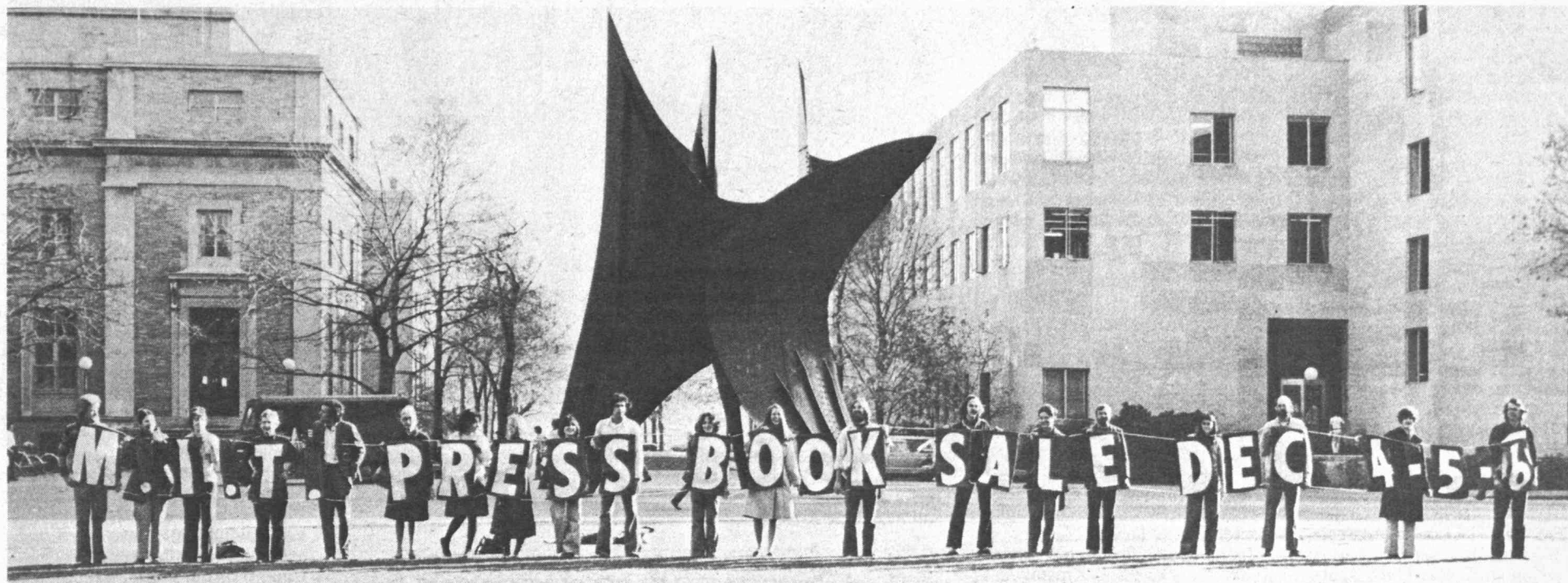


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of Technology

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TECH TALK

November 26, 1975
Volume 20
Number 17

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MIT PRESS employees will have their hands full December 4-6 when more than 50,000 books go on sale in the Sala de Puerto Rico of the Student Center at discounts ranging from 50-99 percent off regular retail prices. Hundreds of titles, including gift, student, and professional books will be

featured at the annual event—to be heralded by this banner extended across Massachusetts Avenue. Hours for the sale are 10-10, December 4 and 5, and 10-4 on December 6. Shoppers are encouraged to go early since some titles are in limited supply. The event is open to the public.

Foster Intellectual Dishonesty

Education Researchers Say Tests Mislead

By PATRICIA M. MARONI
Staff Writer

If parents had the right to examine the standardized tests used to evaluate their children, the quick-answer paper-and-pencil measurement business would have much to answer for, according to a professor of engineering science and education at MIT.

In articles published in the *National Elementary Principal Magazine*, Professor Judah L. Schwartz of MIT's Division for Study and Research in Education says, "All too often what is being tested is performance on wrong, ambiguous, misleading and trivial items. This in-

cludes the categorization of children by machine-scoring. If a child does not compute well enough, however, it seems of little comfort to know that he computes more skillfully than 50
(Continued on page 7)

Ad Hoc Committee to Review International Commitments

The MIT faculty has voted to establish an ad hoc committee for one year to "review the scale and nature of MIT's international contractual commitments for education and/or research whether at MIT or abroad."

The formation of the nine-person committee, to be called the Ad Hoc Committee on International Institutional Commitments, was approved at the monthly faculty meeting on Nov. 19.

The committee was established on the basis of a recommendation by an earlier ad hoc committee appointed last spring and chaired by Dr. Charles P. Kindleberger, Ford International Professor of Economics.

Professor Kindleberger's committee submitted a motion at the faculty meeting for the establishment of a standing Committee on International Institutional Commitments, but the ad hoc committee was substituted as the result of amendments to the motion.

The revised motion directed the committee to make a final report to the faculty at the end of its one-year term and to recommend at that time whether the committee should be continued on a permanent basis.

The motion also urged the administration to keep the committee informed of prospective international commitments. It said the committee would stand ready on request to consult with the administration or

IAP Deadline

Today (Wednesday, Nov. 26) is the deadline for submitting new listings for the Final Guide to IAP '76. Listings should include the time and place of the first meeting of activities.

Because January 15 is Martin Luther King Day—a new Institute holiday—people planning activities for Thursdays should be aware that there will be only two Thursdays during IAP '76.

Several Benefits Cited

Corporate Bigness Regarded as Strength

By ROBERT C. DI IORIO
Staff Writer

The case for corporate bigness is stronger than even many business executives realize, according to an article in the current issue of MIT's *Sloan Management Review*, a journal devoted to stimulating the information exchange between the academic and business worlds.

"There is evidence that long-run competitive performance or corporate capitalism is socially beneficial, despite the fact that some key free market traits are missing," said Arthur A. Thompson, professor of economics and business administration at the University of Alabama's Graduate School of Business.

Among the long-term benefits to consumers from competition among large firms such as automakers, television manufacturers and household appliances producers, Dr. Thompson said, are:

—Increased rates of technological progress and new product innovation.

—Low-cost production efficiency, sustained with above average productivity gains.

—Slower rates of price increases, and in some cases price declines.

—Profit rates comparable to those earned in "allegedly 'more competitive' industries."

Although the available evidence in
(Continued on page 6)

White Answers Science Charge

An article in the November 21 issue of *Science* magazine, headlined "Methanol at MIT: Industry Influence Charged in Project Cancellation," drew a quick response last week from Dr. David C. White, Ford Professor of Engineering in the School of Engineering and director of the MIT Energy Laboratory.

Dr. White, in a letter to the editor of *Science*, said methanol research at MIT has not been terminated and that the article presented a one-dimensional view. Dr. White pointed out that the automotive and oil industries have consistently encouraged the Energy Laboratory to undertake methanol research.

The one project that was cancelled—a proposal to test a methanol-gasoline fuel mix using a fleet of cars driven by MIT community members—was not initiated for several reasons, including its estimated cost—\$200,000 to \$300,000—and the fact that additional laboratory work should precede such a fleet test, Dr. White said.

Dr. Thomas B. Reed of MIT's Lincoln Laboratory, who proposed the fleet test and who was quoted in *Science* magazine as believing it was not initiated because of industry pressure, is continuing to work on projects that flow from the association of Lincoln Laboratory and the Energy Laboratory, Dr. White said.

faculty initiators of projects that involve such international institutional commitments.

The ad hoc committee will be appointed jointly by the President and the Chairman of the Faculty and
(Continued on page 3)

Supervisors Complete Training Program

Terms like "informed decision-making," "effective feedback" and "creative problem solving" are now everyday vocabulary for 18 employee supervisors from MIT's Physical Plant Department who recently completed a new management training program.

The eight-week program, which concluded Tuesday, Nov. 18, was conducted by Northeastern University's Center for Continuing Education, a group that has designed similar programs for Liberty Mutual Insurance, the US Department of Transportation, Raytheon, Damon Corp., and the Department of Health, Education and Welfare.

Philip A. Stoddard, vice president in charge of operations for MIT, said the course was specially designed for persons who had recently been promoted to supervisory status and for established supervisors who had never taken a management training course or wanted a refresher seminar.

Participants in the program were: Henry B. Antinarelli, Dennis Baron, Ralph H. DeMarco, Joseph D. Gibbs, George J. Gillis, Richard T. Greenough, Ralph V. Jackson, Ronald I. Mendes, Charles B. Milano, Donald J. Olson, Kevin R. McDonagh, August L. Perry, Austin H. Petzke, Leo S. Plagenza, George S. Reid, Robert G. Stedman, William

G. Tanner, and Alfred J. Texeira.

Howard F. Miller, executive assistant to the director of physical plant, Henry J. Leonard, superintendent for support services, and Morton Berlan, superintendent of telecommunications, were responsible for arranging the program.

Marshal E. Johnson, program director of Northeastern's Center for

Continuing Education, who designed the program, said, "It's not always easy feeling part of a university that produces some of the most brilliant people in the world. But by recognizing commonplace experiences as valuable to everyday problem solving, the supervisor can successfully meet the requirements of management.



CERTIFICATE OF ACHIEVEMENT is awarded to Physical Plant administrative officer Kevin McDonagh by Marshal E. Johnson from Northeastern and Howard Miller of MIT Physical Plant upon completion of eight-week supervisory management seminar. Seated to the left is Ronald Mendes of MIT's Carpentry Shop, and at right, Donald Olson of the Electrical Shop. Eighteen supervisors from Physical Plant received certificates.

Center Closed

The MIT Information Center, Rm 7-111, will be closed all day Thanksgiving, Thursday (Nov. 27), and will reopen at 9am Friday (Nov. 28).

Pianist Ruskin to Solo With Symphony Orchestra

Pianist Abbott Ruskin will be soloist with the MIT Symphony Orchestra under the direction of David Epstein, at a concert at 8:30pm, Saturday, Dec. 6, in Kresge Auditorium.

The program will feature Mendelssohn's *Fingal's Cave Overture* and Schumann's *Symphony No. 4 in D minor, Opus 120*. The concert will conclude with one of Samuel Barber's major compositions, the *Piano Concerto, Opus 38*, with Mr. Ruskin, soloist.

The work—Barber's only piano concerto—has its stylistic roots within the traditions of the Romantic Era in music. It was premiered in 1962 at Philharmonic Hall in New York during the opening week of Lincoln Center and won the Pulitzer Prize for Music in 1963.

Abbott Ruskin is a graduate of the Juilliard School of Music in New

York, where his first teacher was Rosina Lhevinne. He later studied under Sascha Gorodnitzki. Mr. Ruskin has received numerous prizes, including the Kosciuszko Foundation's Chopin Award.

He has performed as soloist with the Chicago Symphony, the Minnesota Symphony and the Philadelphia Orchestra and was chosen by the distinguished Soviet composer, Dimitri Kabalevsky, to perform his *Third Concerto* when the composer was invited to conduct the National Symphony in Washington.



Tucker Memorial Concert Lists Violin, Piano Sonatas

An evening of sonatas for violin and piano will mark the 1975 Gregory Tucker Memorial Concert, Tuesday, Dec. 9, at 8pm in Kresge Auditorium.

John Buttrick, pianist, and Roman Totenberg, violinist—who were both musical colleagues of the late Professor Tucker—will perform Mozart's *Sonata in B flat, K. 454*, a sonata movement (1897) by Ravel—a first performance of the work in this area—the *Debussy Sonata* and Beethoven's *Sonata in G Major*,

Opus 96. The concert is sponsored by the MIT Music Section and will be open to the public free of charge.

John Buttrick is director of music at MIT and Roman Totenberg is chairman of the String Department at Boston University's School of Music.

Professor Tucker served on the MIT music faculty from 1947 until his death in 1971, and was a major force in planning and establishing the present vigorous music program at MIT. He performed as an ensemble player with the Juilliard String Quartet, with many other groups, and as a solo recitalist. His compositions included chamber music as well as works for theater and modern dance.

Nevelson Sculpture Installed

Acquisition by MIT of a major sculpture by Louise Nevelson, one of America's most celebrated contemporary artists, has been announced by Professor Wayne V. Andersen, chairman of the Committee on the Visual Arts.

The large black steel construction, entitled *Transparent Horizon*, was installed last week at the northeast end of the East Campus Houses quadrangle and adjacent to the new Chemical Engineering Building, designed by I.M. Pei.

"Nevelson has generously contributed the design of this heroically scaled work to the Institute to foster a continuing collaboration between education and the creative process," Professor Andersen said.

The installation will be celebrated officially on Dec. 10 with a series of events to mark the occasion. A brief site ceremony will take place at 3pm, and from 5-6pm the artist and Professor Andersen will hold an informal conversation with an audience in Room 9-150.

Preliminary discussions concerning a sculpture by Louise Nevelson for MIT were held among Nevelson, I.M. Pei, Professor Andersen, and Mrs. Ida Rubin, of the Council for the Arts at MIT, in the fall of 1974. Nevelson then visited MIT to evaluate possible sites related to the chemical engineering facility.

A maquette for *Transparent Horizon* was presented to the Committee on the Visual Arts in May, 1975, and was enthusiastically endorsed by the members and by Professor Raymond F. Baddour, head of the Department of Chemical Engineering. The project was facilitated with the cooperation of the Council for the Arts, the Planning Office and Physical Plant.

For a number of years, MIT has applied the practice of including a fraction of a percentage of the cost of a facility for artistic purposes in order to enhance the visual quality of the campus.

Three Jazz Groups In Concert Dec. 12

A jazz concert featuring three MIT student groups—the Festival Jazz Ensemble, the Halbert White Quintet and the Concert Jazz Band—will be held at MIT's Kresge Auditorium, Friday, Dec. 12 at 8:30pm.

The 21-member Festival Jazz Ensemble, directed by Herb Pomeroy, will play selections by David de Grand, Mike Gibbs, Hal Crook and Rob Mounsey—all Boston area composers.

Mr. Pomeroy, of Brookline, is chairman of the Jazz Composition Department at the Berklee School of Music. Soloists with the Ensemble include Hal White, trumpet; Frank Ruiz, saxophone; Lee Allen and Phil Comeau, piano.

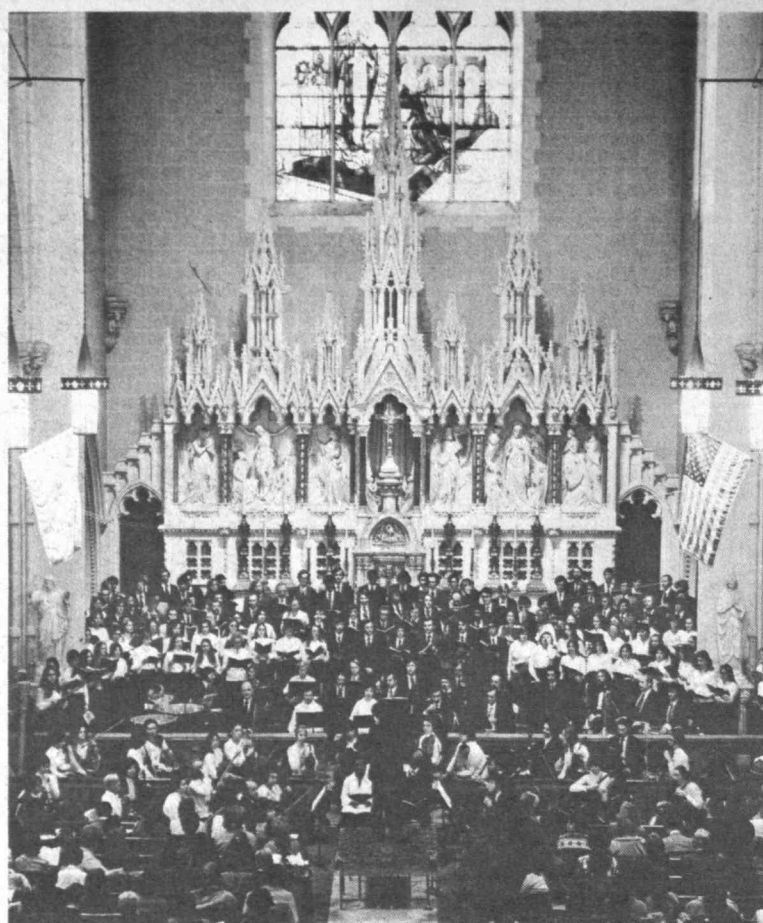
The Halbert White Quintet, which includes Halbert White, trumpet; Phil Comeau, piano; Eliot Goldstein, drums; Frank Ruiz, saxophone, and Rick Stone, bass, will play original contemporary jazz pieces.

The rest of the program will feature swing blues arrangements played by the MIT Concert Jazz Band, a 22-member group under the direction of Everett D. Longstreth, an instructor in music arrangement at the Boston Conservatory of Music.

Tickets will be distributed, free of charge, in the lobby of Building 10 on Dec. 4 and 5 and Dec. 10-12. Remaining tickets will be sold at the door for \$1.

ASCE Award

Ignacio Rodriguez-Iturbe, of Bedford, visting associate professor of civil engineering, was recently named a recipient of the American Society of Civil Engineers' Walter L. Huber Civil Engineering Prize. The award honors Professor Rodriguez-Iturbe's research into hydrology, particularly in the analysis, synthesis and sampling of hydrologic processes.



"A WONDERFUL HALO of resonance around their voices," was how Boston Globe critic Richard Dyer described the performance of the MIT Choral Society with John Oliver conducting, Sunday, Nov. 23. Sacred Heart Church in Cambridge was filled to capacity for the concert of Brahms' *German Requiem*. The Choral Society plans to give two more concerts in the spring, featuring works by Vivaldi and Bach. If orchestra size permits, the concerts will be held in Kresge Auditorium.

—Photo by Mike Richard

IAP Seminar to Examine Designs of Alvar Aalto

Revival of interest in the work of Finnish architect and designer Alvar Aalto, 77, who designed Baker House over 25 years ago, will gain fuel with an IAP seminar entitled *Finnish Form on the Charles: Alvar Aalto and Baker House*.

The seminar—to be held Jan. 12-16, from 2-4pm in the Baker House master's suite lounge, will be sponsored by the MIT Planning Office. The seminar will give an overview on Aalto's work as well as investigate the design of Baker House (one of two completed buildings by the architect in the US), its environment, the present use of the residence in relation to student life styles and future restoration plans for the building.

In conjunction with the seminar there will be a wide ranging exhibition of the modern master's work at the Boston Architectural Center at 320 Newbury Street in Boston from Jan. 9-28. The show will be jointly

High School Visits Wanted

Students returning home for the holidays are asked to help the Admissions Office by talking with seniors and juniors in their former high schools.

Those willing to participate by visiting guidance counselors or prospective applicants may stop in the Admissions Office for up-to-date information on admissions and financial aid.

"The personal experiences of students at MIT make the best sales pitch we have," according to Sandra Cohen, assistant director of admissions. "Because they are known, students who visit their high schools are invaluable in helping us spread the word to high school students."

Those planning high school visits may stop in the Admissions Office (Rm 3-108) today (Wednesday, Nov. 26) with any questions they have.

De Neufville Cited

Professor Richard L. de Neufville, associate professor of civil engineering, has won the 1975 award from the Special Programme Panel on Systems Science of the North Atlantic Treaty Organization. The prize of more than \$1,000 was for Professor de Neufville's paper "Systems Analysis of Large Scale Public Systems: New York City's Water Supply Network as a Case Study," published in *The Journal of Systems Engineering*.

sponsored by the Planning Office and the Architectural Center.

The exhibition has received wide note in New York City where it is now showing. It includes furniture, fabrics, lighting, slides of his buildings, a movie on the architect and some of his sculptures never shown in the US.

Persons interested in signing up for the seminar should contact Doris Coles at x3-5831.

Major Exhibit Has MIT Works

Two MIT posters are included in a major exhibit, "Images of an Era: The American Poster 1945-1975," which opened at the Corcoran Gallery of Art in Washington, D.C., Friday, Nov. 21.

The posters are "Stop Oil Pollution" by Jacqueline S. Casey, director of design services, and "Loudspeakers" by Ralph Coburn, graphic designer in Design Services. They are among some 200 posters in the exhibit which was organized by the Office of Exhibitions Abroad, National Collection of Fine Arts of the Smithsonian Institution.

The exhibit will run through January 4, 1976, in Washington, then travel to Houston in February, Chicago in April and New York in May. Arrangements are being made for the exhibit to tour Europe from September 1976 through July 1978.

Stanley Exhibit At Faculty Club

Showing in the MIT Faculty Club, the month of December, will be an exhibition of paintings and drawings by Idahlia Stanley, whose works are part of numerous private collections in the US and part of the National Collection of Fine Arts at the Smithsonian Institution, Washington, D.C.

Ms. Stanley, who is chairman of the art department at Roxbury High School in Boston, has studied under artists Sahl Swarz and Arthur Polansky while at Brandeis University and Thomas Fogarty at the Art Students League in New York City. Her work has been exhibited at the Worcester and Baltimore Museums of Art and she has had numerous one-woman shows in the New England area.

Ms. Stanley is married to Professor H. Eugene Stanley, associate professor of physics and Hermann von Helmholtz associate professor of Health Science and Technology.

Meeting Planned For New Program

Interested in the interactions between technology and law in the worlds of science, government and industry?

An experimental semester-long internship in Washington, DC, is being organized for Spring 1976, in which undergraduate students may earn both credit and a living stipend while working fulltime on responsible technical and research assignments. Sites will include federal regulatory agencies, law firms specializing in science/technology problems, and public interest advocacy groups.

An information meeting will be held on Tuesday, Dec. 9 from 4-5pm in Rm. 1-135. Questions? Contact Tim Bird, Law-Related Studies Program, x3-1368, Rm. 4-209.

Seelinger Named Assistant Dean

Alice Seelinger of Arlington, Mass., has been appointed Assistant Dean for Student Affairs at MIT.

Dean Seelinger will have primary responsibility for graduate student housing affairs, including publication of the booklet, *Graduate Residence*. She will continue her duties as administrative officer of the Dean's Office, a post to which she was appointed in 1972.

Dean Seelinger has worked in the Dean's Office for eleven years. In her new capacity she will coordinate all administrative aspects of undergraduate housing assignments, billing, record keeping, and house governments.

Her appointment was announced by Dr. Carola B. Eisenberg, MIT Dean for Student Affairs.

Echoes

50 Years Ago

Professor J.T. Norton of the Department of Physics explained how distances of one hundred millionth of an inch can now be measured by means of x-ray.

A broadcast from station WBZ, given by the Mandolin and Glee Clubs, featured F.D. Gage '22, instructor in Electrical Engineering, singing several of his own compositions, "Down in Egypt," "Troubles," and "Happiness Blues."

40 Years Ago

Professor Ross F. Tucker, Head of the Building Construction Department, was appointed by the Chamber of Commerce in Washington to serve on a committee investigating housing problems.

Famed pianist, Felix Fox, was the featured soloist at a joint concert by the MIT Glee Club and the Wellesley Choir at Walker Memorial.

25 Years Ago

At a meeting of the American Physical Society, scientists from Brookhaven National Laboratory described a new cloud chamber developed for atomic research.

For the first time in Institute history, employees were awarded service pins for 25 or more years of service. Julia Comstock, long in charge of the Institute's historical records and an employee since 1892, was given special commendation for her 58 years of service.

Prepared by Ethel I. Newell, MIT Historical Collections, x3-4444.

TECH TALK

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Cranberry Processing Researched

In their processed forms, cranberries come to us in a number of guises—as sauce, jelly, juice and more. And to have a sufficient number of the berries on hand for processing for the whole production year, it is necessary to freeze a large percentage of the annual crop during the fall harvest season.

Because this is an expensive form of storage, however, scientists from MIT's Department of Nutrition and Food Science have joined in the search for a less costly preservation method.

From the standpoint of cost and energy utilization, storage of the berries at refrigeration temperature of 40°F is ideal. (Prior research has indicated that cranberries stored for up to 14 months in a 100 percent nitrogen atmosphere at 40°F can be made into a sauce without loss of color or flavor.)

The major barrier to ambient storage has been the deteriorative changes to the fruit due to enzymatic, microbial or chemical action. These have to be prevented or minimized for the cranberries to be made into acceptable consumer products.

The MIT researchers studied the feasibility of storing cranberries for up to one year at 40, 77 and 99°F as a whole fruit coarse puree, including seeds and skins. Microbial spoilage was prevented by addition of potassium sorbate (0.1 percent) or pasteurization and aseptic packaging. The puree was stored in both polyethylene and glass containers.

Changes in anthocyanin content, pH, soluble solids, gel strength of jellied sauce and pectin content were studied. Enzyme assays for peroxidase and polygalacturonase activity were used to determine adequacy of heat treatment.

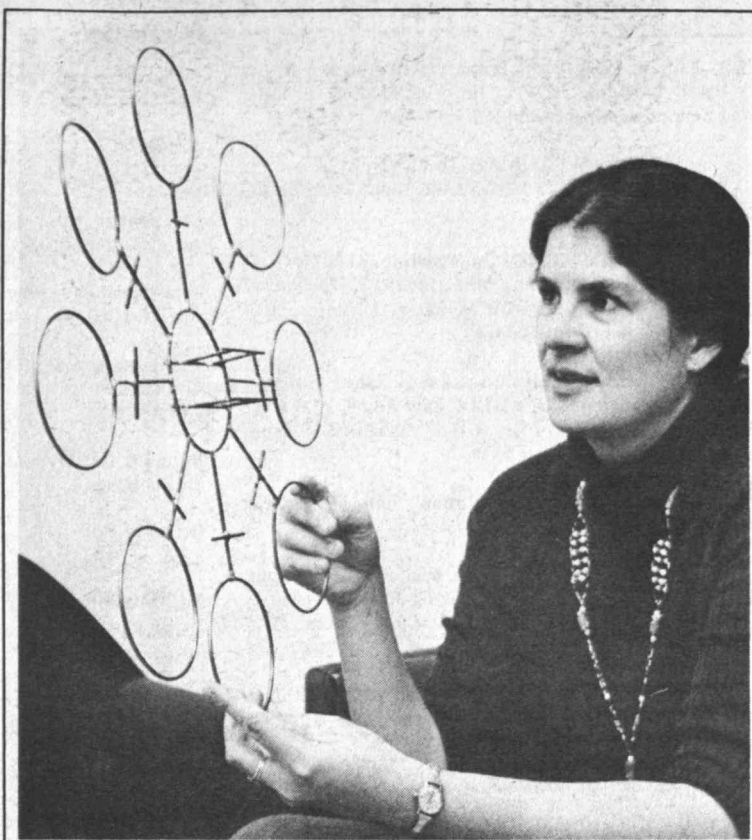
The findings: Of the three storage temperatures studied, only 40°F was found to satisfactorily retain color and gel formation ability for one year.

Storage in hermetic glass jars only moderately improved stability compared to polyethylene.

Jellied sauce prepared from the puree received sensory evaluation ratings similar to those of commercial sauce.

Thus, the results of the study indicated that long-term refrigerated storage of cranberry puree is feasible.

The research was funded by Ocean Spray Cranberries, Inc. of Hanson, Mass., the nation's largest producer of cranberries and cranberry prod-



Mary Rowe, Special Assistant to the President and the Chancellor for Women and Work, holds a metal sculpture of the logo of the Federation of Organizations of Professional Women (FOPW) which she will formally present to the Soviet Women's Committee next week. The sculpture, made by Sandy Yulke, a graduate student in earth and planetary science, is in recognition of International Women's Year. Dr. Rowe will be in Moscow as a delegate to a US State Department/Johnson Foundation sponsored US-USSR Seminar in Early Childhood Education exchange visit. During the last year she has been one of nine members of the national council of the FOPW.

Committee to Review International Commitments

(Continued from page 1)

will consist of four faculty members, a representative from the Committee on Educational Policy, two students and the Provost and Vice President for Research, or representatives designated by them. The chairman will be a faculty member designated by the Chairman of the Faculty.

The faculty also approved without

ucts, through a graduate fellowship.

The researchers were A. Bradford Holmes, a graduate student from Stoughton, Mass.; Dr. Zeki Berk, a visiting professor from the Department of Food Engineering and Biotechnology at the Technion in Haifa, Israel; and Dr. Samuel A. Goldblith, Underwood-Prescott Professor of Food Science and Director of Industrial Liaison at MIT.

change another motion offered by Professor Kindleberger's committee. This reminded the faculty and the administration of the responsibilities of the Committee on Graduate Student Policy in connection with graduate courses of study and students working for advanced degrees, and urged that "in connection with new programs or substantial changes in existing programs the CGSP be informed in timely fashion of proposals involving foreign commitments."

The committee headed by Professor Kindleberger was appointed in April by President Jerome B. Wiesner on a motion passed by the faculty. This followed discussion of the procedures followed when MIT entered into an agreement with the Atomic Energy Organization of Iran for the training of Iranian graduate students in nuclear engineering.

More Sensitive Measures Urged for Social Research

By CHARLES H. BALL
Staff Writer

An MIT psychologist has urged researchers studying how people relate to their environment to "go back to the drawing board" to develop more sensitive measures.

Dr. Sandra C. Howell, professor of behavioral sciences in the MIT Department of Architecture, said that techniques that emphasize the collection of "codable" data such as "one-shot-surveys" and mailed questionnaires may actually obscure patterns of behavior which individuals adopt in response to where they live.

"These methods don't tell us very much at all about lifestyles and appear to mislead us into making gross generalizations which then become the basis for social policy and programs," she said.

Professor Howell criticized "inappropriate and premature use" of sophisticated data analysis techniques in a paper presented at a recent meeting of the Gerontological Society, the organization of professionals in the field of aging. The paper grew out of work done by Professor Howell and by Gayle Epp, a member of her staff and an MIT graduate in planning, to develop design evaluations of housing for the elderly. The research was supported by the US Department of Health, Education and Welfare.

"We've known for a long time that statistical methods are only as good as the data input, but we have been slow to be sufficiently critical about the input. She said, "It is simply not possible, for example, to understand the meaning of home and neighborhood by asking questions related to satisfaction at a single point in time."

"Our current computer programs can only handle clearly coded responses to specifically worded questions," she said, "and that is simply not the way human beings move, psychologically, either through life or their environments. In order to extricate ourselves from the 'conceptual trap' we now find ourselves in, environmental psychologists need to rediscover approaches that take into account the stream of comments of those being interviewed and to conduct repeated observations of people using spaces."

These observations and in-depth interviews will lead back to more reliable hypotheses which prepare the scene for quantitative methods, she said.

As an example of how an extended

interview can provide enriched information, Professor Howell cited a recent survey that asked a resident of an elderly housing project:

How many people here do you consider your good friends?"

His coded answer was zero, which was true of 35 percent of the persons surveyed. Such results would lead planners to increase formal programs for the "isolated."

But his extended comment was as follows:

"I don't know people much. Just say, hello, going downstairs once in a while... I got nothing against them. But I can't call them my friends because I don't know them, you see... Very good friends? Where are you going to find very good friends today. Not many good friends today... Just nice people to talk to. Go down to meetings, people stop in for coffee. I don't even know their names... I never ask their names, anyway. They're all good friends. They never did anything wrong to me. But I can't call them my friends because we don't have that much time here... To have friends you have to stay a long time—20 years maybe—to have a real friend."

During the interview he received a call to meet someone downstairs.

United Way Shows Gain

MIT's United Way campaign stood at \$84,652 with 1,940 gifts as of Friday, November 21.

"That's an encouraging increase of 400 donors and \$12,000 over the previous report," Dr. Irwin W. Sizer, chairperson of the 1975 MIT drive, said.

"Now that the drive has been extended until Thursday, December 4, we are hopeful that we can still top last year's total of \$101,000," he said.

"Another encouraging sign is that the average gift is nearly \$44 this year—up about \$10 from a year ago. That speaks well for the MIT community, particularly at a time when money is so tight."

Dr. Sizer said he hoped the size of the average gift would not deter people from making smaller gifts. "There are still about 1,000 people who contributed last year who have not come forward yet this year. If we could encourage them to give \$5, \$10 or \$20—whatever they can afford—we will meet our goal."

New Inexpensive Method Found For Separating Cells

Cells Separated into more than 100 fractions

By BARBARA BURKE
Staff Writer

A simple, inexpensive method of separating living cells according to their electric charge has been developed at MIT.

The separation technique, which is expected to have wide applications in biomedical research, uses commercially available equipment costing under \$1,500. It was developed by Professor Nicholas Catsimopoulos, a biophysicist, and Dr. Ann L. Griffith, research associate, both in the MIT Department of Nutrition and Food Science.

Professor Henry H. Wortis of the Department of Pathology, Tufts University School of Medicine, collaborated in testing the method. The three reported their work in *Life Sciences*, an international journal specializing in rapid communication of biological research. The work was sponsored by the National Cancer Institute and the National Science Foundation.

Professor Catsimopoulos and Dr. Griffith hope to use the technique—among other applications—to isolate "killer cells" that attack malignant tumors.

These "killer cells" are thought to be a subpopulation of lymphocytes (white blood cells that defend the body against disease). If they could be isolated, or obtained in almost pure samples, researchers could then study their function, and perhaps ultimately even culture them for use in treating cancer patients.

The MIT technique is based on the fact that when cells are suspended in certain buffer solutions, they take on a negative electric charge, whose magnitude depends on macromolecules in the cell membrane. When the cells are placed in an electric field, they move towards the opposite charge. (Such movement is known as electrophoresis.)

"All cells migrate toward the positive electrode, but some go faster than others," Dr. Catsimopoulos said.

A previous method of separating cells by electrophoresis is expensive (more than \$20,000) and of limited resolution.

The high-resolution MIT method can separate cells into more than 100 fractions. It can be used both to study a small number of cells, and to separate cells in bulk for tissue cultures.

The apparatus used is a cylindrical glass "doughnut" about two feet tall, with an outer cooling jacket and an inner cooling tube. (Cells must be cooled to keep them alive in the electric field, and to slow their metabolism so the macromolecules on the membrane won't change, affecting the charge.)

A density gradient is put into the cylinder, to keep the cells from sinking, and the cells are carefully layered on top. About four hours after the low electric current is turned on, the cells have migrated about two-thirds the way down the gradient, how far depending on their charge.

Simply draining the gradient would mix the cells, so instead the researchers have



MIT researchers separate blood cells according to their electric charge, using an inexpensive technique developed by research associate Dr. Ann L. Griffith, and Professor Nicholas Catsimopoulos. Left to right are Dr. Griffith, Professor Catsimopoulos, and graduate student Christos Platsoucas, all in the Department of Nutrition and Food Science.

devised a somewhat more complicated system for retrieving the cells. The gradient is pumped up through a tube while another solution is pumped into the bottom of the cylinder at one-fourth the speed, creating a sharp interface, or boundary, between the two.

As the gradient is pumped out, each thin layer of cells reaches this interface and is neatly sucked up the tube. The electric current is on at all times, to keep the cells from spreading in different directions.

Recently, Dr. Catsimopoulos, Dr. Griffith and graduate student Christos Platsoucas successfully used the method to study red blood cells and to separate B and T lymphocytes. ("B-cells" produce antibodies, while T-cells are responsible, among other things, for graft rejection, and resistance to viruses and parasites.)

They are now experimenting with different gradients and buffers, and attempting to isolate lymphocyte subpopulations, such as killer cells.

"We plan to use this equipment to see whether cell properties change with different states of development, and how they correlate with cell function," Dr. Catsimopoulos said. "It's a very new technique; we don't know what we'll find."

THE INSTITUTE CALENDAR

November 26
through
December 7

Events of Special Interest

Energy Workshop at MIT - All-day energy information workshop Sat, Nov 29, Kresge. Welcoming remarks by Gove, Micheal S. Dukakis. Keynote address, "Overview of Energy Choices - How Should Educators Look at the Energy Problem?", David J. Rose, nuclear engineering, 9am. More than 2 dozen experts participating in workshops and panels, including Irving Kaplan, nuclear engineering, secretary of faculty; John F. Elliott, metallurgy; Karen Polenske, urban & regional studies; David Wood, MIT Energy Laboratory. Evening guest speaker, Dixy Lee Ray, former assistant secretary of state, former chairman US Atomic Energy Commission. Reservations required, contact Dr. George P. Sakalosky, 424-2455. Free.

Seminars and Lectures

Wednesday, November 26

The Kinetics of B Lipoprotein Metabolism* - Gilbert Thompson, MD, FRCP, MRC Lipid Metabolism Unit, Hammersmith Hospital, London, England. Nutrition & Food Science Seminar. 9am, Rm E18-408.

Numerical Study of MODE-like Eddies* - Breck Owens, Woods Hole Oceanographic Institution. Oceanography Sack Lunch Seminar. 1pm, Rm 54-611. Bring lunch, coffee available.

Peruvian Revolution 1968-1975* - David Scott Palmer, government, Bowdoin College, Cynthia McClintock, political science, George Washington University; and Wayne Cornelius, political science. CIS Seminar. 9-11am, Rm E53-482.

Probabilistic Analyses of the Consequences of Nuclear Reactor Accidents* - M. Maekawa, G. Nuclear Engineering Doctoral Seminar. 4pm, Rm NW12-222.

Monday, December 1

Urban Surplus Labor on Tanzania: Policy Options* - Richard Sabat, The World Bank. CIS Seminar. 12n, Rm E53-482.

The Report of the Massachusetts Commission on Nuclear Safety* - George W. Rathjens, political science, past chairman of the Commission. Nuclear Engineering Seminar. 3pm, Rm NW12-222. Coffee 3:30pm.

On the Optimal Control of the US Economy* - Michael Athans, systems science and engineering, director of ESL. Control & Communications Seminar. 4pm, Rm 39-500.

Classical Gauge Fields* - T.T. Wu, engineering & applied physics, Harvard University. Applied Mathematics Colloquium. 4pm, Rm 2-338. Coffee 3:30pm, Rm 2-349.

Study of Surface Fatigue by Exo-Electron Emission* - Ernest Rabinowicz, mechanical engineering. Mechanical Engineering Seminar on Mechanics of Materials. 4pm, Rm 3-133. Coffee 3:30pm, Rm 1-114.

Possible Links Between Trace Metals and the New England Red Tide* - Don Anderson, G. Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics Seminar. 4pm, Rm 48-316. coffee 3:45pm, Rm 48-410.

The Biblical Understanding of "Human Nature" - Rev. John Crocker, MIT. Crossroads Lecture. 4pm, Rm 4-145.

Computer Modelling of the Molecular Mechanics of Activated Skeletal Muscle* - John Wood, G. MIT Rehabilitation Engineering Center. Harvard-MIT HST Program in Biomaterials Science Seminar. 4:30pm, Rm 37-212. Coffee 4pm.

Tuesday, December 2

Plasma Ion Energy Measurement* - Don Cook, G. Nuclear Engineering Doctoral Seminar. 12n, Rm 38-166.

Gear System Vibration* - W.D. Mark, Bolt, Beranek & Newman. Applied Mechanics Seminar. 3pm, Rm 3-133. Coffee 4pm, Rm 1-114.

An Approach to Highly-Integrated Computer-Maintained Cellular Arrays* - Frank Manning, Project MAC. Project MAC Seminar. 3pm, 545 Tech Square, Rm 512A. Refreshments 2:30pm.

Space Power Systems* - Richard Kline, Grumman Corporation. Aero/Astro General Seminar. 4pm, Rm 35-225. Coffee 3:30pm, Rm 33-222.

The Office of Technology Assessment: Overview and Materials Programs* - Jack Wachtman, Office of Technology Assessment and the National Bureau of Standards. Materials Science & Engineering Seminar. 4pm, Rm 4-270. Coffee 3:30pm, Rm 8-314.

Observations of the Carbon Monoxide Line in the Galaxy* - Nicholas Z. Scoville, University of Massachusetts. Astrophysics Colloquium. 4:15pm, Rm 37-252. Refreshments 3:45pm.

Poetry Reading* - Dick Lourie. Sponsored by humanities, literature section. 8pm, Stu Ctr Mezzanine Lge.

Politics and the Popular Arts** - Lillian Hellman, visiting professor, humanities. Humanities Seminar. 8:30pm, Rm 9-150.

Wednesday, December 3

Complement Synthesis by Long-Term Primary Cultures of Human Monocytes* - Peter Einstein, MDPA, Harvard Medical School. Nutrition & Food Science Seminar. 9am, Rm E18-408.

The New Alchemy Institute** - John Todd, New Alchemy Institute. Technology Studies 21.785 Lecture and slide show. 11am, Rm 20D-205.

New Applications of Magnetic Liquids in Machine Elements* - Frederick D. Ezekiel, formerly on MIT faculty. Mechanical Engineering Systems & Design Division Seminar. 12:05pm, Rm 3-465. Bring lunch, coffee & tea provided.

The Politics of Organized Irrationality: The Case of Zaire* - Arpad von Lazar, politics, the Fletcher School of Law and Diplomacy. MIT-Harvard Joint Africa Luncheon Seminar. Luncheon 12:30pm, Harvard CIS, Rm 1, 6 Divinity Ave.

Nodal Methods for Reactor Analysis* - Randal Sims, G. Nuclear Engineering Doctoral Seminar. 3pm, Rm NW12-222.

The Beginning of Solid State Physics at the Bell Telephone Laboratories: 1900-1947* - Lillian Hartmann Hoddeson, physics, Rutgers University. Technology Studies Seminar. 4pm, Rm 20D-205. Coffee 3:30pm.

Experimental and Analytical Investigations of LMFBR and Upper Plenum Mixing* - Y. Chen, G. Nuclear Engineering Doctoral Seminar. 4pm, Rm NW12-222.

Thursday, December 4

MHD Equilibrium and Collisional Transport in Tokamak at High Beta* - Dieter Sigmar, nuclear engineering & aero/astro. Plasma Theory Seminar. 11am, Rm 36-261.

Hydrodynamic Optimization of Ultrafiltration Systems* - Joseph Shen, NSR Energy Fellow, mechanical engineering, Thermal-Fluids Seminar. 4pm, Rm 3-343.

Revolution and Romanticism in Nineteenth Century Painting** - Judith G. Wechsler, architecture. Humanitas, an Evolving Perspective Seminar on Technology & Culture. 4pm, Rm 9-150.

The Energy Crisis - Fact vs Myth - a Global Perspective* - Bernard Feld, physics. Physics Colloquium. 4:15pm, Rm 26-100. Refreshments 3:45pm, Rm 26-110.

The Sun, Sea and Survival* - Clarence Zener, Carnegie-Mellon University. Energy and the Environment Seminar sponsored by Lowell Institute, New England Aquarium & MIT Sea Grant Program. 7pm, New England Aquarium Auditorium. Free.

Friday, December 5

Efficient Development of New Separation Processes* - E.N. Lightfoot, University of Wisconsin. Chemical Engineering Seminar. 2pm, Rm 10-105.

Fixed Point Theorems in Formal Languages* - S. Eilenberg, mathematics, Columbia University. Systems, Communications and Control & Computer Science Seminar. 3pm, Rm 37-212.

MHD Spectra - Discrete and Continuous* - John M. Greene, Princeton Plasma Physics Laboratory. Plasma Dynamics Seminar. 4pm, Rm 36-261.

Community Meetings

The Wives Discussion Group** - Led by Myra Ridriques, social worker; Charlotte Schwartz, sociologist, & Carol Hulsizer. Wed, 2:15pm, Stu Ctr Mazzanine Lge. Babysitting Stu Ctr Rm 473

MIT Diet Workshop** - Thurs, 12n-1pm, Stu Ctr Rm 491.

MIT Womens Forum** - Meetings Mon, 12n, Rm 10-105 (Tues in case of holiday.)

Social Events

Christmas Rat - Sat, Dec 6, 8:30pm, Sala. Light & dark beer, 16 oz/\$.25. Wine available. Live announcer & records by WTBS. Free, college ID required.

24 Hour Coffeehouse* - Enjoy relxng conversation, piano playing, games, inexpensive food, candy & drinks. Open 24 hours per day, 7 days per week, Stu Ctr 2nd fl lge.

Singles Cocktail Party* - Sponsored by Over 30's Singles Club. Wed, Dec 3, 5:30-8pm, Fac Club cocktail lge. Cash bar.

Over 30's Singles Club - Lunchtime meeting in Stu Ctr East Lge (small dining room off Lobdell) Fri, 12:30-1:30pm, New members always invited. Alice, x3-3400 or Marty, x8-1206 Draper.



The ice rink was still more like a duck pond when this picture was taken but it is expected to be solid for skaters today (Wednesday, Nov. 26) or Friday, Nov. 29.

Movies

Generation and Propagation of Sound; Magneto-hydrodynamics* - Fluid Mechanics Films. Wed, Nov 26, 4pm, Rm 39-400. Free.

Arnold** - LSC. Fri, Nov 28, 7 & 9:30pm, Rm 26-100. Admission \$.50, ID required.

Steppenwolf** - LSC. Sat, Nov 29, 7 & 9:30pm, Rm 26-100. Admission \$.50, ID required.

And Then There Were None** - LSC. Sun, Nov 30, 6:30 & 9pm, Rm 26-100. Admission \$.50. ID required.

Les Enfants Terribles* - With English subtitles, narrated by Cocteau. Foreign Literature & Linguistics Film. Mon, Dec 1, 7pm, Rm 54-100.

Rarefied Gas Dynamics; Fluid Dynamics of Drag (Part I)* - Fluid Mechanics Films. Tues, Dec 2, 4pm, Rm39-400. Free.

Othello* - Humanities Film Series. Tues, Dec 2, 7pm, Rm 26-100. Free.

The Crowd* - Cities on Film Series (New York) sponsored by Undergraduate Urban Studies Program. Tues, Dec 2, 7pm, Rm 7-431. Free.

Rarefied Gas Dynamics; Fluid Dynamics of Drag (Part I)* - Fluid Mechanics Films. Wed, Dec 3, 4pm, Rm 39-400. Free.

Thunderball** - LSC. Fri, Dec 5, 7 & 10pm, Rm 26-100. Admission \$.50, ID required.

Zero de Conduite (Vigo); A Day in the Country (Renoir)* - Film Society. Fri, Dec 5, 7:30 & 9:30pm, RM 6-120. Admission \$1.

The Hospital** - MidNite Movie. Fri, Dec 5, 12m, Sala. Free, ID required. Bring blanket.

Emmanuelle** - LSC. Sat, Dec 6, 7 & 9:30pm, Rm 26-100. Admission \$.50, ID required.

A Funny Thing Happened on the Way to the Forum** - LSC. Sun, Dec 7, 6:30 & 9pm, Rm 26-100. Admission \$.50, ID required.

Lobby 7 Events

Wellesley Madrigal Singers* - Wed, Dec 3, 12n, Free.

Music

Tickets on Sale - Tickets for The Institute PDQ Bach. LSC's Registration Day Concert (Mon, Feb 2, 8pm, Kresge) will be on sale beginning Wed, Dec 3. Locations: Wed, Dec 3 & Fri, Dec 5, Bldg 10 Lobby; Thurs, Dec 4, Bldg 7 Lobby; after Fri, Dec 5, LSC office, Stu Ctr 457. Tickets: \$3 & \$4.

MIT Concert Band* - Program features works by Vittorio, Giannini & Gordon Jacobs, including "Prelude and Happy Dance" by Kazdin & world premier of "Fanfare for Dec 5, 1901" by Hazzard. Fri, Dec 5, 8:30pm, Kresge. Free.

Chamber Music Society Concerts* - Wed, 5:15pm, music library Bldg 14E.

Theatre and Shows

Musical Theatre Guild Directors Meeting - All persons interested in being director or musical director of spring musical, Fiddler on the Roof, should attend meeting Mon, Dec 1, 7pm, Stu Ctr Rm 439 or call x3-6294.

Dance

MIT Folk Dance Club* - **International:** beg-intermed Sun, 7:30-11pm, Sala. **Balkan:** advanced Tues, 7:30-11pm, Stu Ctr Rm 491. **Israeli:** all levels Thurs, 7:30-11pm, Sala. **Easy International:** Fri, 12n, Kresge Oval of Bldg 7 Lobby, depending on weather.

Exhibitions

Creative Photography Lab Exhibit* - Works by Melissa Shook on exhibit beginning Fri, Nov 21, thru Dec. Hours: 10am-10pm.

Faculty Club Exhibit* - Lithographs and photographs by Deborah Dyer, daughter of Professor Ira Dyer, head of Ocean Engineering. Nov. Mon-Fri, 9am-11pm, 6th fl Faculty Club.

Otto Piene: Paintings, Gouache, Drawings* - Works by the director of MIT's Center for Advanced Visual Studies. Exhibit divided into 3 locations: paintings, Hayden Gallery; gouache, Hayden Corridor Gallery; drawings, CAVS. Fri, Nov 7-Sun, Dec 7. Hours: Hayden, 10am-4pm, daily, Tues evg 6-9pm; CAVS, Bldg W11, Mon-Fri, 9am-5pm. Free.

MIT Historical Collections* - Permanent exhibition Mon-Fri, 9am-5pm, Bldg N52, 2nd floor. **Bicentennial Exhibit:** Katharine Dexter McCormick, '04, exhibit in Bldg 4 corridors.

Schumann at Work on a Song* - Music Library exhibit of manuscript facsimiles & pictures. Daily, Bldg 14E.

Hart Nautical Museum* - Permanent exhibit of rigged merchant and naval ship models, half models of yachts and engine models. Open daily in Bldg 5, 1st floor.

Athletics

Community Hockey League** - Try-outs Wed, Nov 26 & Sun, Nov 30, 8-11pm, skating rink. Info: Ken, x3-7813.

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

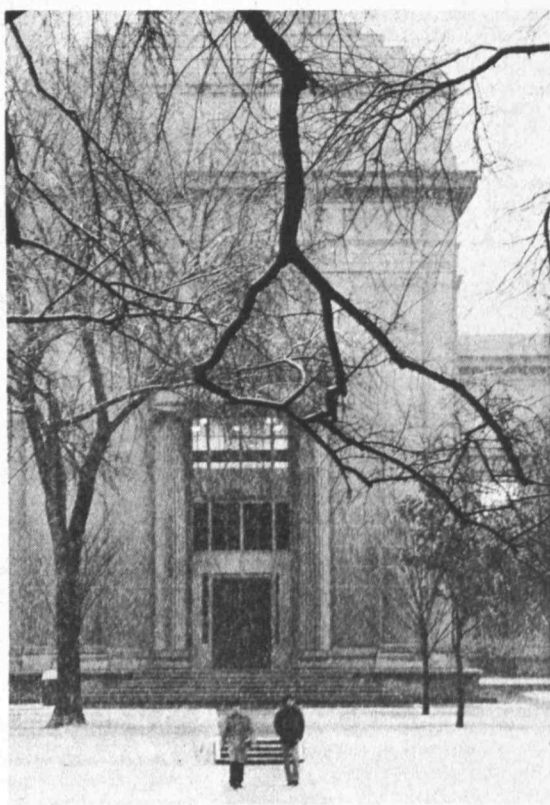
Send notices for December 3 through December 14 to the Calendar Editor, Room 5-111, Ext, 3-3279, before noon Friday, November 28.

The mad wind's night work, the frolic architecture of the snow



The Snowstorm
Ralph Waldo Emerson

Photos by Calvin Campbell



FEW COULD DISREGARD the winter forecast of MIT meteorologist Hurd C. Willett when the first snows came to Cambridge last Monday. Students on Kresge Plaza were inclined to accept the granulated slush as a necessary evil, while those more sentimentally inclined enjoyed the transformation of Killian Court into a veritable postcard scene. Before plows could be marshalled or snowballs molded, however, Tuesday morning's thaw had restored practically all green to the campus.

INSTITUTE NOTICES

Announcements

Cable TV at MIT: Pre-IAP Program Dates—IAP course 129, sponsored by CAES. Limited to 15 people. All sessions 10:11:30am. Wed, Nov 26 & Fri, Dec 5: Operation & discussion of black & white studio, Rm 9-255. Fri, Nov 28 & Mon, Dec 8: Black & white studio, operation phase II, Rm 9-355. Mon, Dec 1 & Wed, Dec 10: Introduction to electronic video editing, Rm 9-351. Wed, Dec 3: Introduction to portable video camera: hands on experimentation, playback and discussion, Rm 9-351.

All Foreign Students—If you are going home for Christmas vacation, come get a Certificate of Eligibility (I-20 or DSP 66) from Foreign Student Office, Rm 3-107.

Basic Pistol Marksmanship Course—Thurs, Dec 4, 6:30pm, duPont Pistol Range. Fee: \$20, covers everything. Open to first 20 members of community to register. Registration: Tom McLennan, x3-3296 or Andy Platias, x8-1417 Draper.

UNICEF Christmas Cards and Calendars—Now on sale at TCA, Stu Ctr 4th fl, 11am-3pm. Many different designs, including assorted, as well as wall & desk calendars.

MIT Furniture Exchange—Open Tues & Thurs, 10am-2pm, 25 Windsor St, to buy and sell. Tax free donations gladly accepted.

Discount Tickets—Available for Wed, Dec 10 open rehearsal, TCA, Stu Ctr Rm 450, x3-4885.

Placement

The following companies will be interviewing during the time period covered by the current Institute Calendar. Those interested may sign up in the Career Planning and Placement Office, Mon-Fri, 9am-3pm, Rm 10-140, x3-4733.

Monday, December 1—3M Co. **Tuesday, December 2**—3M Co; Asiatic Petroleum Corp; FCM; Union Carbide Corp. **PhD geology.** **Wednesday, December 3**—National Security Agency. **Thursday, December 4**—Alpha Industries, Inc; Air Products & Chemicals, Inc.

MIT Club Notes

Backgammon Club*—Wed, 7:30pm, Rm 4-151. Bring boards.

MIT Baha'i Association*—Will gather Mon, 5pm, Rm 8-105, every other week (Dec 1 & 15)

MIT Ballroom Dancing Club**—The club will be very active this term with frequent workshops & dances. New members welcome at all functions. Info & times: Carl Sharon or Doug King, 536-1300.

Beefaroni Chess Club*—Alternative chess club. Interested in playing relaxed serious chess: Info: Gary Kaitz, 494-8234 or x3-6304 Dorm.

Bridge Club*—ACBL Duplicate Bridge. Open pairs Tues & Thurs, 7pm, Stu Ctr Rm 473.

MIT/DL Bridge Club**—ACBL Duplicate Bridge. Tues, 6pm, Walker Memorial Blue Rm.

MIT Chess Club*—Meetings Sat, 12n-7pm, Stu Ctr 407.

MIT Choral Society—New members are invited to audition Mon, Dec 1. Come to regular rehearsal, 7:30pm, Rm 10-250, and audition afterwards.

MIT Figure Skating Club**—A chance for figure skaters who feel confident at skating forwards and who can at least make an attempt to skate backwards to meet as a group. Sun, weather permitting, 11:30am-1pm, skating rink. Free, need athletic card & skates.

Hobby Shop**—Mon-Fri, 10am-6pm, Rm W31-031. Fees: \$10/term for students, \$15/term for community. Info, x3-4343.

Math Club*—Meeting Sun, 4pm, Rm 4-182.

Psi Club*—For all graduates of Silva Mind Control. Wed, 5pm, Rm 1-132.

MIT Science Fiction Society*—Invites people to the world's largest science fiction library, Stu Ctr Rm 421, and to its zany weekly meeting, Fri, 5pm, Rm 1-236.

Shotokan Karate Club**—Rigorous training for intercollegiate competition & self-defense, given by 6th degree black belt. Mon & Wed, 8pm, duPont wrestling rm; Sat, 1pm, duPont 2nd fl dance rm.

Space Habitat Study Group*—Interdisciplinary studies on space colonization. Wed, 7:30pm, Rm 4-270. Office, Rm 24-415.

Strategic Games Society—Sat, 1pm-1am, Walker Rm 309 & 318. Offers opponents and discounts on merchandise to members plus gaming & periodical library. Info: Paul Bean, 266-6108.

Student Homophile League*—Gay Lounge, Rm 50-306, open daily for lunch & random other hours, x5-6745 Dorm. Tom, Contact Line, x3-5440, provides info, referrals, counseling or just talking to gay persons. Meetings 1st & 3rd Sun every month. Gay Lge. Consult bulletin board, Bldg 3, for info.

Student Information Processing Board*—Meetings Mon, 7:30pm, Rm 39-200. Info: x3-7788.

MIT Tae Kwon Do**—For information call Barbara Illowsky, 492-4945.

The Tech—Organizational meetings Wed & Sun nite, Stu Ctr Rm 483. New staff members in all departments are always welcome.

Technique—MIT yearbook needs photographers, writers & workers. Sat, 11am, Stu Ctr Rm 451, x3-2980.

Tiddlywinks Association*—Wed, 8pm, Stu Ctr Rm 473.

Voo Doo**—General meeting, Sun, 2pm, Rm 20-318.

MIT Wheelmen*—Meetings Tues, 7:30pm, Rm 1-203.

New UROP Listings

For more detailed information on UROP opportunities listed, MIT undergraduates should call or visit the Undergraduate Research Opportunities Program Office, Room 20B-141, Ext. 3-5049 or 3-4849 unless otherwise specified in the listing. Undergraduates are also urged to check with the UROP bulletin board in the main corridor of the Institute.

Computer Sciences

The project deals with the structure of biological macromolecules and their analysis through computer applications. The aim is to develop and implement a number of innovative programs for solving and interpreting the structure of molecules, especially macromolecular nucleic acids. A PDP 11/50 system is available. The student should have a background in Fortran programming and preferably experience with computers of the PDP 11/50 type. Contact Prof. Alexander Rich, x3-4715 or Dr. Gary Quigley, x3-4710.

Division for Study and Research in Education

Students are encouraged to participate in psychological research examining questions pertaining to the structure of the lexicon and the processing of semantic information. Specific questions to be examined include: 1) bilingualism 2) match an categorization processes; and 3) semantic information during sleep. The students will be involved in the actual execution of the experiments and their analysis, as well as in design and interpretation. Contact Dr. Benny Shanon, x3-5428, or 661-8126.

Project MAC

The Computation Structures Group at Project MAC is engaged in the development of a new type of computer architecture based on the concept of data-flow program representation. An architectural prototyping facility using microprocessors is being constructed, and there are numerous opportunities for research in the different aspects of its development. The work to be done includes (but is not limited to) hardware design with microprocessors, development of languages for architectural description, and the design and implementation of an integrated software/hardware system. Contact Prof. Jack Dennis, Rm NE43-530.

Massachusetts General Hospital Boston, Ma.

An opportunity exists for an undergraduate interested in participating in a research project involving human hemoglobin in solution, intact red cells and the processes that influence its relationship with oxygen. Several analytic techniques are being utilized, including a dynamic display of the complete oxy-hemoglobin dissociation curves, blood-gas measurements and column chromatography for characterization of hemoglobin types. Advanced level of related laboratory experience is desirable.

Tufts Medical School Boston, Ma.

Multiple antibiotic resistance in bacteria is a major health problem. This laboratory is studying this plasmid-mediated infectious resistance which can be transferred easily among various bacterial species. The approach is to isolate the piece of extra-chromosomal DNA (R factor) away from the bac-

terial cell and to study control of its replication and transfer. Other work concentrates on the regulation of expression of certain antibiotic resistance genes, most notably that to tetracycline. Students interested in joining an ongoing basic science project with clear medical-health relevance are invited to participate. The only requirement is experience in sterile technique, but background knowledge of molecular biology is recommended.

Deaconess Hospital Boston, Ma.

Study of physiological roles and significance to the animal of various biochemical components, usually enzymes, found in tissues. Specific projects include: the quantification of the amino acid composition of many tissues under varying physiological conditions; the quantitative determination of enzymes specifically related to organ function; and the identification of which basic enzyme functions are absolutely necessary for growth or biochemical differentiation to occur. Other topics include: the developmental formation of certain enzymes in a single tissue; chemical identification and partial purification of isoenzymes from different tissues; the study of concurrent changes in physiology and morphology of that tissue; and a study of the effects of an exogenously-altered physiological state on enzymes.

Veterans Administration Hospital W. Roxbury

The Research Director of the Massachusetts Chapter of the Association of Paralyzed Veterans of America would like to become involved in a study of how wheelchair design and construction materials can be modified. The project would include an analysis of what disabled persons don't like about present designs and a modification of materials and design to lighten a chair.

Environmental Law Boston, Ma.

A private legal organization involved in researching the legal and technical issues of environmental protection and regulation would like to involve students in the preparation of court cases for litigation. Students with technical expertise would work on projects on highway design, ecological impact of off-shore drilling, effect of drinking water regulation and energy facility siting.

Cambridge Collaborative Cambridge, Ma.

Cambridge Collaborative is studying new applications of continuum mechanics to the measurement of pulmonary function in infants and adults. The aim is to develop non-invasive measures of pulmonary function which will yield information that has been inaccessible with conventional techniques. Opportunities are available for undergraduates to study fluid flow and propagation in the upper airways, respiratory mechanics, and physiology, mechanical design of devices to couple external instrumentation to the airways of adults and infants, data acquisition and processing systems, and development of a clinical protocol for data acquisition from infants.

Graduate Studies

The following descriptions of selected graduate fellowships have been received recently by the Graduate School Office. More complete descriptions are available in the office, Rm 3-136.

Josephine De Karman Fellowships

Approximately 12 fellowships, each worth

\$2,500 for the 1976-77 academic year will be awarded by the Josephine De Karman Fellowship Trust. Graduate students entering their third year or after of graduate school and senior undergraduates are eligible. Students in any discipline may apply; however, special consideration will be given to applicants in the humanities. Foreign students already enrolled in a university in the US are eligible. Deadline: January 31, 1976.

International Development Research Centre

The International Development Research Centre is offering awards to Canadian graduate students working in fields related to international development. Applicants must have completed all the requirements for the PhD except the thesis by September 1976. The research topic may be in any area of the field of international development such as agriculture, food and nutrition sciences, population and health sciences, informational sciences, and social sciences, etc. It is expected that research will be conducted in a developing country and that the applicant will be associated with an institution in the country in which the research is to be carried out. Applications available in the Graduate School Office. Deadline: January 31, 1976.

Foreign Studies

Rome Fellowships

The American Academy in Rome offers a limited number of two-year fellowships for young artists and scholars ready to do independent work. The fellowships carry a stipend of \$4,500 a year. Application deadline: December 31, 1975. Contact the Graduate School Office, Room 3-136, for further information.

Religious Activities

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

Black Christian Fellowship*—Bible study Wed, 7pm, Masterton Lge, E Campus. Prayer group Mon-Fri, 12:15pm, Walcott 310, E Campus.

Prayer Time**—Lunch hour Bible classes led by Miriam R. Eccles, Fri, 1-2pm, Rm 20E-226. All are welcome.

Campus Crusade for Christ*—Family Time Fri, 7:45pm, Rm 37-252.

Celebration of Holy Communion**—MIT Lutheran & Episcopal Ministry, Wed, 5:05pm, Chapel. Supper following, 312 Memorial Dr.

Christian Worship Service*—Sun, 10:45am, Chapel. Refreshments following service.

Hillel*—Traditional services Fri, 4pm, K kosher Kitchen & Sat, 9am, Chapel.

Islamic Society**—Prayers Fri, 1pm, Kresge rehearsal Rm B.

Vedanta Society: Meditation & Gita*—Led by Swami Saravagananda, Fri, 5:15pm, Chapel.

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 Institute 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 5-105. Please submit all ads before noon, Friday, November 28. They will be printed on a first come first served basis as space permits.

For Sale, Etc.

Pr Pirelli radial snows, 175SR14, hrdly used, \$50/pr; 2 Japanese acoustic guitars, class \$30; stl str w/case \$45. Rusty, x3-4361.

Copy printing Screw Press, cast stl, exc cond, for wdcuts, etchings, bkbinding, etc, 11x15" bed, nw \$200, only \$125. Evgs xcept Fri, 566-2891.

Lk nw pots & pans, glasses & other K utensils; Lawson 96 gold sofa. Call, 389-8837, 6-9pm.

Motobecane mirage 10 spd, 21", gm mech shape, \$70 or best. Rob, 547-2416, evgs or lve msg.

Child x-entry skis, 170 cm, w/poles, \$24; boots: sz 7, \$9; sz 6, \$12; sz 5 1/2, \$5; sz 2, \$5; almost nw MRC 501N throttle packs for N or HO gauge trans, \$17, x8-1463 Draper.

Nw pr sz 8 Fabiano blu hiking boots, \$25. Mary, x3-4903.

Novus 650 pckt calc, 4 fctn, nw, \$9; Koho hcky stick, nw \$3.50. Ed, x5-8395 Dorm, evgs.

Compl 20 gal aquarium set w/plants & doz tropical fish, \$75. Bernard, 494-8920, evgs.

Pr 5.60x15 VW stud snows w/rims, yr old, best. Ed, x3-3854.

Pr C78x13 snows, less 2 K, \$30, x3-1636.

Canon VT body, Leica lens, Sekonic lite mtr, \$140 or best. Paul, 247-2986.

Zenith 19" b&w TV, UHF/VHF, ivory case, runs well, \$50, x3-4119.

F clothing, famous name swtrs sz 36-38, blouses & shirts sz 10-14, var others, cheap, all \$4 or less; Greek caftan, \$10. Gail, x8-1216 Draper.

Lg Adverts, \$188/pr; Technics 1500 trnbt, \$149; Marantz 220B rcvr, \$228; b nw. Bob, x3-4242.

Pr goldpierced earrings, Bonwitt Teller, sz of 1/2 dollar, \$10; dk pine oval DR tbl w/ 2 lves, Rapids Furn, \$150. Pat, x3-2603.

Almost nw pr snows & whls for Buick Electra 225, x8-1618 Draper.

Canon FD 135 mm f2.5 lens, lk nw, \$95. Dave, x3-5980.

Olds Royale snows, 4 exc cond, H78x14. Call, 484-1804.

Nw 20 hp Merc outbrd motor, \$650. Burt, x8-3583 Draper.

Rugs, lamps; sm tbls; K set; sm washer & misc items. Sundry, x8-1211 Draper.

Dansk Smooth Flamestone dishes, 1 soup bowl, \$6; 4 cups & saucer sets, \$13/ea; 4 dinner plates, \$14/ea; 2 salad plates, \$7.50/ea; whole set \$100. Carol, x3-1332.

Kodak Sound Super 8 movie sys; mdl 130 Ektasound camera, mdl 235 proj, repro sound & pic, units xcept super 8 are sound super 8, \$350 value, \$100/ea or \$175 comb, x5311 Linc.

Mtd snows for BMW 2002, \$25/ea or best. Frailey, x3-4974.

Pr '74 VW snows w/rims, lk nw, blk wall, sell cheap. x3-6310.

Bge sofabed, slps 2, perf cond, \$60; glass coffee tbl, 50x50x10 w/wd base; \$25. Sia, x3-3911.

Cntryside Premium 7.00x13 snows, 4 ply nylon, used 1 seas, \$15/pr. Gene, x3-3692.

Photomic FTN body w/mtr & case, exc cond, \$165. Bob, x3-7856.

Sears Slvrtn elec guitar, exc cond, dbl pickup, 6 way adj bridge, vibrato tailpe, 2 adj pickups, inlaid markers, 6 stl str, playing instr w/case, great for beg, \$40. x8-3388 Draper.

Leica lenses: 35 mm RF Summieron for M3, \$190; 50mm Summieron collapsible, \$90. R Taylor, x3-5142.

Moving, must sell: f clothes sz 10-12, \$1-\$3; 16" truck rim, \$5; pickup tire change, \$10; pottery tools, \$1; metro-nome, \$5; presch jungle gym, \$25; chemical toilet, \$60. Bob, x8-4587 Draper.

Rims, 15", for Dodge '73-74; 13" 4-hole rims for Pinto, x8-3844 Draper.

Wstgsh elec stove, top of line, 30", slide in, self-cln, wht, nvr used, orig \$380, ask \$275. Howard, x3-2837.

Pr G78x14 Sears Dynaglas ww snows, mtd & blnd Buick rims, used 1 seas, exc cond, \$60. Hank Goodman, x8-4166 Draper.

Nice soft dbl bed, box spr & matt, 2 mos, perf cond, pd \$100, selling \$70. Alan, 646-4625, evgs.

M bckl ski boots sz 9 1/2 W. Call, 491-1619, aft 2.

Heathkit AR 1500 amfm rcvr, perf cond, yr old, \$350. Jon Lueker, 247-8355.

Lg wd wardrobe, 67"x45", gd cond, \$15. x3-7138.

Rock'n'roll limited, rare tapes, Led Zeppelin, The Who, Queen, etc, free list, Rolling Stones bootlegs, \$5 & under. Gary, 494-8234.

Sm crib w/nw matt, \$5. Semira 494-8444.

Singer sew mach & cab, almost b nw; f 3 spd bike, x8-1871 Draper.

Lvg, must sell misc camping equip; typwtr; B scale; dinnerware; tray; lampshade, etc. Catherine, 494-8801.

Antique player piano, rebilt; nw 17" Eng saddle; nw dishwasher used 3 mths; 2 mtrcycles: 350 Bultaco, 250 Husqvarna, both '73. Betty, x359 Linc.

Contemp furn orig from Contemp Interiors: lge chr w/ftstool, tangerine; coffee tbl, freeform glass; fruitwd DR tbl, buffet, china cab; exc cond; also dbl bed. Call 646-1262.

Radial belted snows, 165 SR 15 for Saab or similar, 4 for \$10/ea. Call, 232-0205.

Blk 84" naugahyde couch, \$150 or best. Terry, x8-4061 Draper.

Pr 14" stud snows w/rims, used 1 yr, \$30. x3-2683.

Hart 190 cm skis, Look Nevada bnrgs, gd cond, \$25. Call, 494-8886.

Lg mutant pineapple plants from Hawaii, 2, approx 2 yrs old, \$15 & \$25. Pat, 623-7354.

GE 3 chord organ on legs, \$19; Allstate 6 car trainset, \$8; Easy-Bake oven, \$6; all gd cond. Mel, x5556 Linc.

Port 8 trk tape player, batt or AC, \$20; GE elec knife, 2 blades, holder, \$10; Magnus chord organ, \$25; all gd cond. Dick, x3-4635.

Baby carriage/stroller, lk nw, \$40; 2 child folding booster chrs, \$4/ea; play stove & washing mach, \$9/ea; all exc cond. x8-4095 Draper.

Wht vinyl couch, \$25; desk, \$10; stl bkshlf, \$5; all gd shape. Per, x3-3920.

Couch, \$50; chr, \$25; both gd cond; tbl & 4 chrs, gd cond, \$50; dbl bed, matt & dresser, \$50; LR crtns; var sundries; must move, gd brngs, Mel or Jackie, x3-2982.

Air Force parka, gd cond, \$30 or best. Bacon, x3-2558, Tues or Thurs.

Tires, exc cond: reg E78x14, 1 Frstne belted, 1 Delta belted, \$15/ea; snows: pr 7.75x14 Gdvr Vitacord, \$30; pr E78x14 Dunlop CW44, \$15 or best. Call, 383-0205.

Snows, BR 78x13 Frstne T&C radials, used 2,925 miles, \$35/pr. John, x3-2869.

K tbl / 3 chrs, \$35; 2 bar chrs, mahog finish, \$30. Euren, x8-3501 Draper.

Exquisite mtch pr framed Panamanian molas (reverse applique native art). Bill, 868-8895, evgs.

Antiqued wht BR set, \$75; BR set, dresser w/mirror, m chest, \$40; 4 fold wd chrs, \$40; binoculars, 80x40, b nw, orig \$70, \$50; wht rabbit fur parka, sz 14, \$20; wl blk maxi coat, sz 14, \$15. x3-4437.

Fr velvet red carpet, 12'x12', 100% wool, incl pad, x5773 Linc.

Dual 1009 changer w/Shure M44/E crtrdg, 1st offer over \$30. Call, 492-1992.

Pr Frstne T&C ww VW stud snows, 5.60x15, 1 nvr used on nw 4 bolt rim, other 3/4 tread on lk nw rims, blnd; also v misc VW parts. Tom Keim, x3-2237.

Turn-of-the-cent LR furn, 4 pc, love-seat, couch, 2 chrs, recently reuphol in velvet. x3-7924.

Danish design sofa & chr, \$75; mtl desk w/chr, \$75; 14,000 BTU AC, \$100; crtns, \$40; fan, \$10; bkshlf, \$15. Patil, 494-0390.

Sinclair scientific calc, perf basic fcctns plus log & trig, 8 mos, \$35. Tracy, 661-8859.

Unused 180 cm Graves Comp sloham skis, mtd nw Solomon 502 bnrgs, orig \$250, \$125; Nordica pro boots, sz 7-8, orig \$120, \$60. Call, 267-5503.

K set: tbl w/formica top, chrome legs, 4 chrs w/blk uphol & chrome legs, exc cond, \$25. x3-2766.

Furn avail 12/14: twn bed, \$20; chrs, \$3/ea; sm tbl, \$4; chest drwr, \$10; lamps, \$5 & \$8, etc. Call, 494-8995.

Airequipt 450 ES slide proj, remote cntrl, stack loader, mtl & carousel slide trays, \$50; dbl bed, box spr & matt, \$15. Heidi, x3-1505.

Imported Span guuitar, perf cond, \$35; toy drum set, \$10. Nicholas, x314 Linc.

Snows, E78x14, almost nw, \$30/pr. Mark, x3-7350.

Bkcases, 2, 39"x75" hi & 37"x86" hi, adj shlvs, \$35/ea; mtl bedframe, \$8. Call, 484-3017.

Do Xmas shopping here at MIT, hand-made Amer Indian jewelry, turq silver, liquid silver, pukka shells, etc. Arlene, x3-6779.

Calrk's Wallabees, f sz 7N, b nw, dark leath, 2 wks old, too sm, must sell quick, nw \$34, \$28 or best. Barry, x3-5358.

Shredder-bagger, 5 hp True-Test, Briggs & Stratton eng, used 1 seas, \$135. Dennis, x5745 Linc.

Snows: pr 5.60x15 mtd on rims, exc cond, \$30. Dick x3-5203.

Vehicles

'64 VW bug, selling parts, transaxle. Fenders, lamp assmblys, radio, hood, rear lid, etc. x8-3379 Draper.

'64 Olds Delta, gd cond, all power & AC, \$575. Ken, x3-4426.

'68 VW Sqbk, 78K, \$600. Call, 396-8215.

'68 Olds, 4 dr sed, p st & br, tinted wndshld, postraction rear end, 4 nw tires, exc run cond, ask \$900. Call, 396-5339, aft 6pm.

'68 Volvo 122S, 80 K, exc cond, std, nw Michelin radials, nw elec work, gd body, little rust, wht vinyl roof, 27 mpg, \$1,100. Matt, 661-2023.

'68 Datsun 510, gm, 54 K, some body rust, \$500. Bob, 494-8683.

'69 VW bug, auto; rebilt eng & trans, nw brakes, muff, bearings, 98 K, \$800. x3-7283.

'69 Pont Firebird, auto, ac, p st & br, vinyl top, gd rubber w/snows, \$900; '69 BSA 650, dual carb, top end rebilt, \$700; '52 Ford f-1 pickup, stoc, v gd cond, Runs daily; best. Jones, 484-7363.

'70 Torino GT, 351, 4 barrel, stereo, sev nw parts, \$850 firm. Ted, x8-3577 Draper.

'70 Ford Frln 500, 2 dr, red/wht, sgl ownr, \$900. x3-3746.

'70 Fiat 124, 40 K, gd run cond, 25+ mpg, amfm, ideal commuting, lvg cntry, must sell, \$450 or best. Irving, x3-1715.

'70 Toyota Corona RT 40, in accident, eng in tact. Kay, x8-1357 Draper.

'71 Chevy Vega htchbk, yel, gd cond, 50 K, wht, \$1,000. x3-6943.

'70 Fiat 124, 4 dr sed, 4 spd, amfm, radials, snows, low gas mileage, gd cond, \$1,200. Alan Shorb, x3-1587.

'71 Merc 4 dr wed, p st & br, vinyl rf, radio, snows, \$1,500. Joe Saccoccio, 438-3107, aft 5pm.

'72 Chevy Vega htchbk, 46 K, gd cond, \$900; mtd stud snows, \$60. Kathie, x3-6685.

'72 Chevy Nomade wgn, V8-307, 51 K, AC, radio, snows, gd cond, \$1,590. Call 738-8166.

'73 Chevy Vega GT, auto, radio, 40K, \$1,900 or best. Johansson, 535-4600, x220, aft 6pm.

'73 Pinto wgn, auto, radio, 22 K, exc cond, mtd snows, \$2,200. Dan, x8-4583 Draper.

'73 Chevy van, 1/2 ton, long bed, 350 auto, gd cond, \$2,400, x8-1558 Draper.

Housing

Bel, 6 rm apt, nwlly decorated, 1/2 blk T & stores, \$275. x7004 Linc.

Bel, avail 12/1, 5 rm 3 BR apt in 2 fam hse w/lg yard, v qt nbrhd, pref cpl w/chldrn, \$300 + util. Gilles, x3-7425.

Bkline, sub BR apt 12/1-2/4, fully furn, nr 2 T sta, 30 min walk MIT, top fl 2 fam hse, nr Kennedy birthplace, 2 mos rent incl everything, \$300. x3-2380.

Camb, Cent 'q, lg 5 BR apt, 2 blks Mass Ave, l, K, LR, porch, avail immed. Call, 47-8854.

Ski rental Fryeburg, Me, 3 BR chalet w/frpl, 10 min Pleasant Mtn, 20 min N Conway, \$125/wk. Steve, x5584 Linc.

Jay Peak, lakeside ski hse, 6 BR, 2 LR 2/frpl, K, 2 DR, \$250/wk incl ht & util. Christine, x3-2743.

Waterville Est, tri-lvl condo, slps 6, pool & sauna, avail 12/1-5/1, \$1,500. Call, 665-8638.

Vt chalet, avail Xmas-NwYr holiday, ski Stratton, Bromley, Magic, Okemo, 4 BR, 2 frpl, \$50/day all incl. Sureau, x447 Linc.

Chalet, Conway slps 10, elec, 1 1/2 B, avail a eas \$1,500, month \$600 + util. Frankel, x3-6824.

Animals

Kittens, 13wks, 3 f, 2 m, trained & v healthy (fresh food only), only to gd homes. Joannathan, 232-2914.

F seal-point Siamese kitten nds affectionate home \$25. x3-2459.

Wanted

Garage for '59 Jag, now thru spr. John, 535-1904.

Pr used fig skates, f sz 7 1/2-8. Cathy, x3-2030.

Wanted for cash, spinet or console piano. x3-3273.

Environment org, Friends of the Earth, nds volunteers Wed & Th evgs at info ctr, Stu Ctr Rm 002, drop by or call. x3-7922.

Sm or compact car, gd cond. Masao Sato, x3-3818.

Used vac clnr. Martha, x3-5306.

Sr fac visitor from UK nds 1 or 2 BR housing for fam in Camb, 1st & 3rd wk Dec. x3-2242.

Car to drive 1 way to Ft Lauderdale or Miami, exc refs, lvg 12/26 or 27, call for arrangements. Judy, x3-1493.

Wl pay stu driving from Pgh, Pa to Bos after Xmas or IAP to bring sev boxes, or wl pay 1-way rental of sta wgn for same. Sue, x3-3270.

TV, b&w; bac clnr; bkshlvs, x3-7107.

Stu nded for psych exper w/pay. Pls lve name & nmb w/ Judy, x3-6047.

Tekts for The Who, 2, wl pay \$15. Ed, x8-1811 Draper.

Urgently nd lg trunk, gd cond. x3-3394.



Neil Lieblich, left, president of the MIT Logarithms, receives a check for \$100, from Chesley Logcher, co-chairperson for student services of the MIT Women's League (formerly the Technology Matrons). At right is Artemis Gyftopoulos, president of the Women's League. The money will help defray expenses of the musical group on a planned tour. The Women's League also donated \$200 to the women's basketball team to aid their travel plans to attend an invitational tournament in Chicago.

Corporate Bigness is Asset

(Continued from page 1)

support of these claims is neither complete nor entirely consistent, Dr. Thompson said, they are "worth a serious look because if it should turn out that the long-run performance of corporate-dominated markets outweighs any lack of competitive vigor in the short-run, then the case for deconcentration is weakened greatly."

Calling attention to the renewed pressure for stepped-up antitrust investigations, Dr. Thompson warned that the case for corporate

capitalism and corporate giantism "boils down to a matter of trade-offs between the short run and the long run."

If the standards used to judge performance are geared to the size of profit margins and the presence or absence of price competition, then there is merit to the claim that smallness might improve market performance, he said.

However, in industries where technical progress and productivity gains are a function of large size, then "oligopolistic forms of corporate capitalism can offer greater social potential.

"In such cases, society will be better off over the long term with markets comprised of firms able to exploit the full range of size-related advantages, even if corporate prices do yield above-average profits, than it will be with atomistic competition where markets are 'freer' and profit margins thinner.

"Indeed," he concluded, "the arithmetic of long-term performance makes the argument for bigness quite decisive (despite gaps and contradictions in the accumulated evidence) except for two things. One, large size breeds an uncomfortable and sometimes politically tenuous, concentration of power and, two, the competitive character of corporate capitalism does not offer society as reliable protection against abuses of market power and anticompetitive practices as does market capitalism."

A problem in determining whether the long-term advantages outweigh the short-run gains is the lack of a reliable yardstick for long-term performance.

"With the debate over bigness growing, the time is propitious for both corporations and independent analysts to begin to measure and evaluate the contributions of large size to increased technological progress, faster gains in productivity, improved access to scale economies, flatter or even downsloping price trends, a higher quality of consumption and rising living standards.

"Otherwise, when the time comes in the not too distant future for Congress to once again scrutinize the legitimacy of giant-sized firms, corporate executives may not be armed with the facts necessary to deflect the course of antitrust policy from the path of divestiture and dissolution."

The Sloan Management Review, published three times a year at MIT's Sloan School of Management, also includes in its Fall issue an article on inflation and the housing market by MIT professors Franco Modigliani and Donald Lessard.

Thurrow to Speak

Dr. Lester C. Thurrow, professor of economics and management at the Sloan School of Management, will discuss "The US Economy: What is it Becoming?" at the Cambridge Forum, Wednesday, Dec. 3, at The First Parish in Cambridge.

Club Closed

The MIT Faculty Club will be closed Thanksgiving Day (Thursday, Nov. 27) and also Friday (Nov. 28). Regular service will resume Monday, (Dec. 1).

Rmmate for Qtr Century Club Hong Kong trip, 4617. George, x3-5505, aft 3pm.

Visit prof from Norway seeks 2 BR hse 1/76-12/76. Elaine, x3-4330.

Roommates

F to share spac qu 2 BR Som apt w/2, top fl 3 fam hse, lg parlor & K, back porch, \$90 incl ht. Mary, x3-4971.

F, 3 looking for 4th to share 4 BR Cldg Crnr, Bkline apt, pkg, nr T, \$85.25 hts. Gay, x3-7170.

F to share lg Back Bay apt, non-smoker, indep, grad stu pref, \$137 incl ht. Alice or Mary Jo, 266-7962, evgs.

Nd rmmate for Tang Hall apt, avail 1/1, 15th fl facing river, \$101. Pam, x3-6750.

F rmmate for 3 BR Wrtwn apt, working prsn pref, nr bus, pkg incl, \$84 & util. x3-1659.

Rmmate to sh spac Wellesley hse, incl refig, dishwasher, washer/dryer, etc, wl have lg upstairs BR, nr Wellesley Col, & MIT-W exch bus, \$130 + util. Tulga, x3-6646.

F rmmate, 23+, qt, responsible for sunny, cln apt, 5 min walk H Sq, 2 Siamese cats. Francoise, 876-7242.

Carpools

Organizing carpool Billerica-MIT, hrs 9-5 or wl arrange, share driving. Bill, x3-1849.

Ride nded temp from Wakefield to MIT, 9-5, M-F, Doris, x3-2396.

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 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 Grades II-IV 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 Officers to apply for positions for which they feel they qualify.

Dick Higham 3-4278
Pat Williams 3-1954
Carolyn Scheer 3-1595
(secretary — Dixie Chin)

Virginia Bishop 3-1591
Mike Parr 3-4266
Ken Hewitt 3-4267
(secretary — Joy Dukowitz)

Sally Hansen 3-4275
Evelyn Perez 3-2928
(secretary — Susan Bracht)

Admin. Staff, Acquisitions Editor, in the MIT Press to continue development of lists in Architecture, Urban and Regional Planning and Development, Environmental Studies and related areas in social and political sciences; develop programs in related areas of visual arts. Book publishing background, preferably in acquisitions, knowledge of the academic areas named above, and demonstrated history of success in developing similar publishing programs required. A75-65 (11/26).

Admin. Staff, Asst. Staff Writer, in Resource Planning will assist staff writer in the preparation of campaign publications, of proposals to individuals, corporations and foundations, and of other fund-raising statements, brochures, newsletters and support materials. Involves compiling and organizing a wide variety of information often obtained through interviews and discussions with members of the faculty and administration. Candidate must be able to work independently, have a college degree and demonstrated writing and research skills. Knowledge of MIT desirable, but not essential. A75-66 (11/26).

Spons. Res. Staff, in Center for Cancer Research to do work in immunology and leukemogenesis; perform cytotoxicity assays; coordinate mouse breeding; inject and bleed experimental animal subjects; perform varied biochemical and tissue culture procedures. Bachelor's degree required. Two or more years post-graduate immunology or related research experience required. D75-181.

Spons. Res. Staff, Programmer, in Center for Space Research will write, debug, test and run programs on an IBM 360 to assist in reduction and routine analysis of plasma data from various deep space probes and earth orbiting satellites. Background in natural sciences, preferably physical sciences, experience in Fortran programming in large-scale systems use, in handling large volumes of experimental data and working with I/O systems required. Supervisory ability also necessary. D75-232 (11/19).

Spons. Res. Staff, in the Automatic Programming Group, Project MAC, to work on projects to explore the transfer of state of the art technology in computer representations of knowledge to the area of military command and control. Ph.D. computer specialist, experienced in extracting and defining DOD requirements for advanced command and control systems, in interactive computer based natural language processing related to manipulation of large relational data bases required. Candidates should also have work experience in Automatic Programming, an excellent working knowledge of LISP, and familiarity with current issues in artificial intelligence research. D75-234 (11/19).

Spons. Res. Staff, Systems Programmer in Laboratory of Nuclear Science (Linear Accelerator, Middleton, Ma.) RSX-aaD real-time operating systems on a tightly coupled dual processor configuration of PDP-11/45 computers with a variety of non-standard peripherals including CAMAC and a GT40 interactive graphics computer. Thorough knowledge of DEC PDP-11 machine code and I/O handling and a minimum of one year's experience as a systems programmer on a RSX-11D real-time operating systems required. Strong computer science background at BS level or equivalent desired. D75-120.

Admin. Asst., Exempt, in Mechanical Engineering Undergraduate Office to manage several administrative aspects of undergraduate program: maintain student records; coordinate teaching assignments; schedule courses; act as information resource for inquiries within and outside MIT. MIT experience, typing skill necessary. Familiarity with undergraduate academic administration helpful. E75-45 (11/26).

Engineering Assistant, Exempt (part-time) in Physics Dept. to work with lab scientists and technical personnel to collect data on current laser research programs and their effect on repair modification and calibration of support activities; assist senior staff member in designing nonstandard circuit modifications related to high voltage power supplies, infrared detector techniques, nanosecond switching, mode locking and high power pulsed measurements. Design experience, extensive background (minimum 10 years experience) with complex instrumentation in laser research required. 20 hrs/wk. E75-43 (11/19).

Sr. Secretary V will handle general secretarial duties including occasional manuscript typing; provide administrative assistance in Humanities Dept. for all Humanities majors; maintain student records; assist in student registration for Humanities courses; act as liaison between Registrar's office Curriculum Committee, faculty advisor, and students; maintain record of student theses; arrange meetings and use of lounge; assist in preparation of analyses, reports, statistics, new programs. Requires good secretarial skills, tact, ability to work independently, set priorities and deal with people. B75-639 (11/26).

Secretary IV-V to Associate Provost. Perform secretarial duties which include maintaining calendar and files, handling incoming mail and calls, reconciling special accounts. Provide support in connection with MIT Press Editorial Board and other committees, and with supervisor's other teaching and editorial responsibilities. Excellent typing and 1-2 years secretarial experience required. Shorthand preferred. B75-644 (11/26).

Secretary IV to handle general secretarial duties for the Director of the Center for International Studies and occasional correspondence for the Assistant Director: type from machine dictation; arrange appointments and travel; draft responses to routine correspondence. 1-2 years secretarial experience, good typing, ability to set priorities in a busy environment required. B75-638 (11/26).

Secretary IV to 3 faculty members in the Sloan School (Systems Dynamics and Manpower and Labor Relations groups): type letters, manuscripts, including technical material from machine dictation; edit and coordinate report preparation; arrange meetings and travel; maintain files and publication records. Excellent typing, English grammar, office procedure skills required. Shorthand, familiarity with Institute procedures preferred. B75-641 (11/26).

Secretary IV to Laboratory for Nuclear Science Group (faculty, other academic staff, students): type correspondence, technical reports; make seminar arrangements; answer phones, file. May provide supplementary secretarial service to headquarters office in peak periods. Ability to work independently, excellent shorthand and typing skill necessary. B75-629 (11/19).

Secretary IV, part-time, to Economics faculty member to type manuscripts, letters, class material including technical, mathematical data; arrange files; handle appointments and perform some duties related to publication of *Journal of International Economics*. Excellent typing, organization skills required. Approx. 20 hrs/wk. B75-631 (11/19).

Secretary IV, to Executive Director, System Dynamics Group, Sloan School, will type varied material from draft, machine, and shorthand dictation; organize and maintain files, arrange travel and appointments; research subject material. Excellent typing, organization and English grammar skills, initiative required. Applicants should have previous secretarial experience and flexibility to work overtime. Shorthand or speedwriting helpful. B75-351.

Secretary III-IV in Nuclear Engineering will assist other secretary in providing secretarial service to faculty and research staff: type technical reports, class material and general correspondence; handle other general secretarial duties including travel arrangements, maintenance of special files, compilation of statistics. Typing, organization skills required. Experience with technical typing, machine dictation helpful. B75-634 (11/19).

Secretary III-IV part-time, in Biology to handle general secretarial duties: type correspondence, technical manuscripts from handwritten drafts; monitor research grants; assist with administrative procedures. Excellent typing, familiarity with accounting procedures and ability to work independently necessary. 15 hrs/wk (M-F 9am-12n). B75-636 (11/19).

Secretary III to 4 faculty members in the fields of finance and economics, Sloan School: handle general secretarial duties including typing of technical manuscripts. Excellent typing, secretarial school training or experience necessary. Shorthand/speedwriting preferred. B75-637 (11/26).

Secretary III in Admissions Office to perform secretarial duties especially pertaining to foreign student admissions: handle mail, immigration matters, various forms required by foreign students. Will also answer phones, assist with orientation programs, special projects and overflow typing. Excellent typing, 2 yrs. office experience required. Ability to organize, work with people and under pressure also required. B75-640 (11/26).

Secretary III in Meteorology Department to type, file, answer phones, xerox, handle requisitions, travel vouchers. Typing, spelling and organizational skills required. Some college and/or secretarial training preferred. Must be able to occasionally work overtime. B75-627 (11/19).

Computer Operator III-IV, part-time, in the Lab for Nuclear Science: will

operate IBM 360/65 Operating System; perform all phases of batch processing installation (input-output, set up, console operation); act as liaison with IBM customer engineers in correcting hardware/software malfunctions; perform necessary maintenance functions such as cleaning tape drives. Ability to operate IBM 360/65 computer complex without supervision, knowledge of HASP and OS operating commands required. 4pm-8pm, 20 hrs/wk. B75-650.

Sr. Accounting Clk. V, in Medical Dept. to handle purchasing, accounting and payroll functions, petty-cash fund; arrange for maintenance and repair of facilities and equipment. Will also type personnel forms and handle other administrative projects. Good typing skills plus accounting and/or payroll experience required. Must be able to work independently and under pressure. 3 1/2 hr/wk. B75-632 (11/19).

Payroll Clerk III-IV in the comptroller's Payroll Office will compile totals of payroll charges from Institute departments; process adjustments and other special procedures (vacation charges, etc.) as required. Facility with figures, accuracy with detailed work and discretion in the handling of sensitive information necessary. Applicants must be able to communicate effectively on payroll matters with Institute staff and faculty. B75-642 (11/26).

Cook's Helper, hourly, in Student Center kitchen will prepare and cook vegetables; clean and prepare vegetables and fruits for salads; clean work area. Neatness, ability to read and follow recipe instructions required. 40 hr wk, 10:30am-7:30pm. H75-159 (11/26).

Parking Lot Attendant, hourly, for the Campus Patrol Parking Division, to facilitate authorized parking in selected parking areas; make periodic foot patrols within assigned areas. Applicants must be high school graduate or equivalent, be able to work independently and maintain accurate records. 40 hr/wk. H75-166, 167, 168 (11/26).

Waitress/Waiter, Set tables, take orders, serve food and beverages on banquet trays. Clear and reset tables. Dust chairs, wipe table clean. Experience is helpful but not necessary. 5:00pm-9:00pm, H75-142. Positions include possible weekend work.

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 STAFF:
A75-26, District Officer, Resource Devel. (11/12)

A75-59, Applications Programmer, Off. of Admin. Inf. Syst. (10/22)

A75-60, Systems Analyst, Off. of Admin. Inf. Syst. (10/8)

A75-63, Asst. Director, Development Off. (11/5)

A75-64, Area Coordinator/Systems Analyst, Off. of Admin. Inf. Syst. (11/12)

BIWEEKLY:
B75-253, Sec. IV, Mech. Eng. (11/19)

B75-254, Sr. Clk. IV-V, Comp. Acctg. Off. (11/19)

B75-273, Sec. IV, Mt. Sc. & Eng. (7/9)

B75-427, Comp. Op. IV, Off. of Admin. Inf. Syst. (9/10)

B75-475, Sec. V, Chemistry (11/12)

B75-543, Sec. IV, Chem. Eng. (10/15)

B75-547, Sec. V, Civil Eng. (10/15)

B75-580, Sr. Clerk III, Admissions (10/29)

B75-585, Sec. III, Mat. Sc. & Eng. (10/29)

B75-586, Sec. IV, Planning Off. (10/29)

B75-590, Sec. III-IV, Res. Lab. of Elec. (11/19)

B75-593, Sec. IV, Resource Devel. (11/5)

B75-957, Sec. III-IV, Technol. Studies Prog. (11/5)

B75-600, Sec. IV, Engineering Lib. (11/5)

B75-602, Sec. IV, Chemistry (11/19)

B75-603, Sec. IV, Urb. St. & Pl. (11/5)

B75-614, Acctg. Acct. V, Comptroller's Acctg. Off. (11/12)

B75-616, Section Head V, Medical (11/12)

B75-621, Sec. III, Psychology (11/19)

ACADEMIC STAFF:
C75-28, Nursing Supervisor, Medical (10/8)

C75-29, Assistant Science Librarian, Science Library (11/12)

C75-30, Tech. Instructor, Mech. Eng. (11/12)

C75-31, Asst. Humanities Librarian, Science Library

SPONS. RES. STAFF:
D75-8, Biophysicist, Nat. Magnet Lab. (6/25)

D75-48, Economist, Energy Lab. (6/25)

D75-107, postdoc. res., Lab. for Nuc. Sc. (6/25)

D75-111, Programmer, Artificial Intell. Lab. (6/25)

D75-112, Engineer, Energy Lab (6/25)

D75-125, energy modeling, Energy Lab. (8/6)

D75-150, Systems Programmer, Hlth. Sc. & Tech. (9/3)

D75-153, Applications Programmer, Lab for Nuc. Sc. (9/10)

D75-161, Economist/Policy Analyst, Energy Lab. (9/10)

D75-166, Operations Branch Mgr., Energy Lab. (9/17)

D75-167, end-use technology, Energy Lab. (9/17)

D75-169, Plasma Physicist, Res. Lab. of Elec. (9/17)

D75-178, Programmer, Center for Space Res. (10/1)

D75-202, Scientific Programmer, Earth & Pl. Sc. (10/15)

Standardized Tests Scored By Education Researchers

(Continued from page 1)

percent of the norm population." Professor Schwartz is now working with Edwin F. Taylor, a senior research scientist in the Department of Physics at MIT and editor of the *American Journal of Physics* to devise new elementary school mathematics tests. They supervise Project TORQUE at the Education Development Center in Newton, Mass., and are funded by the Carnegie Corp. of New York. TORQUE is attempting to diagnose learning problems in five areas: computation, measurement, estimation, graphing and scaling, and word problems. Approximately 20 professionals work on this project in Chicago and Los Angeles as well as in the Boston area.

A test on estimation for example, may be constructed around a child's interest in pets by asking such questions as "About how much food does your dog eat in a week?" or "About how long does it take your dog to run around your house?" The premise, the MIT scientists say, is that life is a series of interrelated patterns, and that elementary school classrooms should reflect a richness of situations that make a child ask: "Am I learning well enough?"—not, "Am I doing better than everyone else?"

Unlike the well-known multiple choice tests, which Dr. Taylor says

"penalize deep-thinking students and foster intellectual dishonesty," the new tests do not assign children all-inclusive scores.

It is a reflection of the magnitude of a \$100 million testing industry, Professor Schwartz claims, that test scores in America ultimately affect everything from hiring policies to government and foundation funding.

"Few people stop to question, however, to what extent the original tests discriminated between white suburban children and inner-city minority youngsters," he said.

A major aim of Project TORQUE is to develop tests that respect the diversity of ethnic backgrounds. As a way of validating tests, the TORQUE staff has devised back-up games to assess the composite influences that make up a child's world. For example, "City Blocks" is a territory game that evaluates a child's understanding of volumes. A board game called "Measure and Move" requires a working ability to measure lengths in centimeters.

These games are made available to the classroom teacher for a "fine-grained" diagnosis of a youngster's difficulty in approaching a test, Professor Schwartz said. In this way, perimeter-diameter confusion, reading difficulty, and the inability to measure correctly are readily detected so that the child is not penalized for cultural differences.

According to Professor Schwartz, the curricular, socioeconomic, and psychological effects of this plan could revolutionize the testing industry.

"The mere possibility of producing generations of thoughtful leaders instead of intellectual followers," he said, "would mean a significant victory for creative intelligence and individualism."

Andrew Silver TV Director

Andrew Silver of Boston, who received a BS degree in 1964 and SM degree in 1967—both in management—is the director of "Next Door," a short story by Kurt Vonnegut, Jr., adapted for television. The film will be shown on WGBH-TV in Boston, at 8pm, December 11, 12:30pm, December 13 and 9:30pm, December 15.

Obituaries

Former Professor Arguimbau

Lawrence Baker Arguimbau of Onset, a former professor at MIT, died suddenly Saturday, Nov. 22.

He was born in Brooklyn, N.Y., in 1906, and graduated from the Westfield, N.J., high school. After a short time with the Bell Labs, he entered Harvard and graduated cum laude in 1930. He then worked at the General Radio Company designing electrical equipment.

D75-205, Research Engineer, Economics (10/22)

D75-210, machine vision research, Artificial Intell. Lab. (10/29)

D75-219, continuing education, Chemical Eng. (11/5)

D75-220, Executive Director, continuing education, Chemical Eng. (11/5)

D75-222, biochemist, Nutrition and Food Science (11/12)

D75-223, mineralogical, chemical research, Earth & Pl. Sc. (11/12)

D75-226, Neurophysiological research, Cent. for Space Res. (11/19)

D75-229, Research Engineer, Energy Lab. (11/19)

D75-230, Engineer, Energy Lab. (11/19)

H75-55, Tech. B., Lab. for Nuc. Sc. (6/25)

H75-117, Tech. B., Radioactivity Center (10/15)

H75-120, Campus Patrol Officer (10/1)

H75-125, Electrician, Phys. Plant (10/8)

H75-143, 2nd Cl. Eng. (10/15)

H75-157, Tech. C. (EM), Lab. for Huc. Sc. (11/12)

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

B75-575, Sr. Clerk III

B75-608, Cl-Messenger II

B75-561, Secretary V

A75-49, Admin. Staff

B75-617, Secretary IV

B75-633, Lib. Gen. Asst. III

H75-137, Waiter/Waitress

B75-623, Secretary IV

D75-181, Spons. Res. Staff

D75-571, Clerk-Typ. III

B75-613, Acctg. Asst. V

B75-566, Secretary IV

B75-584, Secretary IV

B75-552, Admin. Asst. V

D75-138, Spons. Res. Staff

D75-204, Spons. Res. Staff

B75-605, Secretary IV

The following positions are on HOLD pending final decision:
B75-606, Secretary III
B75-306, Secretary V
B75-622, Tech. Asst. IV
B75-620, Sr. Computer Operator V
H75-139, Waiter/Waitress
D75-129, Spons. Res. Staff
D75-164, Spons. Res. Staff
D75-126, Spons. Res. Staff
D75-127, Spons. Res. Staff
B75-624, Secretary III
B75-625, Edit. Sec. IV-V

Andrew Dean

Andrew Dean, 63, of Malden, who had been on a long-term disability leave as a porter at Burton House since August, died on Friday, Nov. 21. Mr. Dean first joined the Institute in 1940. He is survived by his wife, Phyllis; a daughter, Mrs. Norman P. Egan of New Hampshire; two sons, Andrew M. Dean of Marshfield and James H. Dean of Malden, and four grandchildren.



SURRENDERING to the mid-day sun, bus patrons on Massachusetts Avenue pay little attention to clouded windows of depot across from MIT's Student Center. It is believed that windows'

smearing appearance is due to the alcohol wash used to remove advertisements and posters from the plexiglass panes.

Innovation Found in Air Terminal Television Screens

By WILLIAM T. STRUBLE
Staff Writer

In the airport terminal, you watch the television screens to see if your plane is on time, late, or in limbo.

But even in the worst of times, changes in information on arrivals and departures are relatively infrequent—perhaps at intervals of tens of minutes, or more. Yet, to maintain such a relatively static display, the electron scanning beam must regenerate the image 30 times per second.

Instead, it would be nice (and perhaps more efficient) to be able to write and erase only as needed. This can be achieved with so-called cathodochromic cathode ray tubes (CCRTs), which have been developed by several laboratories. Now, MIT has filed five patent applications on a CCRT that appears to have distinct advantages over others.

The MIT work, carried out by Dr. Lee T. Todd, Jr., now a member of the faculty of the University of Kentucky, includes the development of a cathodochromic material with greater sensitivity and much higher contrast ratio than heretofore achieved, as well as a new class of luminescent cathodochromic materials with which luminescent CCRTs can be made for night vision applications.

In his work, which ranged all the way from the chemistry and physics of materials development to the design and fabrication of devices, Dr. Todd also improved the speed and legibility of the CCRT by the clever adaptation of a projection tube.

Cathodochromic materials are those that change color (but reversibly) when they are excited by an electron beam—i.e., in a cathode ray tube. The coloration

can be erased by heating the material to about 300°C. In recent years, materials scientists and engineers have been most interested in CCRT devices that use a mineral—bromine sodalite—as the screen material.

There are several reasons for this interest:

—The coloration (or image) of the material has a long lifetime of many months and thus presents a flicker-free display that does not need "refreshing."

—The devices have high resolution of about 100 to 200 lines per inch, which allows viewing of typed or typeset documents with "fine print" on a screen 9 by 12 inches or smaller.

—CCRT images have high contrast even in bright ambient light. Because the image doesn't fade, hard copies of the display can be made rather easily using conventional photo-copying methods.

—The devices have a gray scale (familiar to photographers) of more than 30 levels, which permits viewing many types of information.

—And, the display is generally a dark image on a white background, which seems more psychologically pleasant for reading than the reverse.

The writing and erasing rates of CCRTs are slower than those of standard phosphor television displays. However, there are many applications in which these slower speeds are acceptable—including document retrieval, newspaper photo-composition, the aforementioned airport flight schedule displays, signature verification, electronic mail, and numerous medical applications.

Moreover, the slower data rates are compatible with transmission over tele-

phone and radio communication channels, a feature that opens up the possibility of placing remote terminals in homes, offices, and motor vehicles without new and extensive transmission and receiving systems.

Other problems to date have included high costs of CCRT systems, fragile CCRT design features and limited screen size—problems that the MIT research seems to have overcome.

The work by Dr. Todd was carried out as his doctoral thesis in the Crystal Physics Laboratory of the MIT Center for Materials Science and Engineering, under the supervision of Dr. Arthur Linz, senior research associate, and Professor David J. Epstein, both of the Department of Electrical Engineering and Computer Science. He was assisted also by Eugene F. Farrell, department staff member.

Bromine sodalite is normally produced by a hydrothermal growth method, at high temperature and pressure. However, this process often results in poorly crystallized material of two phases and a low coloration capability. The second phase is nosean, a mineral similar to sodalite in composition and structure but with a much lower coloration sensitivity and a maximum contrast ratio of about 5 to 1.

A low-temperature, low-pressure technique was developed by Dr. Todd, Dr. Linz and Mr. Farrell for re-reacting this poorer material, the result being an improved powder that is well-crystallized, 100-percent sodalite, which has a maximum contrast ratio of about 40 to 1.

The new luminescent cathodochromic materials found by Todd, Linz and Farrell are made with bromine sodalite doped with germanium. They emit a bright

green luminescence when exposed to ultraviolet light or a rapidly scanning electron beam and appear to be ideal for night vision display devices in aircraft and ships, for example.

Dr. Todd's basic CCRT device is the easiest to produce and the least expensive among CCRTs that are erased by heating—in this case the electron beam heats the screen by scanning in overlapping lines. The cost of parts to fabricate a five-inch-diameter tube is less than \$50. The tube offers high resolution, high contrast, selective erase, rugged construction, normal viewing angle, immediate write after erase, and dark-on-light display.

Another system, based on the Advent Corp. projection tube, uses a mirror to reflect and project the image from the interior face of the CCRT screen. (This image is sharper than that seen on a direct view CCRT screen because the electron beam scatters somewhat in its passage through the screen material, thus reducing resolution.)

Because write and erase times are in part functions of the total area that must be scanned by the electron beam, the projection CCRT permits the use of a 1-x-1½-inch image screen, with a write time of only five seconds and an erase time of just one second. And with the tube, the image can be enlarged to an 8½x11-inch size and displayed, with high resolution and high contrast, at a distance of about one foot. Thus, an 8½x11-inch typed document can be presented in about five seconds and completely erased in one second. Larger displays can be made by using larger projection CCRTs.

Giant Atoms Facilitate Atomic Physics Studies

Mammoth atoms thousands of times larger than normal have been created at MIT's Research Laboratory of Electronics.

Such a giant is created when an atom absorbs so much energy that its outer electron moves to an orbit extraordinarily distant from the nucleus.

"These highly excited atoms are qualitatively different from those in the lower, more tightly bound states," said Daniel Kleppner, professor of physics in the MIT Department of Physics and the Research Laboratory of Electronics (RLE).

"The ability to work with this unusual species enables us to make new studies of basic processes in atomic physics," he said—for example, studying atomic collisions and how atoms are ionized (pulled apart into ions and free electrons) by electric fields.

"They also seem to have important practical applications," he said. "They may be useful in infrared astronomy, and in observing the behavior of a plasma of ions and electrons in thermonuclear

fusion machines like MIT's Alcator."

Working with Professor Kleppner have been instructor Dr. Richard Freeman; research associate Dr. Theodore W. Ducas; and graduate students Michael G. Littman and Myron L. Zimmerman. The work was funded by the Air Force Office of Scientific Research.

Giant atoms are created in interstellar space when a free electron is loosely trapped by a free proton; they were first observed by Soviet radio astronomers in the 1960's. These atoms have interested physicists since that discovery, but working with them in a laboratory has become possible only recently.

"They're so big that they easily collide with other particles and come apart," Professor Kleppner said. "And an extremely small electric field will pull them apart—about one hundred millionth of what's needed to ionize hydrogen in its ground state."

To create stable giant atoms, the MIT physicists excite a slow beam of atoms with intense pulses from two lasers. The process takes place in a vacuum, which keeps the atoms from colliding and falling apart.

"In our machine, these atoms last forever," Professor Kleppner said. "For-

ever' for an atom is a millisecond," he added. "That's the length of time it takes them to go through the machine."

Atoms excited this way have had their outer electrons knocked out as far as the 50th possible orbit, making these atoms 2500 times the diameter of a normal atom.

The physicists want to study how the atoms's size affects its interactions with other particles.

For example, Dr. Kleppner said, "to what extent does the electron of a highly excited atom behave during a collision as if it were free? Can a neutral atom 'tunnel' through a highly excited atom?"

The production of highly excited atoms may also be useful in heating the plasma of fusion machines. To heat the plasma—i.e., increase its energy—one must inject into it a very fast (energetic) beam of neutral particles. (Charged particles can't get into the plasma.)

"Generally you can't make anything go fast unless it's charged," Dr. Freeman said. "So you accelerate a beam of protons and then run them into a sodium vapor. Some of the protons pick up electrons from the sodium, but they're still moving fast."

If one used beams of giant atoms, with loosely bound electrons, "then the charge

exchange should take place much more often," said Dr. Freeman, who is exploring the possibility with Louis D. Smullin, Dugald Caleb Jackson Professor of Electrical Engineering.

The atoms might also be useful in detecting the millimeter and submillimeter radiation coming from such a plasma.

One would first excite the atoms—for example—to $n=30$, where n is the number of the outermost orbit. Then one would apply an electric field that ionizes atoms with $n=31$ but not $n=30$. Millimeter radiation from the plasma would excite atoms to $n=31$, at which point they would fall apart. By detecting the electrons that come out as the atoms are ionized, one could deduce the amount of millimeter radiation.

This potential application of the atoms as detectors of millimeter or infrared radiation may also have applications in astronomy at those wavelengths.

More studies are needed before these applications can be evaluated, Professor Kleppner said. But if they work out, the giant atoms will be not only an intriguing tool for studying atomic behavior, but also a practical tool in developing thermonuclear fusion into a source of safe and abundant energy.