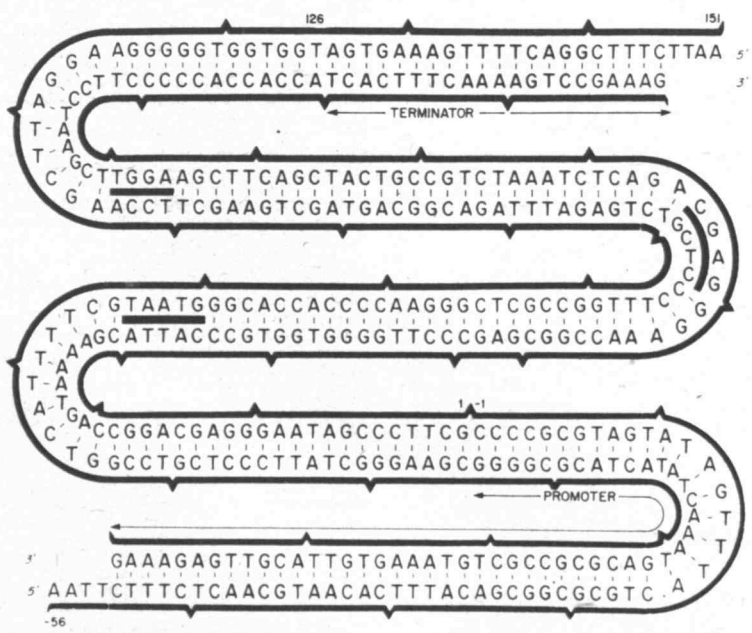


Diagram of complete double-stranded structure of synthetic *E. coli* tyrosine transfer RNA gene, including control elements (promoter and terminator), synthesized in the laboratory of Dr. Har Gobind Khorana at MIT. Segments between points were synthesized chemically, then joined enzymatically to form the entire DNA double helix. The numbers 3' and 5' (three prime and five prime) refer to the polarity of the individual DNA strands. Counting of monomer units starts at the origin of transcription.

Har Gobind Khorana

Dr. Har Gobind Khorana, Alfred P. Sloan Professor of Biology and Chemistry at MIT, shared the 1968 Nobel Prize for his work on unraveling the genetic code. By synthesizing artificial DNA which contained reiterating sequences of nucleotides and studying how they functioned in a test-tube, he was able to find out how the coded information in genes specifies amino acid components of proteins.

Dr. Khorana extended his work to the synthesis of long nucleotide chains and in 1970 announced synthesis of the first artificial gene—for yeast alanine transfer RNA.

Professor Khorana was born in 1922 in Raipur, India. He received his bachelor's and master's degress in chemistry from the University of Punjab, India. In 1948 he took a doctoral degree in chemistry from the University of Liverpool in Great Britain.

He came to MIT in 1970 from the Unversity of Wisconsin, where he was professor in the Enzyme Institute.

The author of more than 300 research papers, Dr. Khorana is a member of the National Academy of Sciences and an honorary member of the Soviet Academy of Sciences.

Thomas P. McLennan Dies

Funeral services were held Saturday, Sept. 4, for Thomas P. McLennan, coach of MIT's highly successful pistol teams for the past 10 years. Mr. McLennan, who would have been 52 on Labor day, died Wednesday, Sept. 1, following surgery at Choate Memorial Hospital, Woburn.

Mr. McLennan came to MIT in 1965 following more than 20 years in the U.S. Air Force where he had been base range officer and officer in charge of marksmanship training at Hanscom Field. While in the Air Force he set a number of individual match records and coached several pistol teams to high finishes in competition with other Air Force units.

At MIT Mr. McLennan had taught marksmanship to several thousand students and employees. The MIT pistol teams were drawn from the ranks of his marksmanship students since few of them, if any, had ever done target shooting before coming to MIT.

Under his coaching, the MIT pistol team was twice National Pistol Champion and always posted a winning season. More than half a dozen of his students won All American status.

In addition, Mr. McLennan taught firearms safety and rifle shooting to hundreds of children at the MIT Day Camp where he was known as "Uncle Tom."

Survivors include his widow, Frances, of Woburn; a son, Thomas P. McLennan, III, of Woburn; three daughters, Kathleen McLennan and Mrs. Nancy Neira of Woburn, and Mrs. Janice Saria of Burlington, and three grandchildren.

CLASSIFIED ADS

Ads are limited to one per person per issue and may not be repeated in successive issues. All ads must be accompanied by full name and Institute extension. Only Insitute extensions may be listed. Members of the community who have no extensions may submit ads by coming in person to the *Tech Talk* office, Room 5-111, and presenting Institute Identification. Ads may be telephoned to Ext. 3-3270 or mailed to Room 5-111. **Please submit all ads before noon, Friday, Sept 10. They will be printed on a first come first serve basis as space permits.**

For Sale, Etc.

PDP-1 mainframe w/logic & 48K core for components, free or cheap to MIT user only; compl 24K PDP-11 Unibus memory; 12" tape-seals, 10 $1.50; fanfold paper tape trays, 25¢. Alan Goldberg, x3-4900.

M Eng 3 spd bike, gd cond, $20; bckse; lamps. Allan, x3-3226.

Canon FT6 w/50 mm f1.8 FD lens w/UV fltr, shldr strap, soft release bttn & instr bklt, exc cond, alum frame blk gadget bag w/interior compartments, $15; 30 day limited grnty. Kevin, 547-4135, aft 7pm.

Simmons beautyrest full sz matt, lk nw, $80. Call 628-3046.

(2) lt blu carpets, 9x12, $35/ea; lg vinyl 2 pc couch, gd cond, $60; or best. Mike, x3-6487.

F 3 spd Schwinn bike, used 4-5 times, exc cond, lk nw, $60 or best. Karen, x3-3651.

Dynaco SCA-80Q integrated amp, 40 W/ch, assembled, 5 mos, w/cab, ask $135. Ed, 876-0113, aft 6pm.

Sm Advent spkrs w/blank wrntys, $120; Pioneer SX 434 rcvr w/blank wrnty, $120; Advent 201 cassette deck w/dolby, $200; Maxell UDC 90 cassettes, best. Martha, 661-7631, evgs.

K sz matt, $20. Call 738-4252, 8:30-9:30am or 7-10pm.

F 10 spd 25" bike, $70; (4) H78x15 tires, mtd 6 bolt Chevy rims, glass belt, 30% tread remaining, $70; tires only, $45. Gary, x3-7006, 10-6.

F camel hr coat w/rabbit fur trim collar & cuff, exc cond, sz 12, $50. Susan, x3-4701.

Pr BF Gdrich slvrtown belted tires, yr, gd cond, $25. Jim Burrington, x3-1836.

Patterned 9x12 carpet, $30; plant light, $14; 2 unfinished chrs, $18. Chris, x7851 Linc.

AC, 11,000 BTU, cools 2-3 rms, $170 or best. Steve, x3-1639.

Lg blk mtl desk, $20; sm wht desk, $10; dbl bed, $30. Call 734-7998.

Yamaha FG 200 folk guitar, gd cond, case, nw $200, ask $120 or best. Call 876-0063, aft 6pm.

(3) E78x14 tires, fair-gd tread, $15/all; compl flyrod outfit 8½', 5½ oz., w/reel, line & case, exc cond, $25. Delaney, x5304 Linc.

For your garden: quality manure from quality horses, free. Call 369-1938.

Sovereign Harmony stl str guitar, sounds gd, best. x3-5788.

Grady 18' wht w/trlr, 75 hp Johnson, exc cond, incl all access, all safety equip, $2,000 firm. Don, x3-2254.

Yel wicker armchr, gd cond, $65. Steve. x3-4680.

AR man trntbl w/Shure M93 crtrdg, dust cover, wlnt base, best over $40. x8-1357 Draper.

Counter hi refrig, $40; AC, $35; dual brnr hotplate, $15, kp try. John, x5-6256 Dorm.

RCA 19" clr TV, $120; sgl bed, $10; asst draperies. Call 628-3051.

Blu 8½x12' carpet; f 3 spd bike; tire pump; sm K tbl w/2 chrs; rocking horse kit; TV trays. Mike, x3-5824.

Qn sz bed, $15; elec heat massager, $6.50; Polaroid super shooter Land camera, $16; 2 typwrtrs, $20 & $30. Beng, x3-3124.

BIC Venturi formula 6 spkrs, $350 or best/pr. Charles, x5-9456 Dorm.

Lg wd desk, $20; desk lamp, lk nw, best; weights, lk nw, best. x5-9668 Dorm.

Couch & chr, $75; stu desk, $5; Phillips 3 spd f bike, $65; twn bed, matt, spr, frame, $75; crib & matt, $40; 2 coffee tbls, $40 & $18; 2 humidifiers, $10/ea; mag end tbl, $5; bkshlf, $5. Call 891-5205.

Port b&w TV, lg scr, easily transported, plays but can use some attention, best over $50. x3-1986.

Hoover port washer & dryer, works well, $70. Call 648-1838.

Remington mdl 99 calc, $75 or best. Matt, x8-4476 Draper.

F 10 spd bike, 5 mos, $70; Singer sew mach, exc cond, $150. Call 494-0146.

Aquar, 55 gal w/std, tank leaks, $50. Charlie, x7133 Linc.

Dbl bed, $30; sm desk, $10; dresser, $10. Liz or Jock, 267-3130.

Nice sm brn carpet, $22; LR chr, $15; bkcse, $20; sm brn TV tbl, $10; 25" m Raleigh Intnl bike, nw $310, wl sacrifice $220; 25" m Dawes bike w/Reynolds tubing, sacrifice $120. Dennis, x8-4583 Draper.

Set pots & pans & sgls, exc cond, $20/all. x3-5364.

Refrig/frzr, 9 cu ft, exc cond, 2 yrs, perf for apt, $70 or best. Brian Evans, x3-6375.

Molded foam chrs, 1 cinnamon clr, 1 cranberry, washable covers, v comf, suitable LR or BR, exc cond, $150 nw, ½ price or best. x3-3503.

Dinner set, 45 pc srvc for 8, brn & gold, $15. Call 547-6471, evgs.

Philco 23" b&w TV, less yr old, orig $205, $100 or best. Call 646-0181.

M 3 spd bike, $25. x5898 Linc.

Qn sz matt, box spr & frame, $50. x7452 Linc.

Marantz 2270 rcvr, $250; Rectilinear III spkrs, $350; Sony TC 355 tape deck, $75; Dynaco Pat 4 preamp & Dynaco 120 amp, $100; Sealy Posturepedic k sz matt w/20 yr grnty, $225. Call 623-1588.

Sears Kenmore dishwasher, $90; Wstghse 9000 BTU AC, $130; dining tbl, $80; 4 K chrs, $20. Call 277-1443, aft 8pm.

SW rcvr, Hallicrafters SX-28, nds some tubes, to 1st taker. Mark, x3-3664.

Cstm made drapes, 18' W, 90" L, deep brgndy antique satin, used 9 mos, orig $110, $60; yards of quality drapery fabrics, orig $4/yd, now $1/yd. x8-2577 Draper.

Antique rnd oak barroom pedestal tbl, $150; 5 spd f bike, $50; tbl, $40; foam matt, $4 & $12; huge plants, $5-$10; bureau, $30; brass fl lamp, $15; blk fur coat, $5; enlarger & photo supplies, $100; elec typwrtr, $50; fl polisher, $20; Call 267-3757.

Hallicrafters rcvr mdl SX-117, exc cond, $150 or best. Henry, x3-5815.

M 3 spd Raleigh Humber sports w/generator front whl hub, $40 or best. Cynthia, x3-5814.

Bed; 10 spd bike; AC; bureau; bkcse; standing lamp; btchr blk tbl; lvg town, wl accept any reas offer. Rob, 492-2377, aft 6.

F 5 spd bike, $75; desk lamp, $7; wall lamp, $5. Call 492-3098.

Unmarked: Samuelson's Readings in Econ, 5th ed, $4; Molecular Bio of the Gene, Watson, 2nd ed, $5; Nerve, Muscle & Synapse, Katz, $2; Linear Prog & Econ Anal, Dorfman, Samuelson, Solow, $8; Elem Dif Equations, Reissner, $6; Elem Dif Equations, Kreider, Kuller & Ostberg, $7; or best. Sue, x3-3270.

Boy 5 spd Tyler bike, gd cond, ask $35. Bob, x8-1231 Draper.

Camb audio rcvr, 25 W/ch, .5% distortion, $329 nw, 6 mos, must sell, $200. Bob D, x3-2843.

BSR 2620 W; BIC 940; Pioneer 7500; pr Studiocraft (Bose) 440; dbl bed frame. Ace, 354-3713, evgs & late nite, kp try.

Rnd butcher blk imitation K tbl, v elegant, best. x3-2311.

Reg sz LR sofa, grn & gold w/brn, $139; mtch chr, $49; coffee tbl, $42; 2 end tbls, $51.50; 2 tbl lamps w/shades, $46.50; no checks pls. Eurene, x8-3501 Draper.

Recliner chr & foot stool, blk imitation leath, worn but gd mech cond, ask $70. Pete, x3-6771.

Sgl loft bed w/matt, ideal for sm rm, $25. Joan, 491-2168.

F 10 spd bike, Tiger frame, Shimano derailleurs, coterless crank, centerpull brakes, as nw, $100 firm. Ray, x3-7118.

Hifi amfm tuner & 4 spd trntbl, blond cab, $30; Regina fl polisher & rug shampooer, $25; Farberware elec broiler, $28. x8-4095 Draper.

K sz waterbed, raised platform frame, nw matt, htr & liner, $175. Zaurie, 547-7350.

Dbl bed, box spr & matt, $25. Call 491-8275.

K sz waterbed w/frame, pedestal, htr, etc, $145. Jack, 277-3164.

Delta Mark 10B CD ignition, assembled, nw, $30. George, x8-4537 Draper.

M Frye boots, 17", sz 10 D, gd cond, were $69, $20. Call 492-4941, aft 5:30 or wknd.

Dbl bed w/5" foam pad, $25; Sears m 3 spd bike, nw but nds some work, $25; 2 man canvas tent, $10; port elec typwrtr w/script type, $50. Don, x3-3739.

HP 25 programmable sci calculator, compl w/ std access, exc cond, $125. Art, x3-6631.

Hosp bed, gd cond, excluding matt. Mary, x8-4486 Draper.

Handmade dbl bed size quilt,lone star pttn, $80; 3 mos old wndw fan, $15. Kate, x5-6587 Dorm.

Twn sz matt, $10; 4 drwr dresser, $10. Victor Endo, 71 Oxford Ave #5, Camb, 864-6516.

Pearled satin wedding gown sz 5-7, cathedral train, long pearled veil, tailor-made, ask $145. Call 494-0411, evgs.

Francescan china, 4 pl settings Constantine, nw, $75. x3-7327.

Contemp couch & chr, $150; washer, $75; wardrobe, $20; refrig, $30; all lk nw. Terry, x8-4061 Draper.

Wright Line 2600 punch for computer cards, best; gray dictating unit using belt tapes. x3-2918.

Pr Hyde ice skates, $10; Hyde bowling shoes, $9, barbell set. C.W. Janiak, x8-3451 Draper.

Marantz stereo power amp, 100 W/RMS ch, US manu, exc cond, $250. Dave, 731-1948, evgs.

M 10 spd Ital bike, 19-20" frame, lock incl, $50. Call 494-0146.

Plants: lemon geranium, African violet, Chinese evergrn, Swedish ivy, asst succulents. Wed, Rm 12-3078.

Raleigh Rcrd 10 spd m bike, 21½", gd cond, $80. Marjorie, x3-3725.

Matt, 3/4 sz (50" w), gd cond, $20. Ellen, x3-4881.

Lvg cntry: qn sz matt, avail 9/30, $25; lg blk chest drwrs, $30; crtns, 4 brn 84x58" W, $25/ea; 2 wht, 84"x68" W, $15/ea; side tbls; bkcses; mirror w/wd frame; clothing: beaut f lamb fur coat, v warm, fitted, trim w/afghan wool, sz 12-14, $150. Call 354-1335.

Apt sale, Wtrtwn, Sat, Sept 11, 10am-4pm: dishes; clothing; bikes; furn, oak tbl & 4 leath chrs, $45; 110 barbell set, $45; twn beds, $20/ea; much more, call for details. x3-1332.

Refrig/frzr, $125; Kenmore port dishwash, $100; both exc cond. Call 522-7639, aft 6pm.

HP 65, 2 yrs, spare batt pack & charger; std pack & home brew radiometry & optics; buyer may copy stress analysis & chem; $350 or best for all. Kim, x8-1868 Draper.

Full sz bed incl Simmons matt & box spr (yr old), mtl frame, matt pad, box cover (1 mo), $90; Sears AC, 14,000 BTU, 220 V, 4 yrs, $90. Call 494-8153, evgs.

Americana Hereshoff 18' catboat, '73, incl trlr, outbrd mtr, dacron sails, slps 2-4, $6,500. Call 358-4897.

Used Emerson refrig, 5.5 cu ft, tbl surface on top, v gd cond, $50. Sam, 547-1382.

(2) wht mtl K cabs, 36" hi, 30" W, 20" deep, 1 drwr, 2 doors, 2 shlvs, $10/ea. x3-5783.

Pr lamps, $15; side tbl, $10; tbl w/glass cover, $25; K cab, $5; TV, nds repair, free. Call 731-5347, evgs.

Twn bed w/sheets, $40; chest drwrs, $40; Peugeot 10 spd bike w/25½" frame, suitable 5'11" or taller, $95; giant wire spools for tbls, $10-$15; all decidedly not junk. Jean Ward, 646-4625, evgs.

Steno type mach, $95. Sheila, x3-5705.

Bed, $25; chest drwrs, $25; shelves, $30; coffee tbl, $45. Mitter, x3-2160.

Vehicles

'62 Dodge Dart, 4 dr sed, V8, auto, runs well, body ok, $175. x3-4301.

'66 Merc Comet, nw exh sys, gd brakes, gd tires, nw tune up, nw starter, ask $525. Fereydoon, x3-4204.

'67 Karman Ghia, 88K, rusty, eng exc, $200. Nancy, x3-3319.

'67 Chevy Biscayne, 6 cyl, orig ownr, runs v well, nw batt, distrib & fuel pump, cleated snows, flawless auto trans. Saleh, 484-1522.

'67 Buick sport wgn, p st & br, stud snows, some rust, exc mech cond, $500 or best. Joe, x3-6746.

'68 Ply Fury, 4 dr sed, fair cond, runs well, $300. Carolyn, x3-7073.

'68 Pont Cat, auto, p st, gd cond, $450. Call 683-3676, N. Andover.

'68 Olds, p st & br, snows, nw starter, batt & muff, exc cond, $650. Call 444-6164.

'69 BMW 2002, below book value, nw stl radials, Konis, alpine wht, $1,200 or best. x3-2235.

'69 BMW 2002, red perf body & mech, nw '74 eng, 59 K, nw radials, amfm radio, sunrf, v cln, just exc, $2,100. Call 494-8444.

'69 Renault 16, runs gd, nw muff & brakes, $500. Chris, x3-1439.

'70 Ply Fury III, 4 dr hdtp, auto, p st & br, AC avail, nw brakes, exh, 2 stud snows, $300 or best. Murray, x7373 Linc.

'70 Toyota Corolla wgn, '72 eng, std, gd cond, 28 mpg, $800. Bonney, x8-1172 Draper.

'70 VW Sqbk, 63 K, gd run cond, body nds work, best. Jack, x8-1204 Draper.

'71 Volvo 144S, 4 dr, great mech cond, auto, AC, radials, amfm tape player, nw valve job, water pump, batt, shock, just tuned, 71K, 20 mpg, comb economy & safety, ask $1,795. Call 266-4280, beg 10:30am or aft 6pm.

'71 Toyota Corona, exc cond, 32 K, auto, nw br & exh, plush int, $1,600. Janice, x8-2471 Draper.

'71 Toyota Corolla 1200, 2 spd auto, nw exh & front brakes, lo mileage, $450. Tony, x8-1319 Draper.

'71 VW Superbug, sunrf, exc cond, $1,400. Ruth Mayberry, x3-7612.

'72 Ford E100 Econoline van, nw tires, sliding side door, chrome bumpers, 302 V8 eng, lo mileage, best. Dave, x7635 Linc.

'72 Vega, 2 dr sed, nw clutch, 48 K, dk grn, nds a little body work, almost nw tires, $900. Arturo, x3-3494.

'72 Vega cpe, for parts, nw tires, nds head gasket, runs, $300 whole car, or best. Rich, x5845 Linc.

'72 Toyota Corolla, auto, p br, 15 K, $1,000. x5-9833 Dorm.

'72 Saab 95 wgn, V4, exc cond & mileage, amfm, stl radials. Mitch, x3-5128.

'72 Fiat 124S, 4 dr sed, orig ownr, 31 K, red, exc run cond, nds slight body work, $1,250 or best. x3-1659.

'73 AMC Hornet Htchbk, V6, 34 K, exc cond, amfm radio, auto, $1,850. x3-7267.

'73 Ford Maverick, auto, exc cond, 36 K, $2,200 or best. Gus, 494-0466, evgs.

'73 Datsun 1200, blu, body damage, $750. Call 232-7483.

'73 Mazda XR3 wgn, marine blu, exc cond, stereo, AC, best. Robert Wynne, 492-1500.

'74 Saab wgnbk, slvr, 41 K, ask $4,250. x3-1917.

'74 Mustang II, 6 cyl, p st, std, radials, xtra snows. x3-2311.

'75 Mustang II Ghia, 4 spd, 6 cyl, amfm, bumper guards, Rotunda 5 yr undercoat, exc cond, $3,345. Joe, x8-3701 Draper.

'75 Chevy Pickup, side pack, util body, ideal for tools or camper, many xtras. Call 543-5804.

'71 Suzuki mdl 500T, titan twin mtrcycl, Cerianni fr shocks, lo mileage, runs & looks gd, $700. Ed, 774-8907.

Housing

Back Bay, Beac St area, BR apt, ww BR/LR area, south exposure, 4th fl, $215 incl util. Call 266-9420.

Back Bay, Beac St, 2½ BR, LR, eat-in K, ww, lndry, $356 incl util. Call 267-8118, aft 6pm.

Belmont, furn rm w/K priv in lovely hse w/grdn, 1 sgl $33/wk, 1 v lg dbl $25/wk/ea. Call 484-6833, morn or evgs.

Bklne, elegant Vic lovingly updated by architect, perf fam-prof home, gracious entry, 5 frpl, 6 BR, magnificent site & details, privacy, adj wooded bldg lot incl, office or apt psbl 3rd fl, $85,000. Call 232-0205.

Camb, Random Hall has sev lg rms for academic yr, shared rms $97.50, sgl $165. x3-7563.

Camb, 15 min walk MIT, BR apt, part furn, avail 9/15, $218 incl ht & util. Larry, x3-6482.

Charlestown, unusual barn & yard, avail immed, designed & blt by architect, must see, yr lse w/opt to buy, $275 htd. Call 413-499-2996.

Jam Pl, apt nr T, LR, DR, K, 2 Br, avail 10/1, $220. Bill Huffman, x3-6879.

Lex, exc cond 7 rm, 4 BR split lvl hse, 1½ B, ww, garage, walk-out bsmnt, qt nbrhd, nr sch & bus, lvg soon, mid 50's. Call 861-9682.

Lex, solid brick cape, lg LR, DR, eat-in K, 2-3 BR, lg yard, $49,900. Call 862-8538.

N Quincy, 5 rm bungalow, exc cond, ww, mod K, garage, AC, frpl, nr beach, $29,000. Jack, x5340 Linc.

Roslindale, 5 rms, 2nd fl, qt apt, adults, no pets. Call 325-6723, aft 6pm.

Saugus, elegant 2 BR apt, 1st fl nw 2 fam hse, d&d, all nw, qt nbrhd, $275 incl ht, util. Ed Gross, x8-3706 Draper.

Wtrtwn, 2 BR, LR, DR, K, B, study, nr T, $325; also Oriental rug, 8'6"x5'2", nego; washer, $60. Call 924-4331.

Campton, NH condo, ski 93 area, great view, yr-rnd recreation, $25,900. x422 Linc.

Animals

Free adorable loving cat, to gd home. Claire, x5-9219 Dorm.

Lost: Alpine Designs daypack, org w/MITOC on flap, reward. x8-4048 Draper.

Lost: m brn bifocal glasses on 8/20, btwn Polaroid, 545 Tech Sq & MIT. x3-1875.

Lost: 3 squash rckts & shopping bag w/coat in it. If found pls contact Ranjan, x5-6138 Dorm

Wanted

Used inexpensive 16 mm movie proj w/optical sound sys, any vintage. Tony Frisiello, x627 Linc.

Chldrn bike & big whls. Waldir, x3-6832.

Qt working f seeks rm in priv home in Camb, Wtrtwn or Ntwn vcty. Sarah, x3-2029.

All yellow pigs, all yrs, party 1 week after yellow pigs day, pls RSVP. Dan, 547-7894.

Set bunk beds & desk. John, x3-6894.

Wl buy student flute or trade for clarinet. x7500 Linc.

Want to rent sm grnhse for private use. Feroline, x3-4914.

Used guitar, gd cond, under $50. Tom, x3-6723.

Books for alternative Bos high sch, texts, refs, resources, fiction, encyc, suitable grades 8-12. Barbara, x3-2502.

Lg window fans; 1" oiled paper tape. Len, x3-1541.

Babysitter in my home on campus, M, W, F, 9-1, beg 9/10, for 2 chldrn, $30/wk. x3-2868.

Zeiss Contax IIIA camera bodies, lenses, access, books, etc. Bob, x5456 Linc.

Sm eng, horizontal drive shaft. Jim, x7682 Linc.

Stu to live-in, child care in exch for rm & brd, arrangements nego, nr H Sq. x3-1592.

Roommates

Rmmate, own BR, LR, K, sm yard, 3 blks MIT, $125 incl util. Leslie, x3-3213.

BR & study, grad or prof f, non-smoker pref, great loc, nice people (2 f), avail immed, $142. Call 354-2250, evgs & wknds.

Rmmate wanted, 445 Marlborough St, Back Bay, lg attractive apt. Mitch or Jim, 266-6281.

F, 25+ to share lg 4 rm Cambport apt w/f 27, no more pets, financially stable pref, sec dept, $96 incl ht. Hedy, x3-3418.

Cpl to share Winthrop hse w/cpl, on shore, 8 rms, 2 priv, easy pkg, avail immed, semi-furn, no pets or chldrn, $140 + util. Call 846-6794, kp try.

(2) grad stus, m & f seek f grad stu (pref 24+ non-smoker) for Allston 6 rm apt, qt str, 1½ mi H Sq, 3 mi MIT, no dogs, $123 incl ht. Jeanne, x3-6734.

Carpools

Carpool or riders, 8am-5pm, Revere to Draper, wl share driving or exp. Jacky, x8-3389 Draper.

Nd ride M-F, 9am, from Hyde Park to MIT, wl share exp. Sue, 361-2329.

Wish to join carpool Camb-Linc Labs, M-F. x3-5945, lve msg.

Wl take riders Arl, Som area, 7:30-4:30. Bill, x8-3546 Draper.

Second driver, riders nded from Arl. David, 646-6607, evgs.

Parking

Note to parking sticker swappers; please remember to inform your supervisor and the Campus Patrol of the exchange you have made so that their records accurately reflect your new parking area.

Wl swap West for Albany or East. Charlie, x3-2394.

Wl swap West for East or Albany. Tony, x3-4156.

Wl swap West for Albany. Fran, x3-7802.

Miscellaneous

Wl type theses, manu, tech, fast & accurate, IBM Correct Selec. Debbie, x3-1848.

Non-tech typing & editing, papers, dissertations, proposals, etc, fast, v exper, reas. Carol, 723-2979, aft 6pm.

Persons or firm wanted to demolish lg barn (23'x43') in Camb nr H Sq, free barn wood. Maureen, x3-3748.

Wl do typing, gen, thesis, correspondence, IBM Selec. x3-1713.

Typing, papers, theses, reports, IBM Cor Sel. x3-7453.

Wl type theses, manu, anything, fast & accurate, reas. Donna, x3-1585.

Truck & labor avail for moving you, reas priced. Louie, 491-2168.

Surplus Property

(1) Mazda eng, 12A block & 1 Mazda eng, 10A block w/box of parts. Can see, W.A. Derry, x3-2777; send Sealed bids to Derry, Property Officer, Rm E19-717, by 9/15, 12:10pm.

POSITIONS AVAILABLE

This list includes all non-academic jobs currently available on the MIT campus. Duplicate lists are posted on the Women's Kiosk in Building 7, outside the offices of the Special Assistants for Women and Work (10-215) and Minority Affairs (10-211), and in the Personnel Office (E19-239). Personnel Interviewers will refer any qualified applicants on all biweekly jobs as soon as possible after their receipt in Personnel.

Persons who are NOT MIT employees should call the Personnel Office on extension 3-4251.

Employees at the Institute should continue to contact their Personnel Offices to apply for positions for which they feel they qualify.

Dick Higham	*3-4278*
Pat Williams	*3-1594*
Carolyn Scheer	*3-1595*
(Secretary — Ann Perkins)	
Virginia Bishop	*3-1591*
Mike Parr	*3-4266*
Ken Hewitt	*3-4267*
(Secretary — Joy Dukowitz)	
Sally Hansen	*3-4275*
Lewis Redding	*3-2928*
Richard Cerrato	*3-4269*
(Secretary — Susan Bracht)	

Sponsored Research Staff, Systems Programmer for the Accelerator Physics Collaboration group of LNS: maintain and improve Digital Equipment Corp. operation system (PDP-10/PDP-6) dual process or computer complex: prepare and maintain documentation; instruct users. Finish modification of the monitor system to handle 2 IBM 2311 disk units and extend capacity to 4 disks; continue development of a provision for monitoring and diagnosing system and hardware errors. Bachelors degree in mathematics, computer science, physics or electrical engineering, including a basic course in computer programming and systems programming required. Knowledge of PDP-10 assembly language and experience with DEC operating systems desirable. D76-147 (9/8).

Admin. Staff, Data Base Manager, in the Office of Facilities Management Systems to act as central source of information and analysis for all Institute physical facilities by maintaining computerized and non-computerized inventories of land holdings and space data. Duties involve data collection, conversion for INSITE and other computerized systems, related report preparation, analysis of data, budget preparation. Bachelor's degree including basic Math. course, or equivalent experience, ability to learn use of computerized space system, training and experience in writing and communication of statistical data required. Experience in facilities management and computer systems desirable. A76-36 (9/8).

Sponsored Research Staff, Experimental Physicist or Electrical Engineer, in the National Magnet Laboratory to assist in the development and testing of forces flow, liquid helium cooled superconducting magnet coils; design electrical and mechanical test systems. Ph.D. in physics or electrical engineering with experimental thesis or MS or BS with experience in superconductivity cryogenics, low temperature instrumentation and superconducting magnet design required. D76-154 (9/8).

Acad. Staff, Tech. Asst. to assist in Biology Dept. research involving isolation and physical characterization of key components of the blood coagulation systems, and studies of the molecular mechanisms by which components interact in fulfilling their physiological roles. Bachelors degree, a background in physical chemistry and some background in biochemistry required. Good laboratory skills also necessary. C76-14 (9/8).

Sponsored Research Staff, Project Engineer in the Harvard-MIT Rehabilitation Engineering Center (Dept. of Mechanical Engineering) which is involved with design construction and evaluation of sophisticated electronic and electromechanical assistive devices for use by handicapped persons. Work will include assisting in development and evaluation of new techniques, devices and systems for application in many areas of sensory and motor impairment, carrying out assignments independently in clinical environments. Bachelor's degree in Mechanical or Electrical Engineering required. Competence in analog and digital design techniques, flair for innovation required. D76-148 (9/8).

Sponsored Research Staff, to do magnet design and mathematical analysis in the National Magnet Laboratory: write and operate computer programs necessary for design of the Alcator C system. Fluency with computer language for the time sharing system and the PDP 11, and with methods of mathematical analysis required. Familiarity with specific programs already in the Alcator engineering library desirable. Position begins January, 1977. D76-151 (9/8).

Acad. Staff, Librarian, Head of Libraries OCLC/LC cataloguing section to act as resource person on all aspects of OCLC system: Conduct instructional sessions on OCLC cataloguing and editing as well as workshops to introduce workshop modifications; collect data for procedures manuals; revise cataloguing and record editing. Position requires Master's degree from accredited library school, LC cataloguing experience, advanced knowledge of OCLC cataloguing system, demonstrated supervisory ability. C76-15 (9/8).

Academic Staff, Administrative Officer, in the Division for Study and Research in Education to plan and coordinate administrative and support services for the Division. Duties include budget preparation; monitoring of accounts; hiring non-academic personnel; preparation of documentation to support academic appointment process; preparation of material related to academic programs. Will handle other special projects as necessary. Excellent administrative experience and skills, facility with budgets and accounting procedures required. Familiarity with current issues in education and cognitive psychology desirable. MIT experience preferred. C76-13 (8/25).

Admin. Staff, Assistant in Donor Relations, in Resource Planning to assist in preparation of correspondence and other written material for the President's and other senior officers' signature. Written material is related to a major fund-raising campaign scheduled to conclude in 1980. A college degree with demonstrated writing and research skills, and a knowledge of MIT is required. Position also requires the ability to work independently and frequently under the pressure of short deadlines. A76-34 (8/25).

Sponsored Research Staff, temp, Jr. Physicist, in the National Magnet Laboratory: assemble and prepare for test equipment by which the cryogenic stability of superconductors is measured; operate the apparatus; evaluate results; recommend experimental methods and modifications to equipment; devise new test methods; reduce experimental data; write up results. BA in Engineering or Physics with demonstrated understanding of the fundamentals of magnetic fields, heat transfer and circuit theory required. D76-146 (8/25).

Admin. Staff, Editor/Writer Assistant, part-time, temporary to provide editing and writing assistance to Executive Officer, Office of the Provost: write and edit copy through production phase; oversee production budget. Newspaper and report writing experience required. 30% time; temp. for six months. A76-33 (8/25).

Sponsored Research Staff, Programmer, in Research Laboratory of Electronics, Theoretical Plasma Physics Recearch Group to administer and maintain hardware and software related to a small PDP-11 terminal concentrator, a Tektronix 4013 storage terminal, Imlac PDP-4 intelligent display terminal, a Gould 5200 electrostatic printer plotter. Will also administer computer accounts; orient new employees to computer equipment; handle related software assignments. Experience with assembly language (preferably PDP-10 and/or PDP-11), LISP, FORTRAN, MACSYMA, operating systems (ITS, Multics, TSO) required. Hardware experience desirable. D76-144 (8/25).

Sponsored Research Staff, Economics/Policy Analyst will conduct analysis of public policies regarding government regulation of private industry and consumer behavior in areas in energy and the environment, and also federal expenditure on research development and demonstration in the energy field, automobile industry; other areas will include synthetic fuels, solar power, conservation practices. Must have training in microeconomics and public policy analysis and/or management of US Federal Programs, training and experience in political science with policy analysis orientation. D75-161 (9/3).

Exempt, Admin. Asst., in the Libraries Microreproduction Lab will have responsibility for office management: financial and statistical records, safety and security duties, personnel and purchasing functions. Duties include supervision of employees and processing of microfilming requests; training of office personnel; management of accounts, billing, collection procedures; preparation of financial reports; obtain security clearance; assure security of classified materials; interview, review performance of office staff; do cost evaluation for purchasing decisions. Experience in supervision, bookkeeping and accounting methods, cost analysis and budget procedures required. Candidates must also have written and spoken communications skills, and a general knowledge of library reference materials and procedures. Typing and general clerical skills preferred. E76-32 (9/8).

Exempt, Admin. Asst. in the Energy Lab to manage contract and fund accounts, budget, payroll allocations; prepare financial status reports; coordinate activities among sponsors, MIT administrative office, faculty, staff and students. Supervise purchasing records; review and monitor monthly statements; assist with special projects as necessary. May assist in arranging workshops and other professional meetings. A Bachelor's degree, facility with figures, ability to type self-generated material required. Knowledge of MIT accounting and administrative procedures preferred. 40 hr/wk. E76-33 (9/8).

Exempt, Assistant Manager in the Dining Service to assist manager in administration and operation of the unit: supervise set-up and cleaning of unit; check and process invoices; take cash register reading; balance daily cash; take, price and extend monthly inventory; replace manager, area or food production supervisor as necessary. Applicants should be high school graduates, be able to speak and understand English; and have knowledge of administration and operation of a food service of this type. Position includes weekend work. E76-30 (8/25).

Exmpt, Dental Hygienist, in Medical Dept. will perform initial examination and charging, prophylaxis, peridontal treatment, plaque control. Take and process x-rays; screen emergencies. Registered Dental Hygienist required, preferably with AB or BS in Dental Hygiene. Previous work experience, including peridontal care preferred. E76-31 (8/25).

Engineering Asst., Exempt in Materials Science and Engineering to assist in research on archaeological materials. Research involves analysis of artifacts, art objects and reconstruction of original technological production process. Will use photomicrography, metallography, photomacrography, electron microanalyser, x-ray diffraction, fluorescence and related analytical techniques. Bachelors degree and experience in fields of anthropology, archaeology and art history required. Candidates must also be able to train students in various analytic procedures. E76-15 (5/26).

Tech. Asst. V temporary in the Technology Studies Program, School of Humanities and Social Science will work on a curriculum development program: will do archival research; interview; write biographies. Bachelors degree, 2-3 years graduate work in the humanities, experience in history of science and black history required. B76-437 (9/8).

Secretary V to Department Head and Executive Officer, Physics Department will handle general secretarial duties related to Dept. academic program and administration: will type technical manuscripts, general correspondence, course materials; arrange complex travel, appointments; act as liaison among supervisors, faculty, students; answer routine correspondence independently. Shorthand, technical typing skill, a minimum of 5 years secretarial experience required. Applicants should be familiar with general accounting procedures and able to set priorities. MIT experience preferred. B76-446 (9/8).

Secretary V to the Head of the Department of Architecture to type correspondence and reports; compose and answer correspondence independently or with oral instructions; maintain calendar; arrange travel; answer phones; screen calls and visitors; on occasion, order food for meetings. Excellent general secretarial skills, command of the English language, a minimum of 5 years secretarial training required. Applicants must be able to set priorities and work independently. B76-448 (9/8).

Secretary V, senior secretary, for the MIT International Nutrition Planning Program. Will handle a wide range of office management and secretarial duties which include acting as secretary to Program Director. Will coordinate project accounts; manage general office workload; direct other secretaries. Responsible secretarial and office management experience, excellent typing accuracy and speed, ability to transcribe machine dictation necessary. B76-386 (8/25).

Secretary V in Aerospace Studies to handle a variety of secretarial and administrative duties: answer independently a variety of inquiries on Institute and Air Force regulations and procedures (from students and others); organize meeting agenda as well as luncheons, social events; do minor manuscript editing; verify accuracy of content using various sources; maintain budget records; assist in budget preparation. Position includes considerable interaction with Air Force personnel, students. Good typing, human relations and administrative skill, ability to handle accounting procedures required. Shorthand and MIT experience desirable. B76-398 (8/25).

Secretary IV-V, part time, to the Director, Office of Facilities Management Systems and a small group involved with internal and external use of MIT's computerized space accounting system (INSITE). Will type; arrange travel; maintain accounts; prepare payroll reports; assist in organizing conferences and in editing a newsletter. Excellent secretarial skills, 3-5 years experience, ability to work independently required. Shorthand/speedwriting and machine transcription skills preferred. This is a job-sharing position. 20 hrs/wk. 1pm-5pm. B76-441 (9/8).

Secretary IV, part-time, to two Biology Dept. faculty members to perform general secretarial duties: monitor grants; type correspondence and technical manuscripts from handwritten drafts; do library searches; handle duties related to personnel procedures; handle reprint mailings. Excellent typing, organization skills, familiarity with accounting procedures required. 15-17½ hrs/wk. Mornings preferred. B76-412 (9/8).

Secretary IV, part-time, for the Electromagnetic Interaction group of the Laboratory for Nuclear Science. Type technical papers, reports, correspondence. Arrange seminars, meetings; maintain files. Fluency in French, excellent shorthand and typing skills, and the ability to work with minimal supervision required. 20 hrs/wk. (9am-1pm). B76-419 (9/8).

Secretary IV to faculty member and research staff in Urban Studies and Planning: type proposals, manuscripts, class materials; maintain and monitor budget records; handle other general secretarial duties including some editing. Excellent secretarial skills (shorthand preferred), ability to handle a wide range of activities, and work independently required. Non-smoking office. B76-420 (9/8).

Secretary IV in Chemical Engineering to assist two faculty members and research staff involved in a national continuing education program. Duties will include preparation of course materials, reports, proposals; arranging travel, appointments. Excellent technical typing, machine transcription skills, ability to set priorities and work independently required. B76-424 (9/8).

Secretary IV to three Political Science Dept. faculty members: type course material, correspondence from machine dictation and handwritten draft; arrange appointments, travel; handle other general secretarial duties as necessary. Excellent secretarial skills, secretarial school training or junior college and a minimum of two years experience necessary. B76-432, B76-433 (9/8).

Secretary IV to large Biology Dept. research group (faculty, research staff, students). Will perform general secretarial duties including taking and transcription of shorthand transcription; typing from handwritten draft, maintenance of financial records; monitoring of budgets. Will also arrange appointments and travel; maintain a small library. Excellent secretarial skills and experience necessary. Must have ability to independently maintain accounts and prepare administrative sections of proposals. B76-434 (9/8).

Secretary IV to Physics Dept. Academic Officer and Graduate Registration Officer: Type and prepare admissions material and correspondence; arrange appointments; prepare weekly colloquium schedule; handle other general secretarial duties as necessary. Good shorthand and typing skills, ability to coordinate several activities simultaneously required. B76-436 (9/8).

Secretary IV to handle secretarial duties for Political Science Department Head and faculty member. Will assist senior secretary in correspondence, manuscript, class materials typing; assisting students with inquiries on programs, procedures; arranging complex travel schedules. Two or more year's secretarial experience, secretarial school and/or college training preferred. B76-423 (9/8).

Secretary IV to two faculty members in the Finance section of the Sloan School of Management: type correspondence; manuscripts, class materials (including some editing); answer phones; arrange travel. Excellent typing, shorthand, machine transcription skills required. Secretarial experience and command of English language also necessary. B76-422 (9/8).

Secretary IV, part-time, in Civil Engineering to type technical notes, correspondence; answer phones for a small reference reading room; set up catalog system for filing and shelving books and reports; maintain list of borrowers. Typing and organization skills, ability to work with minimal supervision required. Approx. 25 hrs/wk. B76-428 (9/8).

Secretary IV to the Administrative Officer in the Joint Center for Urban Studies. Will handle general secretarial duties which include manuscript typing for social scientists, some phone and receptionist responsibility, sharing of food service to Center guests. Excellent typing skill, previous secretarial experience required. B76-438 (9/8).

Secretary IV to three faculty members in the Chemistry Department to answer phones; type correspondence and manuscripts; arrange travel; maintain files. Two to three years secretarial experience, ability to exercise initiative and judgement required. B76-208.

Secretary IV to a group of Earth and Planetary Sciences (geology) faculty members. Will handle a heavy typing load including manuscripts, course material; arrange appointments; handle a busy telephone system. Position includes much contact with students. Excellent typing skills, ability to coordinate own work load independently. B76-394 (8/25).

Secretary IV to academic staff member in the Center for Policy Alternatives on projects related to environmental law and policy, occupational health and safety and the Law Related Studies Program. Will handle general secretarial duties: organization of proposals; budget preparation; project coordination; monitoring accounts; arrange travel. Excellent typing, shorthand (or willingness to acquire shorthand) skills are required as well as ability to set priorities and work independently. Interest in subject matter important. B76-283.

Secretary IV to three faculty members and research staff in geophysics section, Earth and Planetary Sciences. Type correspondence, manuscripts (some technical); maintain files; arrange appointments and travel. Excellent typing including ability to type technical material, English grammar skills (to edit work of foreign staff) required. Applicants must be able to set priorities and work independently. B76-400 (8/25).

Secretary IV to two Alumni Association Regional Directors to handle various duties which include follow-up on activities with members of volunteer organizations; assist in maintenance of information file; collect statistical data; type correspondence; compose routine letters on own; arrange luncheons, dinners, meetings, travel. Will also assist other secretaries as necessary. Selected candidate will be trained to operate IBM MT/ST typewriter. Typing and organization skills required as well as the ability to interact well with people. Shorthand/speedwriting helpful. B76-392 (8/25).

Secretary IV to two physicians in the Medical Department: will schedule appointments; transcribe medical records and general correspondence (machine dictation); maintain files; chaperone routine physical examinations. May attend and take minutes of administrative meetings. Excellent typing skill, the ability to transcribe medical terminology, and to deal sensitively with patients required. Secretarial experience in a responsible position also necessary. B76-389 (8/25).

Secretary IV in the Division of Study and Research in Education will type manuscripts, correspondence; maintain student and course records; assist students and other office visitors. Good secretarial skills, ability to set priorities, previous secretarial experience required. B76-387 (8/25).

Secretary IV in the MIT Sea Grant Program: answer or redirect inquiries (phone or in-person) concerning activities of Marine Industry Advisory Services; organize meeting agenda and materials; arrange luncheons; maintain files; type routine correspondence independently. High school and/or secretarial school training plus 3-4 years working experience required. Interest in the ocean and marine related activities, MIT experience helpful. B76-407 (8/25).

Secretary III-IV in Psychology to handle general secretarial duties: transcribe and type reports and correspondence from machine dictation: prepare course materials; assist in preparation of professional journal. Selected candidate will work as assistant to Department secretary and as junior secretary to Chairman. Excellent typing and English grammar skills, ability to exercise discretion required. College training preferred. B76-249 7/14.

Secretary III-IV in the Office of Personnel Relations. Benefits Office. Will handle varied secretarial duties including typing; scheduling meetings; explaining Benefits programs to employees. Will assume responsibility for follow-through on projects. Secretarial experience, ability to deal with people tactfully and to set priorities required. Shorthand helpful. B76-341 (8/11).

Secretary III-IV to two Psychology faculty members to type technical manuscripts, correspondence and theses; maintain reprint card files; fill reprint requests; do library research; organize reading list materials for classes. Will handle other general secretarial duties including backup typing for other secretaries as required. Excellent technical typing and organization skills, interest in the biological sciences required. Applications should also be able to maintain financial records. College training, shorthand/speedwriting skills helpful. B76-442 (9/8).

Secretary-Receptionist III in Mathematics headquarters: answer phones; answer visitors' inquiries; prepare various material related to student payroll; provide secretarial assistance to headquarters staff, faculty and visitors; sort and redirect mail; maintain office supplies. Excellent typing, ability to organize and handle detail, some office experience required. Technical typing skills helpful. B76-399 (8/25).

Secretary III to faculty members in Sloan School Management Science Group: type correspondence, course material, reports, manuscripts (including some technical material); answer phones; arrange appointments; handle other general secretarial duties as required. Excellent typing, some experience in typing technical material required. Secretarial experience or formal training preferred. Shorthand/speedwriting helpful. B76-413 (9/8).

Secretary III to faculty members and other research staff in the Research Laboratory of Electronics: type technical manuscripts, statistical tables and charts; take and transcribe dictation; arrange appointments and meetings. Excellent typing skill including ability to type technical material required. B76-414 (9/8).

Secretary III to handle general secretarial duties in Center for Space Research: transcribe machine dictation; arrange travel and meetings; answer phones. Excellent English grammar and typing skills, ability to set priorities, familiarity with medical terminology (or willingness to learn) required. Previous office experience also necessary. B76-411 (9/8).

Secretary III, Legal Secretary, in the Office of Sponsored Programs. Will type technical patent applications, correspondence; coordinate patent activities of supervisor and maintain related files; arrange appointments and travel. Good typing and shorthand skill required. Legal secretarial experience helpful. B76-451 (9/8).

Secretary III, part-time, to faculty and research staff members in the Research Laboratory of Electronics. Will handle general secretarial duties; type correspondence, technical materials; answer phones. Good typing skill and at least one year secretarial experience required. B76-452 (9/8).

Secretary III, floater, in the Medical Department to handle a variety of secretarial duties, relieving for other secretaries during vacation, illness, lunch hours and in peak work loads; transcribe machine dictation (correspondence, reports); prepare mailings; file. Will also cover in reception area and other office areas as necessary. Excellent typing skill, flexibility for changing work assignments, previous secretarial experience, preferably in a medical setting required. B76-449 (9/8).

Secretary III in the Department of Architecture to handle general duties: type; answer phones; order supplies; mail weekly newsletter. Typing and English grammar skills required. Familiarity with computer environments desirable. B76-447 (9/8).

Secretary III, part-time, in Medical Department X-Ray/ECG unit: will type medical reports, record cards, form letters. File medical records; answer phones; schedule appointments. Will be trained to administer tests (ECG, etc.). Excellent typing skill, capacity for detailed work required. 30 hrs/wk. (Mon.-Fri., 10am-5pm). B76-388 (8/25).

Lib. Gen. Asst. III, part-time, in Physics Reading Room to process preprints, journals, other library materials; prepare books for shelving; maintain catalogue and shelf list; perform general clerical duties as required. Will maintain reading room in absence of librarian. High school graduate, or equivalent with some working experience required. Typing and filing skill, ability to work with minimal supervision necessary. 20 hrs wk: Sat. 8:30am-4:30pm. Balance of time will be scheduled Mon. through Fri. B76-435 (9/8).

Library Assistant/Secretary IV in Psychology to handle full responsibiltiy for operation of Dept. library: processing new journals and books; locating missing materials; correspondence with publishers on claims and payment matters; reserving materials; ordering books; assisting students in use of library. Will also perform secretarial duties for administrative assistant and faculty member: manuscript typing, light bookkeeping duties and other duties as necessary. Some library experience, excellent typing skills, ability to work independently required. B76-443 (9/8).

Sr. Clerk IV, Media Production Assistant in the MIT Press to be responsible for scheduling, cost preparation and manufacturing procurement of reprints, imports, journals, new titles: Duties include cost estimation, monitoring of expenses, purchasing, selection and ordering of paper, preparing book specifications, checking proofs, coordinating activities among various Press sections, maintaining schedules, typing of reports and letters. Familiarity with book production and manufacturing preferred. Applicants must be able to work under pressure and handle a large volume of detailed work with accuracy. Typing skill for self generated material also necessary. B76-439 (9/8).

Sr. Clerk IV, Design Assistant, in the MIT Press will design book jackets, advertising and display materials; check proofs; prepare specifications and mark up manuscripts for compositors, printers. Applicants must have ability to use photo lettering and photostat machine for many design activites. Graphic design experience desirable. B76-440 (9/8).

Sr. Clerk IV, part-time, in the Medical Department Business Office to provide accounting and clerical support: review and process Blue Cross/Blue Shield invoices; verify patient information with hospitals; type financial reports, correspondence, forms; answer phones. Graduate of 2 year post high school accounting program plus a minimum of 2 years related work experience required. More extensive work experience may be substituted for education requirement. 20 hrs/wk, 5 days. B76-406 (8/25).

Clerk-Messenger III in the Office of Sponsored Programs to perform messenger duties to campus locations; assist in maintaining property records; type; handle incoming and outgoing mail; maintain xerox and postage equipment. Good typing, flexibiltiy to handle various duties required. B76-418 (9/8).

Sr. Clerk-Typist III will handle research and typing assignments in the Office of Resource Planning. Will review records to secure information on donors, which will be used in preparation of donor-relations correspondence and other written documents; transfer appropriate information to office forms; type memoranda, drafts, other material as necessary; maintain files; answer phones; handle special projects as necessary. Position requires excellent typing skills and previous working experience. Also required are the ability to handle detailed work with accuracy, to exercise discretion with sensitive information, and to work occasionally under pressure. B76-402 (8/25).

Sr. Clerk III in Registrar's Office to assist in student registration process and other activities of the office: verify student status; use record keeping computer terminals; type notices to students; answer student requests for information, transcripts, etc. Excellent typing, accuracy with figures and detailed work required. Some college training desirable. B76-409 (8/25).

Technician A,(electronic), hourly, in the Chemistry Department will assist in layout, construction and testing of logic and r.f. prototype circuits; maintenance of instruments, some mechanical work (sheet metal, etc.) in connection with apparatus; provide informal assistance to students on electronic matters; maintain parts stock and literature files. Will also be responsible for liquid helium maintenance in a superconducting magnet. Graduation from a two year technical school or equivalent and a minimum of two years applicable experience required. Experience with digital and radiofrequency circuits and instrument repair also necessary. H76-92 (9/8).

Reactor Operator IV in the Nuclear Reactor Laboratory. Applicants must be graduate of 2 year day technical school or have equivalent experience, specifically in physics, nuclear engineering and MIT Reactor Operation to pass examination of Nuclear Regulatory Commission. A knowledge of electronic circuits is desirable. 40 hr/wk. B76-445 (9/8).

Laboratory Aide, hourly, in Center for Cancer Research to collect, wash, rinse and sterilize various types of laboratory glassware for use in experiments; handle other related duties as required. High school graduate or equivalent required. Experience in scientific glassware washing desirable. H76-90 (8/25).

The following positions were still available at *Tech Talk* deadline. The date following each position is the date of the most recent *Tech Talk* issue in which the position was described.

ADMINISTRATIVE:
A75-71, Documentation Manager, Admin. Info. Systems (7/14)
A76-15, Dir. of Computer Services, Info. Processing Serv. (6/30)
A76-16, Systems Prog., Info. Processing Serv. (7/14)
A76-18, Sr. Applications Prog., Info. Processing Serv. (7/14)
A76-19, Systems Planner, Info. Processing Serv. (7/14)
A76-23, Alumni Regional Director, Alumni Assoc./(7/28)
A76-25, Systems Programmer II, Info. Processing Serv. (8/11)
A76-29, Asst. Dean for Stud. Affairs/Counselor, D.S.A. (8/11)
A76-30, Media Production Manager, MIT Press (8/25)

BIWEEKLY:
B76-189, Clerk III, Admissions Office (8/25)
B76-204, Tech. Typist III, Res. Lab. of Elec. (8/25)
B76-213, Sr. Sec. V, MIT Alumni Fund (6/9)
B76-239, Sec. IV, Office of Resource Devel. (6/30)
B76-249, Sec. III-IV, Psychology (7/14)
B76-256, Sec. IV, Physics (6/30)
B76-262, Admin. Asst. V, National Magnet Lab. (7/14)
B76-280, Sec. IV, Center for International Stud. (7/28)
B76-290, Sec. IV, Lab. for Computer Sci. (7/28)
B76-294, Sec. III, Resource Devel. (7/28)
B76-311, Sec. IV, Materials & Sci. & Eng. (8/11)
B76-313, Sec. IV-V, Office of the Provost (8/11)
B76-317, Sec. IV, Office of the Chairman of the Corp. (8/11)
B76-318, Sec. III, Urban Stud. & Planning (8/11)
B76-326, Clerk/Sec. III, MIT Quarter Century Club (8/25)
B76-334, Sec. III, Sloan School (8/25)
B76-336, Sec. IV, Center for Space Res. (8/25)
B76-337, Sec. IV, Industrial Liaison Office (8/25)
B76-338, Accounting Asst. IV, Urban Studies (8/25)
B76-341, Sec. III-IV, Personnel Relations (8/25)
B76-342, Sec. IV, General Purchasing Office (8/25)
B76-346, Sec./Receptionist III-IV, Graduate School Office (8/25)
B76-348, Sr. Clerk III, Registrar's Office (8/25)
B76-349, Sr. Clerk III, Registrar's Office (8/25)
B76-351, Sr. Sec. V, Humanities Dept. (8/25)
B76-353, Sec. III, Earth & Planetary Sci. (8/25)
B76-359, Sr. Clerk III, Devel. Office (8/25)
B76-360, Sr. Clerk III, Resource Planning (8/25)
B76-361, Sec. IV, Treasurer's Office (8/25)
B76-362, Sr. Library Asst. IV, Baker Eng. (8/25)
B76-363, Sec. IV, Mathematics (8/25)
B76-365, Production Asst./Sec. IV, Campus Info. Center (8/25)
B76-366, Sec. IV, Humanities (8/25)
B76-368, Sec. IV, Humanities (8/25)
B76-369, Sec. IV, Humanities (8/25)
B76-372, Sec. III, Earth Planetary Sci. (8/25)
B76-377, Sec. IV, Chemical Eng. (8/25)

ACADEMIC STAFF:
C76-4, Tech. Asst., Biology (4/28)
C76-6, Microbiologist, Medical Dept. (4/21)
C76-11, Asst. Radiation Protection Officer, Medical Dept. (8/11)
C76-12, Planner, Medical Dept. (8/25)

SPONS. RES. STAFF:
D75-48, Economist, Energy Lab. (6/25)
D75-250, postdoc. res., Physics, Lab. for Nuclear Sci. (1/14)
D76-17, Biochemist, Res. Lab. of Elec. (2/25)
D76-18, postdoc. res., Physics, Lab. for Nuclear Sci. (3/3)
D76-19, postdoc. res., Physics, Lab. for Nuclear Sci. (3/3)
D76-44, postdoc. res., Physics, Lab. for Nuclear Sci. (4/14)
D76-49, Plasma Physicist, National Magnet Lab. (4/14)
D76-57, Stress Structures Design, National Magnet Lab. (4/28)
D76-61, Energy Economist, Energy Lab. (5/5)
D76-67, Biologist/Biomedical Engineer, Mech. Eng. (5/5)
D76-70, postdoc. res., Physics, Lab. for Nuclear Sci. (5/5)
D76-71, postdoc. res., Physics, Lab. for Nuclear Sci. (5/5)
D76-80, Electrical Engineer, National Magnet Lab. (5/26)
D76-84, postdoc. res., Res. Lab. of Elec. (6/2)
D76-105, Engineer, Energy Lab. (7/14)
D76-107, Cost Analyst, Energy Lab. (6/30)
D76-108, Eng. Prog., Res. Lab. of Elec. (7/14)
D76-113, Res. Engineer, Center for Trans. Studeis (7/14)
D76-114, Analytical Chemist, Center for Material Sci. & Eng. (7/14)
D76-115, Immunologist, Clinical Research Center (7/14)
D76-116, Scientific Prog., Earth & Planetary Sci. (7/14)
D76-119, Oceanography Samples Analyst, Earth & Planetary Sci. (7/28)
D76-121, Res. Engineer, Energy Lab. (7/28)
D76-123, Staff Biophysicist or Biochemist, National Magnet Lab. (7/28)
D76-126, Immunologist, Clinical Research Center (8/11)
D76-140, Operations & Instrumentation Manager, National Magnet Lab. (8/25)
D76-142, postdoc. res., Research Lab. of Elec. (8/25)

EXEMPT:
E76-21, Editor, MIT Press (7/28)
E76-25, Administrative Asst., Industrial Liaison Office (8/25)

The following positions have been FILLED since the last issue of *Tech Talk*:

B76-327	Sec. IV
B76-374	Sec.III
D76-32	Spons. Res. Staff
H76-81	Lab. Aide
B76-328	Sec. IV
B76-336	Sec. IV
B76-350	Sec. III
B76-365	Sec. IV
A76-33	Admin. Asst. CANCEL
D76-40	Spons. Res. Staff
B76-310	Tech. Asst. V
B76-371	Sec. IV
A76-17	Applications Analyst
B76-334	Sec. III
B76-331	Sec. IV
B76-347	Sec. IV
E76-27	Admin. Asst.
B76-293	Sec. IV
E76-19	Nurse
E76-20	Nurse
B76-303	Sec. III
B76-405	Lib. Asst. III
B76-380	Sec. IV
E76-23	Area Supvr.
E76-24	Food Service Supvr.
B76-344	Sec. IV
B76-381	Comp. Operator III
B76-330	Sec. IV
B76-395	Circulation Asst.
B76-384	Sec. IV
B76-214	Sec.V
B76-319	Sec.IV
B76-403	Sec. III
H76-93	Driver Utility
B76-416	Sec. III
B76-415	Sec. IV
B76-425	Sec. CANCEL
B76-397	Sec. CANCEL
H76-95	Lab. Asst. CANCEL
D76-145	Spons. Res. Staff
H76-82	Tech. A
B76-379	Sec. IV
B76-393	Clerk II
B76-408	Sec. IV
B76-358	Sr. Clerk
B76-176	Sec. IV
B76-325	Sec. IV
B76-427	Sr. Clerk CANCEL
B76-382	Sr. Clerk
B76-367	Sec. IV
B76-428	Sec. IV
B76-348	Sr. Clerk III
B76-373	Sec. IV
B76-385	Sec. IV
B76-333	Clerk III

The following positions are on HOLD pending final decision:

D76-88	Tech. B
A76-31	Admin. Asst.
B76-401	Admin. Asst. V

Telecopier Mini-Network Begins Campus Operations

A mini-network of telecopiers went into operation across the campus Wednesday, Sept. 1, for a three-month trial period, the Office of Telecommunications has announced.

Telecopiers are facsimile—"fax"—devices which transmit and receive printed documents via standard telephone services. The experimental mini-network will consist of ten Xerox telecopiers in the locations listed below.

The telecopiers can transmit and receive documents up to 8½x11 inches in four to six minutes. Smaller documents take less time.

There will be no direct cost for transmission of messages within MIT. Transmissions outward from MIT will incur normal telepone charges and be billed on a credit card basis.

One major use of the telecopiers is expected to be transmission of messages to the Telecommunicatons Office for subsequent transmission via TWX or Telex to the ultimate destination. Use of Telex and TWX has grown so much—from 64 messages in June 1974 to 306 in June 1976—that it is necessary that such messages be delivered in written form to the Telecommunications Office.

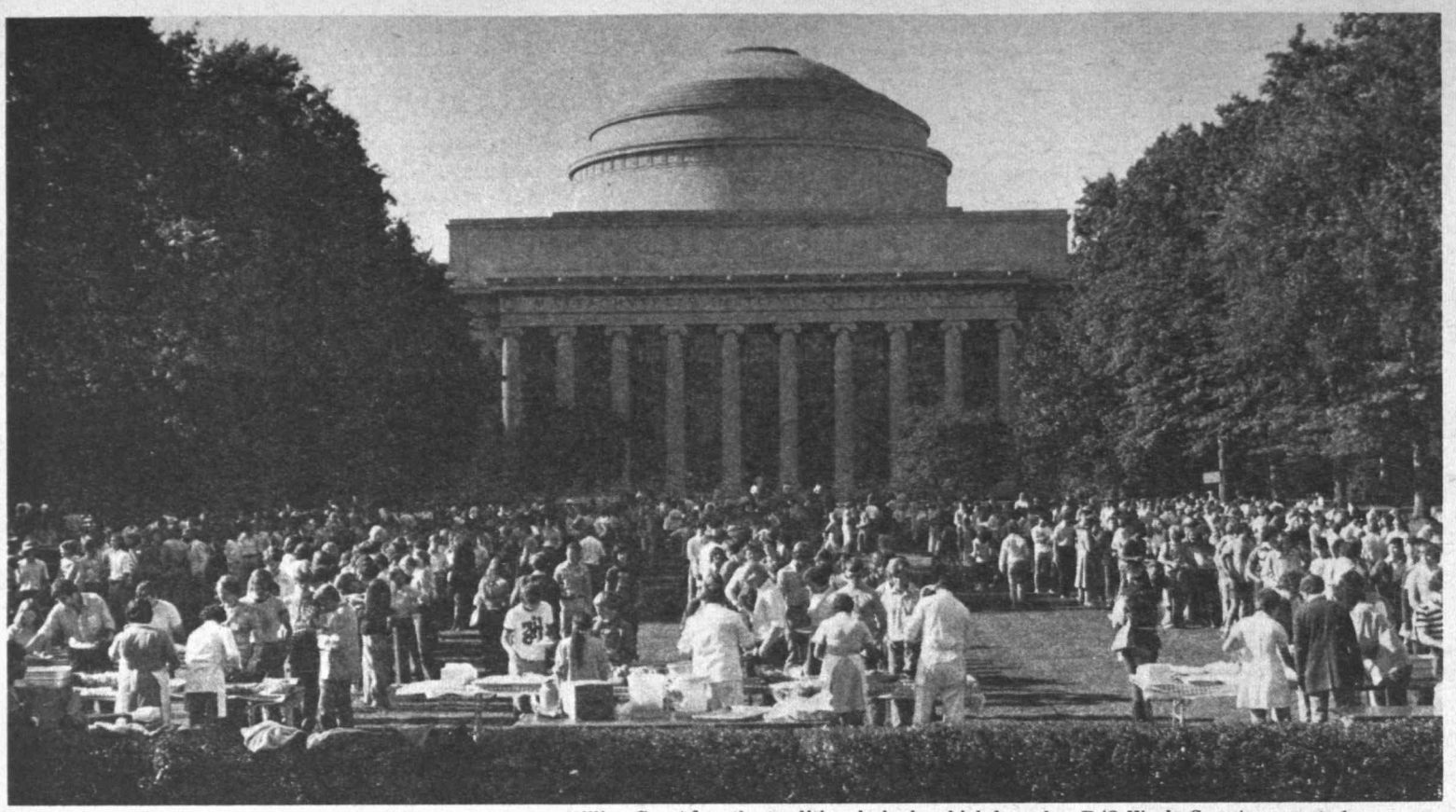
But it will also be possible to use the telecopier for direct transmission of documents to remote locations with compatible facilities. Altogether there are nearly 150,000 telecopiers throughout the United States which can be reached by the MIT mini-network.

Peggy Condon with telecopier in the Telecommunications Office.

Xerox maintains a directory assistance service of listed Xerox telecopier users. Up to three telecopier numbers will be provided per call. The toll-free directory assistance number is 800-255-4180.

TELECOPIER NETWORK

Location	Department	Telecopier Tel. No.
E19-741	Telecommunications Office	(25)3-8000
3-207	President's Office	3-8001
39-623	Industrial Liaison Office	3-8002
3-003	Graphic Arts	3-8003
E52-032	Graphic Arts	3-8004
E40-2nd Flr.	Center for Policy Alternatives	3-8005
E32-1st Flr.	MIT Press	3-8006
26-505	Laboratory for Nuclear Science	3-8007
NE40-408	Laboratory for Nuclear Science	3-8008
9-225	Center for Advanced Engineering Studies	3-8009
54-1417	POLYMODE	3-8010



In their first official act, members of the Class of 1980 throng Killian Court for the traditional picnic which launches R/O Week. See story, page 1.

Cleaning Changes Set

Beginning Monday, September 13, Building Services will phase in a new cleaning program called Frequency Cleaning.

This program will affect all offices and laboratories throughout the campus and the change is expected to be completed by Monday, October 4.

Frequency Cleaning is simply every-other-day cleaning. It involves only the emptying of waste baskets, ashtrays, dusting, rug vacuuming, and the sweeping or mopping of floors. The washing and waxing schedule of floors is not involved in this change.

The every-other-day schedule will be rigidly followed, so office and lab occupants will have to be careful about disposing of perishables in their waste baskets because of possible odors upon spoiling.

If office or lab personnel have any questions concerning this program they should contact their Administrative Officers.

This Week In Sports

Jane Betts Appointed Assistant Athletic Director

Jane Betts, head coach of women's gymnastics and tennis and assistant professor at Valparaiso University, Valparaiso, Ind., has been appointed assistant director of athletics at MIT.

Ms. Betts will also hold the titles of associate professor of physical education and director of women's intercollegiate athletics at MIT. Her appointment was announced by Professor Ross H. Smith, MIT director of athletics.

"This appointment represents a major step forward in the continued development of women's sports at MIT," Professor Smith said.

Selection of Professor Betts followed a nationawide search in which some 50 candidates were reviewed. Eight candidates were interviewed on the MIT campus by a search committe chaired by Professor James W. Mar of the Department of Aeronautics and Astronautics and composed of faculty at large, from the Department of Athletics and students. The search committee unanimously recommended the appointment of Ms. Betts.

"Professor Betts is a top notch person who will do a good job in advancing the women's program within the overall framework of athletics at MIT," said Wendy C. Irving, '77, president of the MIT Athletic Association. "We are very fortunate to have her join the department."

Professor Betts said she looks forward to the continued development of the women's athletic program in parallel with the men's program, one of the most active in the National Collegiate Athletic Association with more than 20 intercollegiate teams and countless intramural and club sports.

At the present there are eight women's varsity sports: tennis, swimming, crew, sailing, basketball, gymnastics, fencing and volleyball. Two other sports—softball and field hockey—are expected to gain varsity status within the near future.

A native of Indianapolis, Ind., Professor Betts is a graduate of Franklin College where she received the B.A. degree in 1962. She received the M.S. degree from the University of Southern Mississippi in 1965 and has done additional graduate work at the University of New Hampshire, Indiana University and the University of Northern Colorado.

After teaching at Perry Township Junior High School in Indianapolis from 1962-64, Professor Betts was appointed assistant professor of physical education at Valparaiso in 1965. At Valparaiso she was instrumental in establishing women's tennis as a varsity sport. Her tennis and gymnastics teams both had winning seasons during 1975-76 and three gymnasts qualified for midwest regional competition.

At MIT Professor Betts will play a central role in all administrative affairs of the Department of Athletics and she will be a member of its policy and personnel committees. Her coaching assignment will be in gymnastics.

Professor Betts has been very active in athletic organizations in Indiana, particularly the Indiana Division of Girls' and Womens' Sports and the Indiana Association for Health, Physical Education and Recreation. In 1970-71 she was one of the organizers of the Indiana Women's Intercollegiate Sports Organization which she has subsequently served in a variety of posts.

Professor Betts is also a member of the United States Gymnastics Federation, the American Alliance for Health, Physical Education and Recreation, the American Camping Association, and the National Intramural Sports Council.

PE Registration Set for Tuesday

Unlike previous years, registration for physical education classes will take place the day after registration for academic subjects.

Registration for physical education classes will take place Tuesday, September 14, from 8:45am until 12:30pm in du Pont Gym.

In past years many students have had to change their physical education selections to accommodate last minute changes in academic scheduling. It is hoped that this year fewer changes will be necessary if students are given an extra day to finalize their academic schedules before signing up for physical education courses.

Microprobe Scans Hair

(Continued from page 1)

tently and temporarily present in the hotel environment. Based on symptoms, some have suggested this might be nickel carbonyl poisoning, but tissue studies using autopsy materials have thus far been inconclusive.

The MIT-Harvard team is scanning hair samples from Pennsylvania for nickel content as well as for other elements. They point out it is not known if, in individuals exposed to nickel carbonyl, the nickel is, indeed, excreted, in part, by deposition in hair, as is the case with such substances as mercury and lead and arsenic. Moreover, if nickel is deposited in hair, it may not be present in sufficient quantities to be detectable by the scanning proton microprobe technique.

The group hopes to report back to the Pennsylvania state health department on the concentrations of some 15 or 20 different elements that are commonly present in human hair in the parts-per-million quantities that make them susceptible to proton microprobe detection. By scanning along each strand, the MIT-Harvard workers hope to be able to give an indication by time as to when the elements were deposited in the hair.

"We do not expect to be able to identify the specific cause of the disease," Dr. Grodzins said. "But we can hope to provide time history information that might serve as clues in the larger investigation."

Development of the scanning proton microprobe as a tool for tissue analysis has been underway for some two years, sponsored by the National Science Foundation. The work is an example of developments in one technical area being modified and applied in another.

Lincoln is a center for advanced electronics research and development. Numerous pieces of electronic communications equipment have been developed there over many years for use on satellites and space probes. The Van de Graaff particle accelerator—capable of producing both electron and proton beams—has long been used to test how the equipment will perform when bombarded by charged particles in space, particularly those associated with the Van Allen radiation belts.

Dr. Grodzins and Dr. Horowitz have for several years been interested in applying fundamental nuclear and atomic physics techniques to the development of improved methods for the assay of biological tissues to determine the spatial distribution of various elements, and, equally important, the time rate at which the elements became incorporated into such tissues as hair and fingernails.

Hair is a particularly useful specimen. In normal persons, hair grows at the rate of about one centimeter a month. Moreover, some elements taken up by the body tend to be excreted, in part, via deposition in new hair growth. Thus, variations in elements found along a single strand of hair could, in principle, be a time guide to when they were placed there by the body.

Dr. Horowitz and Dr. Grodzins developed the scanning proton microprobe for use with a Van de Graaff accelerator of the kind used at Lincoln. It employs a pinhole opening to collimate a very thin beam of protons so that a biological tissue such as a hair strand can be scanned when moved back and forth across it.

When the protons in the beam interact with the various elements present, each gives up a characteristic x-ray emission. The microprobe can be tuned to scan for up to six different elements simultaneously. The elements are identified by the x-ray signatures they produce.

Officials of the Pennsylvania state health department sent to the Harvard-MIT workers both hair strand samples taken from survivors of Legionnaires' disease and hair strand samples taken from individuals in no way connected with the outbreak. The samples were coded so that the Harvard-MIT workers cannot distinguish between test materials and controls.

The Harvard-MIT group expects to report later this week to the Pennsylvania investigators the results of their scanning for each sample submitted.

As for the suspect element, nickel, Dr. Grodzins said it is possible that the scans will be negative for both test specimens and controls.

"This would not rule out nickel," Dr. Grodzins said. "It would simply mean the proton microprobe did not detect it—either because nickel isn't excreted in hair, or because it is excreted in amounts too small to be detected."

The group plans to continue the studies with hair and other tissue specimens taken from humans and experimental animals known to have had nickel poisoning of one kind or another. This could provide a guide to what patterns, if any, exist when excessive amounts of nickel are present in biological systems.

Moreover, hair is not the only biological tissue being studied with the proton microprobe. Others include kidney and eye tissues.

Several students are working on various aspects of the research as theses projects. One, William A. Ladd of Ellensburg, Wash., completed a master of science thesis on the subject a year ago and presently is working at Boston's Children's Medical Center preparatory to entering medical school.

Mycology, Bridge Lessons Planned

Mushroom walks and bridge lessons lead the list of special courses offered by the MIT Women's League this fall.

Mrs. Margaret H. Lewis, lecturer, teacher, epicure and well-known authority on wild mushrooms will conduct four mushroom walks at different sites to teach class members how to collect and identify a few wild mushrooms with confidence. Walks will be held September 14, 22 and 29, and October 5 from 10am to noon. The class will be limited to 30.

Rodger E. Longley, a well-qualified club and duplicate bridge director, will give a course of 10 lessons for intermediates and beginners starting Tuesday, Sept. 21, from 7:30-9:30pm in the Emma Rogers Room(10-340). Lessons will cover standard American bidding, dummy play and defense play.

For further information on these classes, call Mary Pinson, x3-3656 or Terry Palty, 334-4810.

Robot Comes With Freshman

(Continued from page 1)

Intel 8080 for $40.

"The Intel 8080 is a chip or integrated circuit. Alone, it is much like a brain that's not connected to a spinal cord. It's only able to drive a robot when connected to other components. I built a memory, display board, interface, and central processing unit," Mr. Dunnington said.

The micro-computer fits into a briefcase and commands Christopher to do various things. The robot moves about on three wheels—the front one from a motorized wheelchair and the back two from a tricycle. On top of the robot's body rests one arm, two feet long. The arm can stretch out another six inches, rotate, move up and down, and can grasp and raise a good-sized wastepaper basket. Christopher is strong enough to carry its master short distances.

The size of a collie, Christopher gets his energy from five motorcycle batteries. He is constructed mainly of surplus parts.

"All the motors, gears, linkages, and integrated circuit boards are surplus," Mr. Dunnington said. "They're not the best quality, but they are a lot cheaper."

Mr. Dunnington's inventive instincts have been fostered by Fred Himes, an independent inventor whose company is Voice-Act of Ridgefield. Mr. Himes was looking for an assistant to help him during the summer of 1974. Mr. Dunnington got the job. He returned to work with Mr. Himes after graduating from Loomis-Chaffee and has worked under his guidance for the past year.

Why did Christopher come to MIT?

"I'm just getting the computer programs to work and am too close to a breakthrough to leave the robot at home," Mr. Dunnington said. "I hope some of my MIT classes will relate to the robot. If not, I'll work on Christopher in my spare time. If I decide to design a new system, I'll probably build a new robot. Christopher has been developed about as much as it can be."