

## Air pollutants to be studied in new lab

A research-oriented "smog observatory" containing the most sophisticated instruments available for measuring the properties of air pollutants is being constructed on the roof of Keck Laboratory.

To be completed April 1, the laboratory will be used by Sheldon K. Friedlander, professor of chemical and environmental health engineering, and other Caltech engineers and scientists to study the origin, composition, and movement of atmospheric pollutants in the Los Angeles Basin.

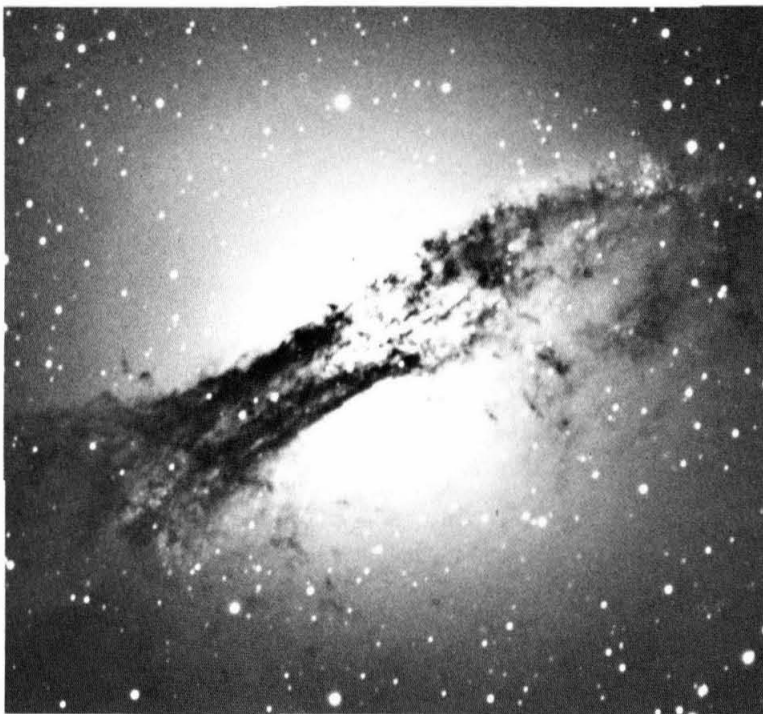
Friedlander said, "We see the laboratory as a place where new instruments can be tested, and, if they are promising, recommended to the Air Pollution Control District and other agencies that have monitoring responsibilities."

He added that the facility will serve as a headquarters for collaborative studies between Caltech and such groups as the Environmental Protection Agency, California Air and Industrial Hygiene Laboratory, and others.

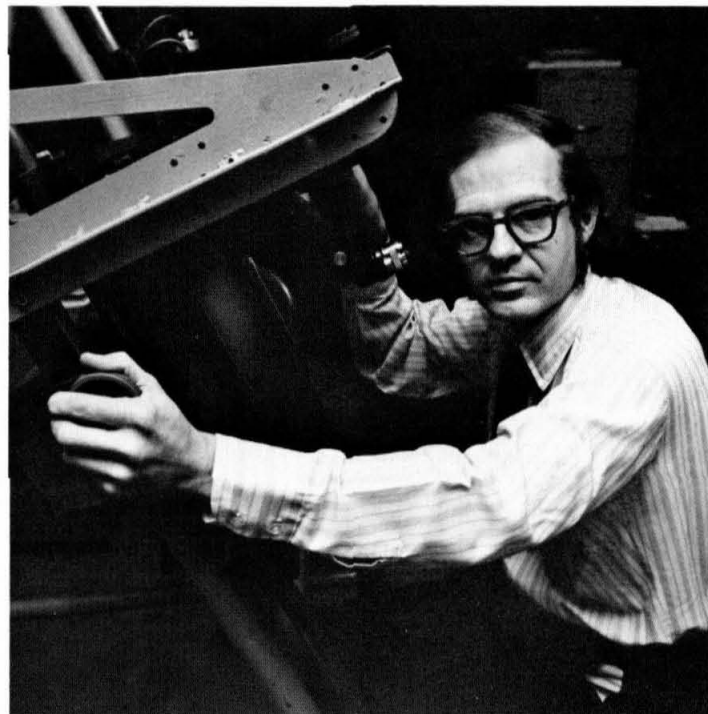
The laboratory will contain the most advanced instruments yet developed to determine the kinds, sizes, and numbers of very small particles in the atmosphere. Friedlander explained that knowledge of the sizes and chemical properties of the particles is essential for an understanding of their origin.

Other instruments will provide research engineers with data as they collect, identify, and analyze trace metals; study their movements through the Los Angeles Basin; and determine where they are deposited. Some of these metals are lead, cadmium, nickel, and zinc.

Adjoining the structure will be a new mooring site for a 2,000-cubic-foot Teflon balloon used by the Caltech engineers to capture samples of smog for analysis.



This galaxy in Centaurus is on a one-way trip, if the findings of James E. Gunn, right, and his colleagues are correct. After spending six years studying a wide variety of evidence, Gunn's group concludes that the



universe has no more than a tenth of the mass—and probably less—needed to close it, and that it will continue to expand forever. This would mean that there will never be another "big bang."

### Astronomers believe

## The universe will expand forever

Will the universe go on expanding forever? Or will its own gravitational energy eventually reverse the expansion and draw all its matter back together again? In other words, is the universe open or closed?

This problem has perplexed cosmologists for decades—and now four astronomers believe they have found the answer.

After considering all available evidence, they conclude that the universe will continue to expand endlessly because it contains too little matter to provide enough gravitational pull to cause it to collapse into itself. If their assumption is true, then there will never be another "big bang" like the primordial explosion that is believed to have given birth to the universe some 14 billion years ago.

Reporting in the *Astrophysical Journal*, the four astronomers are James E. Gunn, PhD '66, Caltech professor of astronomy and staff member of the Hale Observatories; J. Richard Gott III, research fellow

in astrophysics at Caltech; David N. Schramm, PhD '71, now with the University of Texas at Austin; and Beatrice M. Tinsley of the University of Texas.

Gunn explained that the universe is believed to have originated from an incredibly dense clump of matter that exploded into a gigantic, expanding sphere of hot gas. Some parts of the sphere were denser than others, and these eventually condensed into galaxies. The galaxies were at first just clouds of gas, which eventually collapsed into spirals and spheres, and finally some portions condensed into stars.

For cosmologists, the key question is whether the clusters of galaxies are moving apart fast enough to escape the braking effect of gravity. Gunn and his associates have added up the total mass and amount of gravity that can be observed from the motion of objects, and have con-

cluded that the mass falls short of being able to reverse the process of expansion by a factor of 10 to 20.

In reaching this conclusion they evaluated evidence involving the rate of expansion of the universe in relation to ages of stars and metals (the Hubble constant), the amount of visible matter, the possibility of black holes as the locations of undetectable masses, the brightness of galaxies, the ages of stars and metals, the redshift of galaxies, and the production of chemical elements in the universe—particularly deuterium.

Deuterium presumably was made in the first moments of the big bang rather than later in the nuclear fires of stars, for these destroy deuterium rather than produce it.

"Low-density, open universes can manufacture deuterium," Gunn said, "not high-density, closed ones. If

*Continued on page 3*

## Caltech receives grant of \$1,500,000 from IBM

Caltech has received a \$1,500,000 unrestricted gift from the International Business Machines Corporation, to be made over a five-year period. According to President Harold Brown, the gift comes in response to the Institute's \$130 million fund-raising campaign, *Caltech at the leading edge* . . .

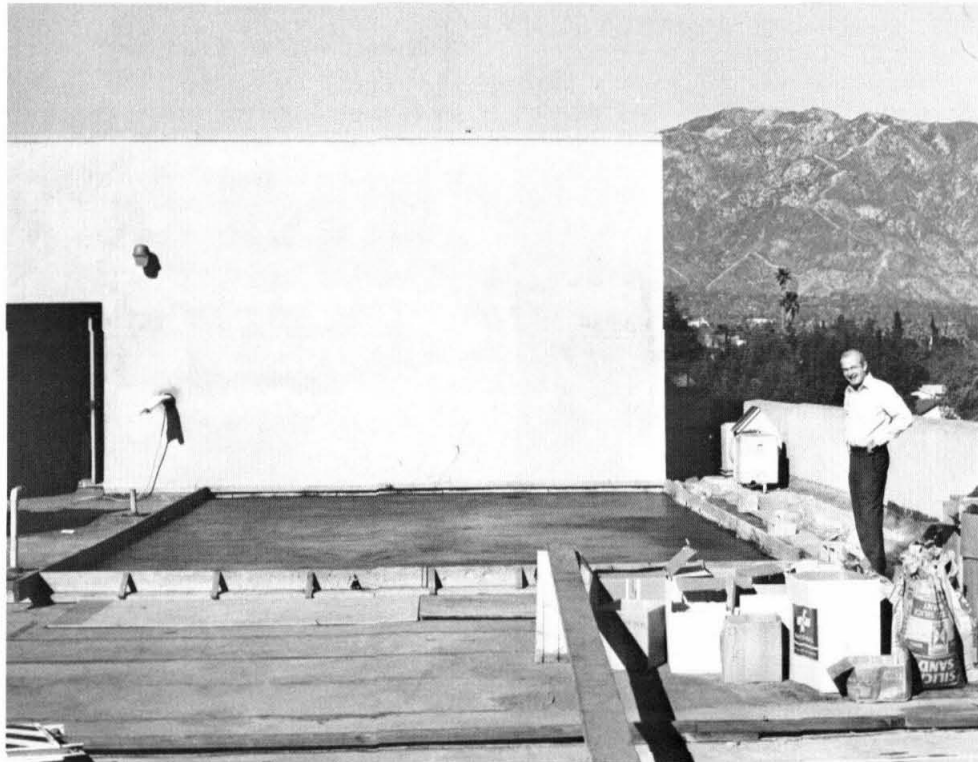
Brown said, "Over the years, IBM has been a leader in responding to the needs of Caltech. We're pleased that by means of this generous gift the company has again reaffirmed its confidence in the Institute as a center of research, teaching, and learning."

"Caltech is particularly grateful for unrestricted gifts such as this one," Brown said, "for they provide a foundation for all of our programs. They enable us to plan on a long-range basis, to meet unforeseen needs, or to take advantage of un-

expected opportunities when specifically designated funds are not available."

Brown also noted the corporation's support of the IBM-endowed professorship in mathematics at Caltech, held by Marshall Hall, Jr., who is widely known for his achievements in group theory and combinatorial analysis. Termed "one of the founding fathers of modern mathematics," Hall has conducted work in combinatorial analysis that is closely linked to the mathematics of computers.

Frank T. Cary, chairman of the board of directors of IBM, said, "We believe that its pioneering programs of education and research have made Caltech a valuable resource with a very special role at the leading edge of scientific discovery. We are pleased that we can assist these programs to continue."



Sheldon K. Friedlander inspects newly-laid foundation of research laboratory. The facility will contain the most sophisticated instruments available for the study of air pollutants.



# The wind: fungus' guide in darkness?

For a long time, scientists have been wondering how the fungus, phycomyces, can "see" in total darkness. Now a Caltech scientist seems to have found the answer.

A miniature plant, the phycomyces can sense, in light or complete darkness and without the sense of touch, any barrier placed in its way—whether it be one as fragile as a spider's web or one as formidable as a brick wall. Research fellow Ernest Y. N. Jan believes the answer lies in a miniature wind-detection mechanism.

Jan's efforts to solve the riddle resulted from experiments he performed while developing his PhD thesis under the supervision of Max Delbrück, Albert Billings Ruddock Professor of Biology.

Phycomyces has a single cell that responds to light, odor, stretch, and gravity. This cell incorporates a kind of sixth sense that "sees" in the dark and enables the plant to grow toward the light.

The tiny plant's ability to avoid a barrier depends partly on the distance between the fungus and another object. Before phycomyces can sense the barrier, which it never touches, it must be within one-fifth of an inch from it.

The hair-thin stalk of the little plant grows an eighth of an inch an hour to a maximum height of three inches. The stalk is topped by a small ball containing about 100,000 spores.

Jan's experiments showed the stalk's surface to be highly sensitive to the motion of air, and he concluded that the barrier affects the flow of air between itself and the stalk—a change immediately detected by the fungus. In one experiment, he subjected the plant to a flow of air from above. This airflow caused the plant to lose its barrier-avoiding ability.

The nature of the plant's wind-detection mechanism is not yet known, according to Jan. He explained that some researchers have suggested the fungus emits some type of gas or moisture—which acts as a kind of biological radar system sensitive to the presence of a barrier.

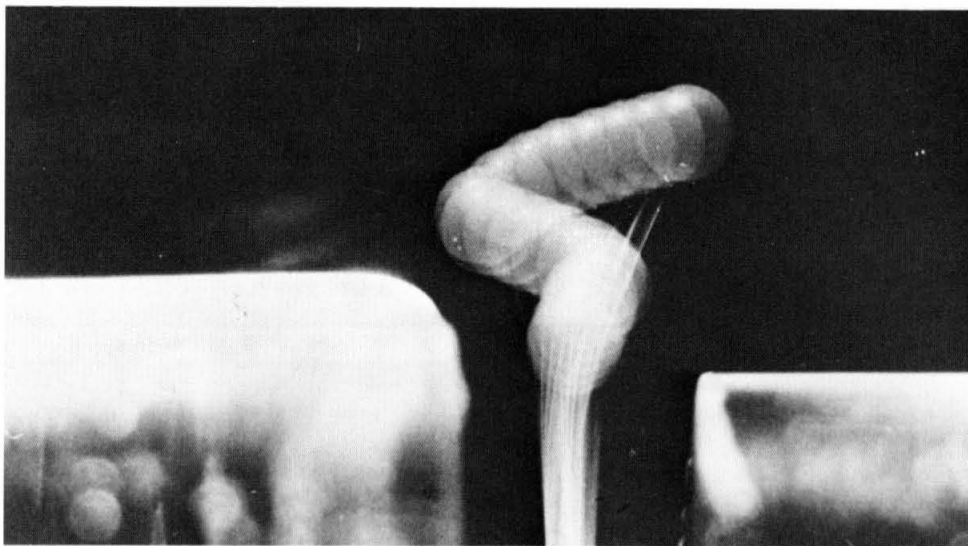
Jan and his co-workers found that phycomyces' ability to avoid an object is not affected by any gas-absorbing, electrical, magnetic, ultraviolet, or light-absorbing properties of the barrier itself.

## Book may look at Caltech pranks

That often-publicized aspect of Caltech life—the student prank—may now become the subject of a book. A publisher has expressed serious interest in the project, and market research to determine reader interest is under way. Alumni can be of great assistance in providing interesting source material. Senior Gregory Simay, features editor of the *California Tech*, needs details of pranks and senior stacks from former Caltech students.

"Although we have reasonably extensive files on Caltech pranks," Simay said, "I'm not aware of any files on senior stacks. And there must be many very funny incidents that have never found their way into the written records."

Material may be directed to Simay c/o *Caltech News*.



Operating in total darkness, this phycomyces is shown maneuvering its way around a barrier. Research Associate Ernest Y. N. Jan believes the fungus may be guided in its travels by means of a miniature wind-detection mechanism.

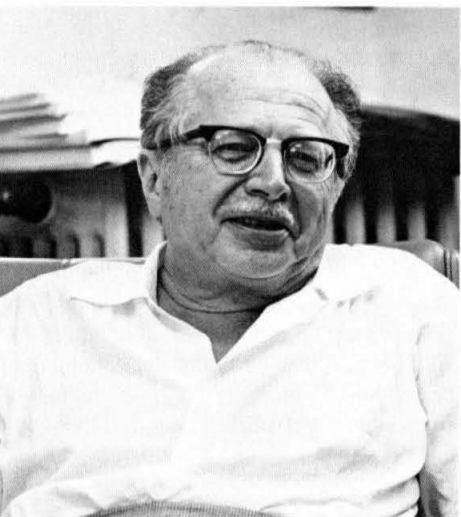
## FACULTY HONORS



William H. Corcoran

William H. Corcoran, BS '41, MS '42, PhD '48, vice president for Institute relations and professor of chemical engineering at Caltech, is recipient of the 1974 Founder's Award of the American Institute of Chemical Engineering.

The award is made to an AIChE member who has had "an important impact on chemical engineering, whose achievements . . . have advanced this profession . . . and who has had a long and distinguished record of service to the profession." A leader in AIChE activities, Corcoran was elected a fellow of that organization earlier this year. Widely known as an authority in many areas of chemical engineering, he is a teacher, educational administrator, researcher, industrial consultant, and writer.



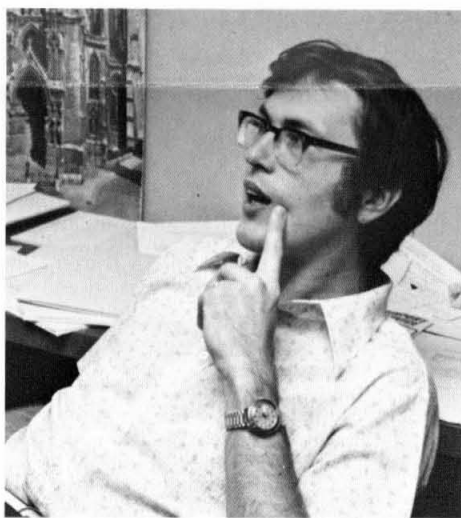
Jesse L. Greenstein

Jesse L. Greenstein, Lee A. DuBridge Professor of Astrophysics, is a recipient of the 1974 NASA Distinguished Public Service Medal.

The award is for his contributions . . . "as a senior scientific consultant on NASA's Scientific Advisory Committee and Astronomy Missions Board, and especially for his leadership of the comprehensive and balanced National Academy of Sciences study which laid the essential foundations for NASA's future astronomical programs."

Roger G. Noll, professor of economics, is co-recipient of the first annual book award from the National Association of Educational Broadcasters. The award was presented for *Economic Aspects of Television Regulation*, which Noll co-authored with Merton J. Peck and John J. McGowan.

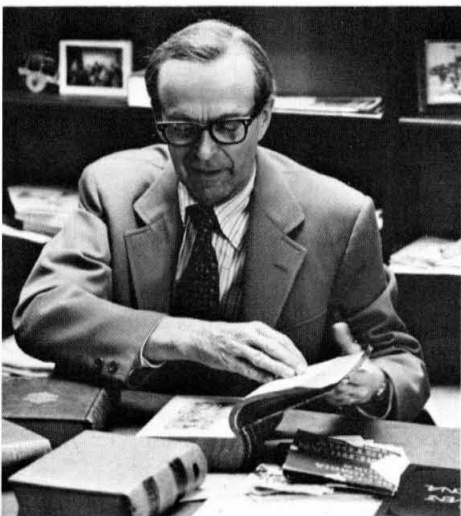
The book was published by the Brookings Institution in 1973 as part of the Brookings Studies in the Regulation of Economic Activity, a research program in public policies that is co-directed by Noll. This year Noll was editor and part-author of another Brookings book, *Government and the Sports Business*, which examines the economic and public policy issues relating to professional sports.



Roger G. Noll

Rodman W. Paul, Edward S. Harkness Professor of History, has been honored by the American Association for State and Local History. His citation, the Award of Merit, was for "outstanding contributions in historical research and writing."

An authority on the early mining days of the west, Paul has written numerous books about this era, including *Mining Frontiers of the Far West*, *California Gold*, and *The California Gold Discovery*.



Rodman W. Paul

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## Placement Assistance To Caltech Alumni

The Caltech Placement Service may be of assistance to you in one of the following ways:

- (1) Help you when you become unemployed or need to change employment.
- (2) Inform you of possible opportunities from time to time.

This service is provided to alumni by the Institute. A fee or charge is not involved.

If you wish to avail yourself of this service, fill in and mail the following form to:

Caltech Placement Service  
California Institute of Technology  
Pasadena, California 91125

Please send me: (Check one)

- ☐ An application for placement assistance.
- ☐ A form indicating a desire to keep watch for opportunities although I am not contemplating a change.

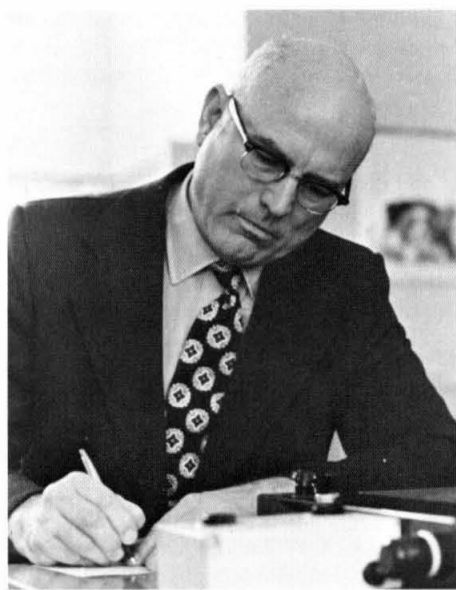
Name .....

Degree(s)..... Year(s).....

Address.....

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Armand DuFresne with matrix communicator.

## Alumnus DuFresne helps the speechless

by Winifred Veronda

A few months ago, Armand DuFresne, BS '38, believed that he had retired. But then he embarked, in a thoroughly unexpected manner, on a new career.

DuFresne would prefer not to call it a career, however. He'd rather term it "a labor of love."

DuFresne's adventure began when his daughter, a physical therapist at Chris Jespersen High School in San Luis Obispo, California, called his attention to the plight of Tony Luis, a ten-year-old quadriplegic who was unable to speak.

Full of enthusiasm, intelligence, and charm, Tony was deeply frustrated because he could only respond to questions with a shake or a nod of his head. Because he's so bright, this inability to answer questions distressed him very much.

DuFresne's daughter, who had worked with Tony at school, appealed to her father for help. So DuFresne embarked on a unique design project that took several months of research.

Before coming to Cambria, California, several years ago, DuFresne had been director of quality control and chief production engineer of Consolidated Electro-Dynamics. From there he went on to become president and director of a medical equipment company, DUPACO, and then head of a succession of firms that designed medical equipment and devices for the handicapped. Now retired, he runs DUFCO, a one-man electronics firm.

In designing a communicator for Tony, DuFresne worked with doctors, therapists, and educators to learn what others had done to aid people with speech handicaps. He discovered that most communications devices were either too primitive or too difficult for a quadriplegic to handle.

His answer to the problem is a simple-to-operate matrix board. A rectangular affair, its front panel has 100 square boxes, with a word and a corresponding symbol in each box. By pushing four buttons, Tony can make the boxes light up, and thus he can form simple sentences.

The biggest problem in designing the matrix board, DuFresne found, was to get its computer components to work slowly enough.

"The parts were designed to perform a million functions per second,"

he said. "When I had completely assembled my first communicator, I found that it worked too rapidly."

Several other area residents donated their time and talents to help construct the communicator. When it was ready, William Kent of the County Office of Education taught Tony how to use it.

"He went absolutely wild about it," Kent said. "Before he had the board, he'd sometimes sob because he couldn't answer our questions. Now he can communicate in a wholly new way, and this ability has opened a door to a new world for him."

Meanwhile, interest in the matrix board has spread among doctors and therapists, and particularly within school districts where there are handicapped children.

"Because of this interest, I've designed an improved model with greater flexibility and I've started limited pilot production," DuFresne said.

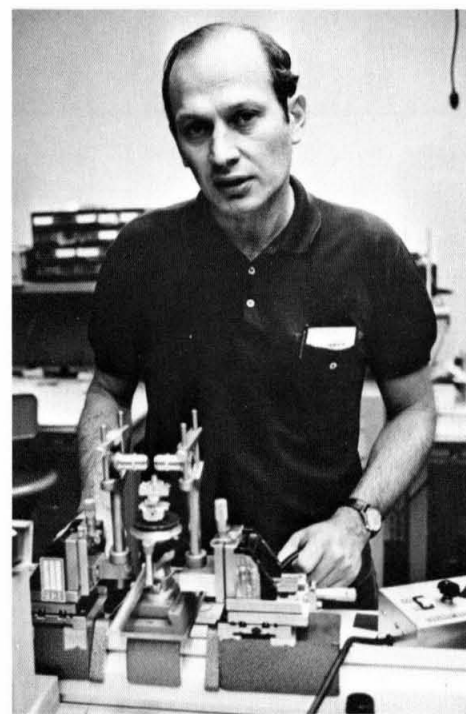
He added that he has been excited by the motivation that the matrix board stimulates in its users. "The excitement of a handicapped person who finds that he can conquer the communicator and move the lights is hard to describe," he said. "Even small children can use it. For this reason, the board is being evaluated for use by adult stroke victims and even autistic children, as well as for those children who are speechless and physically handicapped."

For autistic children, DuFresne explained, the matrix board provides a temporary bridge that may eventually enable them to develop the willingness to communicate directly with people.

While Tony Luis uses his right hand and left elbow to operate the communicator, other people can use both hands, both elbows, or even knees or feet, DuFresne explained.

Commenting on his new and unforeseen career, DuFresne said, "The field is a fascinating one. Through helping people, one obtains great emotional satisfaction, and also the challenge of finding ways to construct an even more effective device."

"The interface between severely handicapped patients and devices of all types needs much exploration and development. I intend to see that the communicator fulfills its potentials and accomplishes its goals."



Amnon Yariv

## Research team designs new laser

A new type of laser designed expressly for powering optical communications systems has been built by researchers at Caltech and the Hitachi Central Research Laboratories in Japan.

Microscopic in size, the laser is energized directly by the current from a low-power voltage source. The device emits a near-infrared beam especially suitable for transmission through optical fibers.

Amnon Yariv, professor of electrical engineering and applied physics, said that artificial corrugation is built directly into the crystalline substance of the laser. This corrugation provides the feedback necessary for consistent oscillation, and it eliminates the need for the end mirrors with which lasers are generally equipped.

To construct the laser, the scientists grew five microscopically thin alternate layers of gallium arsenide and gallium aluminum arsenide. To produce corrugations, they interrupted the process after the growth of the middle layer. Then two more layers were grown on top.

Typically the laser is one-60th of an inch long by one-two hundred and fiftieth of an inch thick. Electrodes on the top and bottom surfaces are used to send a current through the device.

The electric current is carried by means of electrons injected from one side and "holes," or electron deficiencies, from the other. The electrons and the holes collide at the central gallium arsenide layer where they annihilate one another, giving off energy in the form of radiation. As it bounces off the corrugation on the middle layer, the light is forced into coherent laser oscillation.

## Stern is recipient of European honors

Alfred Stern, Caltech professor of philosophy, emeritus, has received two recent honors: an honorary doctorate from the University of Vienna where he earned his PhD degree fifty years ago; and, from Rome, a diploma confirming him as "Honorary Academician" of the Italian Accademia Tiberina.

Stern joined the Caltech faculty as an instructor in 1948 and became a full professor in 1960. He is the author of philosophical books published in several languages and has contributed to leading philosophical journals.

## Alumni wine tastings to be March 7, 14

All Caltech alumni and their friends are invited to the 11th annual Alumni Wine Tasting which will take place on March 7 and 14 at the Athenaeum. Tastings will again be held on two consecutive Friday nights because of the program's popularity.

This year some new but outstanding wineries will be featured: The Beringer Winery, Napa Valley; Giunarra Classic Wines, San Joaquin Valley; Kenwood Winery, Sonoma Valley; San Martin Vineyard Company, Santa Clara Valley; and Rickert & Sons, Santa Clara Valley.

Each program will begin at 8 p.m. with sherry tasting; then a lecture on wine will be given by wine authority Denny Caldwell at 8:30, followed by a wine tasting and cheese sampling. Cost for the evening is \$4 per person.

According to the Alumni Association, a prompt response to invitations is important, since the wine tastings are generally sold out in advance. On their return cards, alumni should indicate their first and second choice of dates. Confirmations will be sent only to those who must be assigned their second choice.

## Open universe

Continued from page 1

deuterium was made during the big bang, the fact that we see lots of it now means that the universe is open."

"The evidence for an open universe is not conclusive," Gunn said, "because each separate argument for that hypothesis has loopholes. But we believe that an open universe is the most reasonable conclusion when we consider all the data at hand."

"For in pulling all the evidence together, it is possible to make a model of the universe that satisfies all the known constraints. And that model is open (or perpetually expanding) by a wide margin."

"But even with an open universe there is a maximum area of finitude from which we can obtain information," he said, "although presumably the universe outside that area is the same as the universe within it."

"In an open universe, things keep moving apart everywhere. Our own supercluster of galaxies is not bound and its members will continue to drift apart. The open universe has a lonely future."

Tony Luis, a quadriplegic, shows how he uses the communicator.





# PERSONALS

## 1922

RICHARD M. BOZORTH, PhD, has been awarded an honorary life membership in the Magnetism Society. His award cited his outstanding accomplishments in the theory and interpretation of the nature of magnet phenomena and in the characterization of the properties of magnetic materials.

## 1928

ARNOLD O. BECKMAN, PhD, founder and chairman of Beckman Instruments, Inc., and chairman emeritus of the Caltech Board of Trustees, received the American Chemical Society's Orange County Section "Service Through Chemistry Award" on November 14 and the USC School of Business Administration "Award for Outstanding Achievement in Business Management" on November 21. Both awards recognize Beckman's efforts and contributions to the scientific and industrial communities of southern California.

RUSSELL J. LOVE has retired as vice president and dean of Cogswell Polytechnical College, San Francisco, but is still doing private consulting work.

## 1931

MAYNARD M. ANDERSON, assistant general manager of the Metropolitan Water District of Southern California, was presented with the Stephen D. Bechtel Pipeline Engineering Award at the annual meeting of the American Society for Civil Engineers. The award is made annually to a member of the society who has made a definite contribution to the advancement of pipeline engineering.

## 1933

TRENT R. DAMES, MS '34, has been named architect and engineering industry finance chairman for the Committee for Economic Development. This nonprofit, nonpartisan group issues policy proposals designed to stimulate economic stability, productivity, and employment. Dames is executive partner of Dames & Moore, worldwide environmental and applied science consulting firm, headquartered in Los Angeles.

## 1934

GEORGE W. HOUSNER, MS, PhD '41, Carl F Braun Professor of Engineering at Caltech, was awarded the Theodore von Karman Medal from the American Society of Civil Engineers. Dr. Housner received this award for his pioneering contributions to the field of earthquake engineering, contributions that have placed it on a solid scientific basis and have made possible major advances in the design of structures.

## 1936

CURTIS G. CORTELYOU retired from the Mobil Oil Corporation on January 1, 1975. He writes, "For the last ten years, I've been responsible for the company's worldwide environmental activities—a most challenging and interesting phase of my 37 years with Mobil. With some limited plans for continued consulting in the environmental field, I hope to play more golf, fish, and build a new home in the Puget Sound country."

## 1940

ABE M. ZAREM, MS, PhD '44, has been named to the California Institute of the Arts Board of Trustees. Zarem is a management and engineering consultant. He was the founder, president, and chairman of the board of Electro-Optical Systems, and is a retired senior vice president of the Xerox Corporation.

## 1943

HERBERT ARTHUR LASSEN, MS '47, PhD '51, manager of Advanced Missions Study in the Space Vehicle Division of TRW Systems group, has received the Spacecraft Design Award from the American Institute of Aeronautics and Astronautics. This honor is given to a design engineer for a concept that leads to significant advancement in the field.

## 1946

KEITH N. DOIG is vice president of Mining Ventures, a new department of Shell Oil that is responsible for mining coal, oil, shale, tar sands, and other minerals.

EBERHARDT RECHTIN, PhD '50, is now chief engineer of the Hewlett-Packard Company in Palo Alto, California.

## 1950

WILLIAM D. CALHOUN has joined Protective Devices, as director of production development, in Costa Mesa, California.

ROBERT V. MEGHREBLIAN, MS, PhD '53, has been elected vice president of the Cabot Corporation. He is a leading expert on nuclear reactor physics, and was responsible for implementing the first scientific instrument payloads flown to Mars and Venus by NASA in its exploration of the planets and deep space. Meghreblian is an associate fellow of the American Nuclear Society; he is co-author of the graduate text book, *Reactor Analysis*.

GEORGE E. SOLOMON, MS, PhD '53, has been named chairman of the Aeronautics and Space Engineering Board of the National Research Council's Assembly of Engineering. Solomon is vice president and general manager of TRW Systems group.



M. M. Anderson



Trent R. Dames

## 1951

EDWIN E. PYATT will spend the 1975 spring quarter as a visiting associate in the engineering division at Caltech. Pyatt will be on sabbatical leave from the University of Florida, where he is professor and chairman of the department of environmental engineering sciences.

## 1953

RICHARD D. DeLAUER, PhD, executive vice president of TRW, Inc., in Redondo Beach, is chairman of the Johnston College Board of Overseers.

RICHARD M. JAFFE has joined Kaiser Industries Corporation in Oakland as director of corporate planning. He had been a management consultant with The Boston Consulting Group.

## 1955

ALLEN E. FUHS, MS, PhD '58, professor of aeronautics at the U.S. Naval Postgraduate School in Monterey, California, has been named editor-in-chief of the American Institute of Aeronautics and Astronautics *Journal of Aircraft*.

RICHARD M. JALI, MS '58, writes, "After spending two and a half delightful years teaching physics and math in a junior college in Malaysia, on the island of Borneo, I've taken the position of technical training engineer for Hughes Aircraft on the F-14 program. This will let me combine modern engineering and some of the best aspects of teaching, and allow me even more foreign travel."

F. CURTIS MICHEL, PhD '62, and DONALD D. CLAYTON, MS '59, PhD '62, were named Andrews Hays Buchanan Professors of Astrophysics at Rice University.

## 1956

JOHN F. KENNEDY, MS, PhD '60, received the Carl Emil Hilgard Hydraulic Prize at the annual meeting of the American Society for Civil Engineers. He is professor of civil engineering at the University of Iowa.

## 1958

HUGO B. FISCHER, MS '63, PhD '66, received the Walter L. Huber Civil Engineering Research Prize at the annual meeting of the American Society for Civil Engineers. Fischer is associate professor of civil engineering at UC Berkeley.

## 1960

EDWARD A. FLINN, PhD, has been appointed director of the Lunar Programs Office in the Office of Space Science at NASA headquarters in Washington, D.C.

ALFRED WASHINGTON HALES, PhD '62, professor of mathematics at UCLA, and Mrs. Hales have announced the birth of their third child, a daughter, Katherine, on October 23.

PAUL C. JENNINGS, MS, PhD '63, has received the Walter L. Huber Civil Engineering Research Prize of the American Society of Civil Engineers. Dr. Jennings received this award for his major contributions in earthquake engineering and structural dynamics, including experimental studies of the dynamics of buildings. He is professor of applied mechanics at Caltech.

## 1961

VICTOR GILINSKY, PhD, has been nominated by President Gerald Ford to the new Nuclear Regulatory Commission, which will inherit the regulatory duties previously held by the old Atomic Energy Commission. Gilinsky had been head of the Rand Corporation's physical sciences department.

## 1964

STEPHEN A. ANDREA, PhD, professor of mathematics at the Simon Bolivar University in Caracas, Venezuela, was decorated in July by President Carlos Andres Perez. The decoration, the Order of Francisco Miranda, is given in recognition of distinguished service to Venezuela in civic or professional fields.

## 1965

LI-SAN HWANG, PhD, has been promoted to vice president of Tetra Tech, Incorporated, of Pasadena. Formerly he had been associate director of the engineering division there.

DENNIS L. OBERG received his doctorate in nuclear physics from the University of Washington and is doing research at the State University of New York, Stony Brook.

## 1966

JOSEPHAT K. OKOYE, MS, PhD '71, was promoted to principal engineer with Leeds, Hill and Jewett Inc., of San Francisco.



Richard Jaffe



Paul C. Jennings

WARREN WISCOMBE, MS, PhD '70, writes, "I have left my former organization (Systems, Science, and Software, La Jolla, California) and have joined the National Center for Atmospheric Research in Boulder, Colorado, to do research in the theory of climate. I find NCAR tremendously stimulating and am enjoying my work greatly."

## 1967

MARY BAKER, MS, PhD '72, married WAYNE WALLACE PFEIFFER, PhD '69. She is a senior engineer with the Rohr Corporation in Chula Vista, California; he is manager of the fuel methods department, Gulf General Atomic, Inc., in San Diego.

## 1968

GREGORY J. BREWER has been appointed Salerno Collegium Assistant Professor of Microbiology at USC School of Medicine. He and his wife, Yvonne, became the parents of a baby girl, Jocelyn, in October. They are living in Arcadia.

NORMAN JENSEN SCHOFIELD, JR., writes, "I have stopped my studies at the University of New Hampshire and have joined the PMI division of GTE Sylvania Corporation at Goddard Space Flight Center in Greenbelt, Maryland. I am a satellite data analyst and programmer doing modeling of the earth's radiation belts for the National Space Science Data Center."

ERIC WICKSTROM is an assistant professor of chemistry at the University of Denver.

## 1969

KENNETH L. JONES received his doctorate from the geology department at Brown University, where he is now a research associate

and member of the Viking Lander Camera Science team, which will analyze photographs returned from the Martian surface in 1976.

RICHARD RUBINSTEIN writes, "I completed my PhD in social sciences at UC Irvine last winter and was on the faculty there (information and computer science) through last spring. I am now gainfully unemployed and intend to remain thus until the right position finds me or vice versa."

AUGUST L. SCHULTZ, MS '70, aircraft commander with the 35th Tactical Fighter Squadron, has been assigned to Kunsan Air Force Base, Korea, for duty with a unit of the Pacific Air Forces.

## 1971

GREGORY EDWARD KANDEL has been working for the Philco-Ford Corporation at its Western Development Laboratories in Palo Alto, California, as a senior software engineer and will be travelling to Harrogate, England, for the installation of a satellite tracking facility.

## OBITUARIES

### 1921

RICHARD M. BADGER, PhD '24, professor of chemistry, emeritus, Caltech, on November 26 after a long illness. Badger, who retired in 1966 after teaching Caltech undergraduates for 37 years, was named in 1961 by the Manufacturing Chemists' Association as one of the nation's outstanding chemistry teachers. He was chairman of the Caltech faculty in 1961-63. Surviving are his widow, Virginia, and two children, Anthony S. Badger and Mrs. Jennifer H. Sultan.

### 1925

FRANK C. A. CLAYTON on November 25. He was retired.

### 1933

NATHAN EISEN in 1974. After supervising a segment of the Manhattan Project during World War II, he became a professor of physics at Los Angeles City College where he taught for 28 years. He is survived by his wife, Carolyn, and two children, Grant and Marie.

### 1934

JOHN E. SHERBORNE on October 28. He was associate research director of the Union Oil Company of California in Brea. A memorial fund has been established at Caltech; the purpose will be designated later.

### 1939

GUSTAV A. ALBRECHT on May 15, 1973. He had been a research fellow in chemistry at Caltech since 1963.

### 1943

PAUL R. SAUNDERS, PhD, of a heart attack on October 31 in San Diego. Saunders was associate dean for basic sciences and professor of physiology at the USC School of Medicine. He is survived by his wife, Esther, and three daughters.

### 1946

DONALD EVERETT ROOT on November 8 in San Diego. He was a technical business broker. Surviving are his widow, Martha, a son, Donald E. Root, Jr., and a daughter, Louise B. Root.

### 1947

JOHN EDWARD FRITZ, MS, on June 8 of acute leukemia. He was associate professor and administrative assistant in the department of civil engineering at Michigan Technological University.

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