

# CALTECH NEWS

August 1986

## Future discoveries will surpass fantasies, Beckman tells graduates

Arnold O. Beckman, who savored his own Caltech graduation ceremony on the front lawn of Gates Chemical Laboratory in 1928, came to campus on June 13 to speak to Caltech's newest group of alumni. Noting that no one likes to be given advice, Beckman told the graduates at Caltech's 92nd commencement that he would pass along "a few suggestions."

"You've successfully completed a very tough curriculum," said the man who has known Caltech as student, faculty member, Associate, lifetime member of the Alumni Association, and chairman, from 1964 to 1974, of the Board of Trustees.

"Savor your achievement to the fullest. But avoid conceit and value humility. Remember the rule that says, 'Don't take yourself too seriously.' I've found it important and useful.

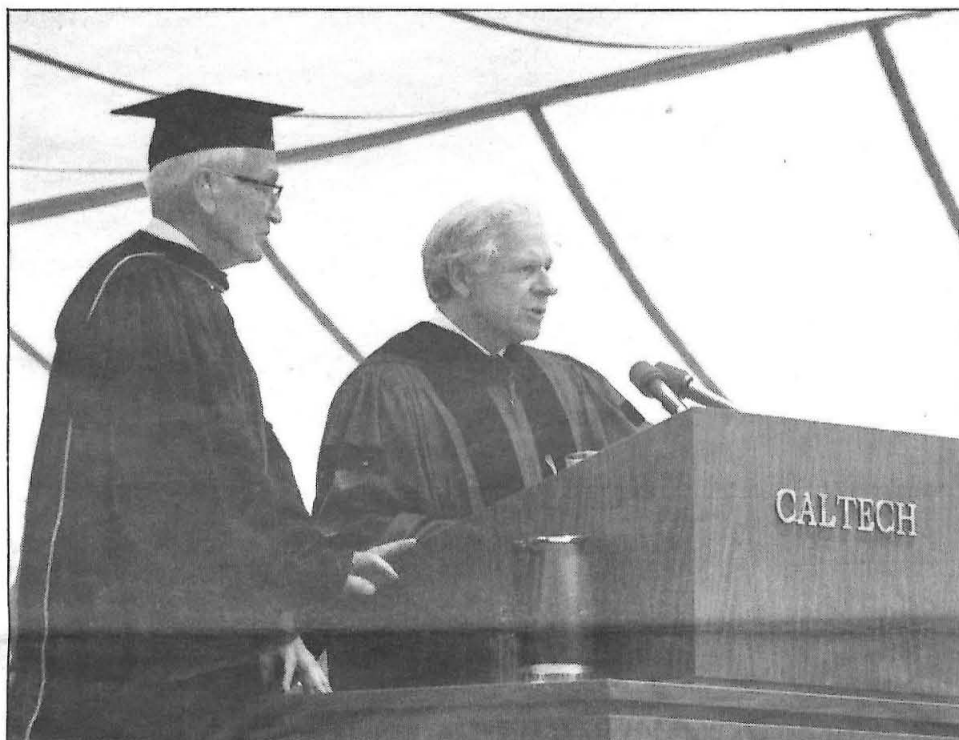
"While taking pride in your accomplishments at Caltech," he continued, "ask yourself if you achieved them on your own or if others helped you. Give your parents a special thanks. And your professors, those who were particularly helpful, it would be a heartwarming experience for them for you to thank them."

Beckman also urged the graduates to remember the contributions of the Caltech Trustees—"45 distinguished men and women selected from throughout the nation, and dedicated to making Caltech the leading institution of its kind in the world. They are the top level of authority; they own Tech's assets. They are responsible for the well-being of the Institute."

On the list to be recognized with thanks was Ruben Mettler, chairman of the Board of Trustees. "We owe him a debt of gratitude," said Beckman.

Noting that many students are subsidized by scholarships, Beckman asked the new alumni whether

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*With Arnold O. Beckman beside him at commencement exercises, President Marvin L. Goldberger announces a \$50 million gift to Caltech from the Arnold and Mabel Beckman Foundation.*

## \$50 million gift from Beckman Foundation announced at commencement

A gift totaling \$50 million from the Arnold and Mabel Beckman Foundation for creation of the Beckman Institute at Caltech was announced at Caltech's 92nd commencement exercises by President Marvin L. Goldberger.

The gift is the largest single gift ever made by the Beckman Foundation.

Goldberger said the primary objective of the Beckman Institute will be to attack problems at the interface between biology and chemistry that require interdisciplinary approaches.

For example, the new science of molecular engineering makes it possible to create materials not found in nature that can lead to spectacular progress in diagnosing and possibly treating disease. The potentials of molecular engineering are enhanced by rapid advances in biological instrumentation.

"This type of interaction transcends disciplinary boundaries, and

has long been characteristic of research at Caltech," said Goldberger. "The Beckman Institute will enable us to harness this power in new and exciting ways."

Ruben F. Mettler, chairman of the Caltech Board of Trustees and chief executive officer of TRW Inc., said, "The Beckman Institute will make scientific discoveries of significant benefit to mankind, and we are deeply grateful for this opportunity. It will provide faculty members with a rapid and flexible means of obtaining research funds for creative and innovative projects that otherwise might not be supported. In the past, some of Caltech's most significant research achievements have depended on just such funding sources."

The Beckman Institute, with its own endowment, will be an integral part of Caltech. It will eventually be housed in a new building on campus that will also contain major instrumentation available to the entire Caltech community.

Research projects to be carried out under sponsorship of the Beckman Institute will be selected by peer review. Projects will receive facilities and support from the Institute for specified time periods so that the mix of projects will change.

Examples of types of interdisciplinary research that might be conducted include the chemical synthesis of new polymers, the development of advanced genetic engineering concepts and instrumentation, the preparation and testing of new types of catalytic and ceramic materials, and the development of computer and instrumentation techniques for protein engineering and human chromosomal mapping.

The Beckman Foundation will grant an initial \$40 million for the Institute, contingent on Caltech raising \$10 million in capital funds from private sources. The Beckman Foundation will then provide an additional \$10 million if Caltech raises an equal amount for the Institute's general endowment from members of the Caltech Board of Trustees.

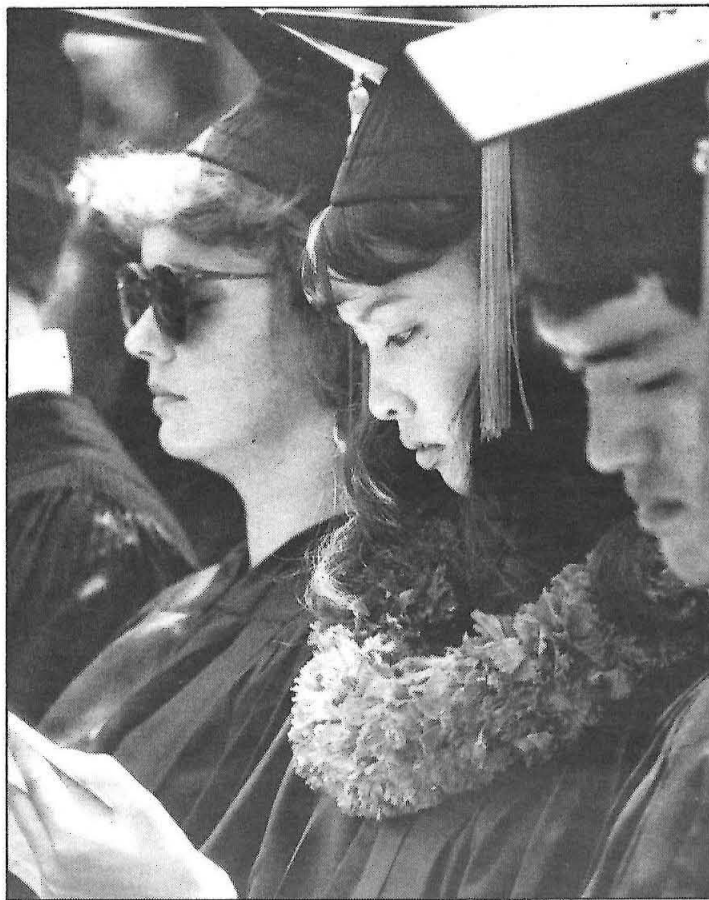
The director of the Institute will be a Caltech faculty member and will report to the Provost.

Said Beckman in explaining the gift, "I've believed for a long time that science and higher education shouldn't depend exclusively on governmental sources of support. Caltech's tradition of excellence makes it an ideal place for the Beckman Institute. Mrs. Beckman and I have strong sentimental attachments to Caltech, and we're certain that the Beckman Institute couldn't have found a more suitable home."

Beckman (PhD '28) is founder and chairman of Beckman Instruments. He was a member of the Caltech faculty until 1940, when he left to devote full time to his company. He served as chairman of the Caltech Board of Trustees from 1964 to 1974, when he was elected chairman emeritus.

He has received many honors for his technical, business, and civic contributions, including the Caltech Distinguished Alumnus Award and the Robert A. Millikan Medal for distinguished service to the Institute.





Left: Commencement day finds Tracy Petersen in a joyful mood. Right: Margaret Carter, Dara Chang, and Chris Chen contemplate commencement rituals during a quiet moment.

## Goldberger awards 495 degrees

President Marvin L. Goldberger welcomed 197 new recipients of bachelor of science degrees, 162 new masters of science, three new engineers, and 133 doctors of philosophy at the Institute's 92nd commencement—a total of 495.

Degrees were almost equally distributed between engineering and the sciences, with a few in the humanities or social sciences.

Of the 197 men and women receiving BS degrees, 89, or 45 percent, graduated with honors, indicating a grade average better than B+.

Goldberger presented the Frederic W. Hinrichs, Jr., Memorial Award for leadership, and for contributions to the student body, to Fred Ferrante, a chemical engineering major. Ferrante served on the Board of Control, which has responsibility for monitoring the honor system, during his four years at the Institute, and was twice BOC chairman.

The Milton and Francis Clauser Doctoral Prize for the greatest degree of originality in PhD research was awarded by Goldberger to William J. Dally for his computer sciences thesis entitled, "A VLSI Architecture for Concurrent Data Structures."

The Lawrence L. and Audrey Ferguson Prize was awarded to Robert Pruitt for the best PhD thesis in biology. His topic was "Characterization of the Genome of *Arabidopsis Thaliana*."

In his concluding remarks to the graduates, Goldberger urged them to consider the contribution they could make to "the world's fight," a fight involving efforts to solve critical problems facing the world—the arms race and the energy problem, for example.

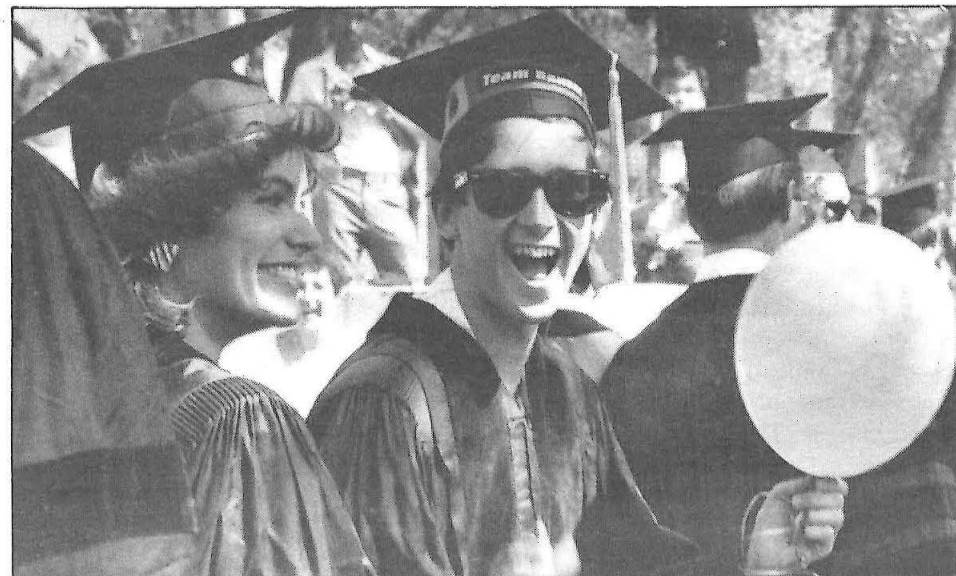
"To make a contribution you have to learn *something*—physics, chemistry, engineering—very well. You have to become a professional and then you can attack broader issues.

"All of you have a great advantage over others wanting to join in the world's fight," he said. "You know how to think about real problems, and you have learned that you can

solve them. The thing you learn particularly at Caltech as you do research is how to separate the signal from the noise—how to discard the irrelevant factors and to see the underlying simplicity. And this is the thing . . . that arms you for the fight."

Basic research endeavors are also vital to the world's fight for growth and survival, said Goldberger. "The types of deeply intellectual efforts that go on in universities are what makes the fight worthwhile—what we must preserve at all costs."

"Between us," he concluded, "Dr. Beckman and I have told you what to do with your lives. The working it out is left as an exercise for you."



In a festive mood, PhD degree candidates Holly Eissler and Jeffrey Zelt march in the commencement procession.

## Think big about future, Beckman advises graduates

*Continued from page 1*

they've given thought to the source of the financial aid they've received. "Have you ever written a thank you?" he asked them.

"You have a moral obligation to repay the part of your education that was subsidized, to put back as much as society has given you—preferably more," Beckman stressed.

"When I came to Caltech as a student in 1923, it never occurred to me to wonder why Caltech was here just when I needed it. But when I became older, I realized that it was not happenstance that Caltech was ready for me. Its founders had created it with foresight and generosity; we have all benefited from that."

Noting that, due to the influence of television it's hard to escape a commercial these days, Beckman said he would give one on behalf of the administration: "Start out by joining the Alumni Association. Later, when you can afford to, join The Associates."

Beckman admonished the graduates, "Your education is well launched. But if you think of graduation day as the terminal point in your process of learning, you will be seriously disappointed. Your need for education will continue throughout your life. And lifelong learning is an exciting process."

In thinking about the future, Beckman urged the graduates to "let your imaginations run wild."

"I got my PhD in June 1928, and I was proud and happy, and excited about the future," he said. "But I was unaware of the extent of my ignorance. I didn't know about antibiotics, about DNA. I knew about  $E=MC^2$ . Certainly no one had any idea that within two decades that equation would usher in the nuclear age that has so changed our world. I knew very little about electronics. I had never heard of the transistor."

"Judging from what has happened in my lifetime, your wildest fantasies about the future and what it will bring will fall short of what you will experience in your lifetime. Discoveries during the next half-century will probably be at least as astounding as those made during my lifetime."

"More researchers are at work than ever before in history. More powerful tools and more sophisticated instruments are available to them than ever before."

"No one has the genius to foresee the breakthroughs that will take place in the coming decades. When you speculate about the future, think big."



## Graduate houses named in honor of Gilloons, Maloneys

Two of the six graduate student houses now under construction will be named in honor of donors who have made generous gifts to Caltech over several years. The donors are Frank J. and Elizabeth W. Gilloon, and Fred V. Maloney (BS '35, MS '36) and Marvis B. Maloney.

The Gilloons have been Life Members of The Associates since 1966, and are members of the President's Circle. From 1919 to 1920, Gilloon was an instructor in civil engineering at Caltech. An avocado and orange grower during the 1930s, '40s, and '50s, he more recently has been involved in real estate development and investing.

Maloney worked for Texaco until he retired in 1970. Now involved in managing his investments, he credits Horace Gilbert's business economics class at the Institute with giving him the knowledge of personal investing that enabled him to build his estate.

Scheduled to be ready for occupancy during the forthcoming fall term, the graduate student apartments resemble units completed in 1984 that received a Pasadena Beautiful Award. Rustic in exterior design, they are made of stucco with rough-hewn wood trim and shingle roofs. They cluster around a central recreation building. The six units are located on a 1.25-acre site just north of the original units on Catalina, and will provide 78 two-bedroom apartments.

## Twelve on Caltech faculty retire with emeritus status

Twelve Caltech faculty members retired this summer, all with emeritus status. They are (followed by the year they joined the faculty): Francis Buffington, professor of materials science (1951); Robert Christy, Institute Professor of Theoretical Physics (1946); Kent Clark, professor of literature (1947); Eugene Cowan, professor of physics (1948); Norman Davidson, Norman Chandler Professor of Chemical Biology (1946); Charles De Prima, professor of mathematics (1946); David Elliot, professor of history (1950); Derek Fender, professor of biology and applied science (1961); William Jones, professor of philosophy (1970); Lester Lees, professor of environmental engineering and aeronautics (1953); Sten Samson, senior research associate in chemistry (1953); and Walter Schroeder, senior research associate in chemistry (1943).



Mabel Beckman (right) with Jean Tang, first recipient of the annual Mabel Beckman Prize.

## Jean Tang awarded Mabel Beckman Prize

Jean Tang, a senior majoring in applied physics, is recipient of the first annual Mabel Beckman Prize. Tang received the award in recognition of her academic and personal excellence, her contributions to the Institute community, and her outstanding character and leadership.

The award was established this year by Caltech in honor of Mabel Beckman, who, with her husband, Arnold Beckman, has supported Caltech in many capacities for more than 50 years. The prize will be awarded annually to a woman stu-

dent upon completion of her junior year.

An outstanding physics student, Tang has been a member of the Undergraduate Standards and Honors Committee and last summer was assistant to the master of student houses, working with summer house counselors.

She also made important contributions as chairman of the teaching evaluation committee for the 1986 student-faculty conference and is vice president of Lloyd House.

## Fund year ends

The Alumni Fund faced a tough task in 1985-86—the first post-Irvine Challenge year—as it set out to consolidate the gains made during that three-year campaign.

During 1984-85, the final year of the Irvine Challenge, Caltech raised gifts of \$1,987,000, with 50 percent of the alumni contributing. This year the fund maintained the same level of participation and raised \$1,828,916.

"Even though we raised a little less money in 1985-86, we are well ahead of where we would have been without the Irvine Challenge," said Harry J. Moore (BS '48), the Alumni Fund chairman. He observed that the year before the first challenge year, participation was at 43 percent and contributions were at \$1,167,000. "We now have a strong base on which to build for future years," he said.

Moore thanked the record 1,223 Alumni Fund workers—and especially the leadership team including Chuck McDougall (BS '47) national campaign chairman; Stan Holditch

(BS '48), special gifts II chairman; Stanley R. Rawn, Jr., (BS '52, MS '53), special gifts I chairman; Tway Andrews (BS '44) and Gordon Barienbrock (BS '58), co-chairmen of the reunion gifts campaign.

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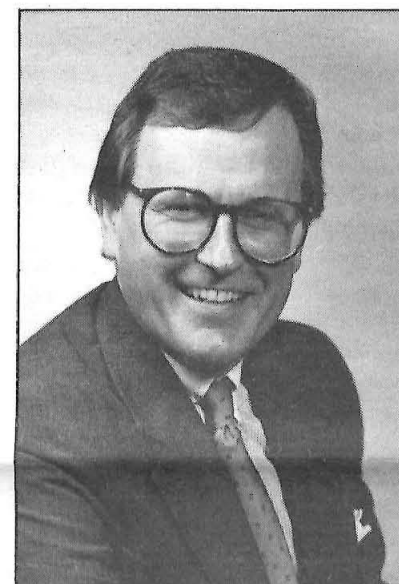
Editor: Winifred Veronda  
Copy editor: Diane Davis  
Personals/Obituaries: Kathy Danaher,  
Muffin Milligan  
Production artist: Barbara Wirick  
Contributors: Phyllis Brewster,  
Heidi Aspaturian  
Photographer: Robert Paz

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## O'Rourke joins Caltech as director of public relations

Robert O'Rourke, who has been assistant vice president for public relations and press secretary to the president of Boston University since 1980, has joined Caltech as director of public relations.

O'Rourke is responsible for Caltech's public relations program, including supervision of publications, the news bureau, and *Engineering & Science* magazine and for coordination of the Institute's community, government, and media relations.



Before joining Boston University, O'Rourke was vice president for institutional relations at the Medical College of Pennsylvania in Philadelphia. He has also been director of public affairs and community health education for the University of Wisconsin Center for Health Sciences in Madison.

In view of the increasing importance of Caltech's interactions with various government bodies, Tom Branigan, who has directed public relations at Caltech since 1981, has been appointed to the newly created position of director of government & community affairs.

## Neugebauer elected to APS

Gerry Neugebauer, director of Palomar Observatory, Howard Hughes Professor, and professor of physics, is one of 23 new members elected to the American Philosophical Society. The oldest learned society in the United States, the American Philosophical Society was founded in 1743 by Benjamin Franklin. It supports and encourages scholarship in all fields of knowledge through its research grants, publications, and library.



The first automated DNA sequencing machine has been developed by researchers at Caltech. The machine uses a laser, colored dyes, and a micro-computer to automatically analyze the structure of DNA molecules.

Lloyd Smith (senior research fellow in biology), working in a research group headed by Leroy E. Hood (the Ethel Wilson Bowles and Robert Bowles Professor of Biology), developed the concept. With Jane Sanders (senior associate biologist) and Robert Kaiser, a research fellow, Smith originated a new chemistry and constructed the first instrument for automated DNA sequencing.

The DNA sequenator will be an enormous aid to research on cancer and genetic diseases, according to its developers. It will also accelerate basic research into the mechanisms of life, and for the first time, it will allow biologists to contemplate the gargantuan task of analyzing the structure of all human genes, a total of three billion chemical units called bases.

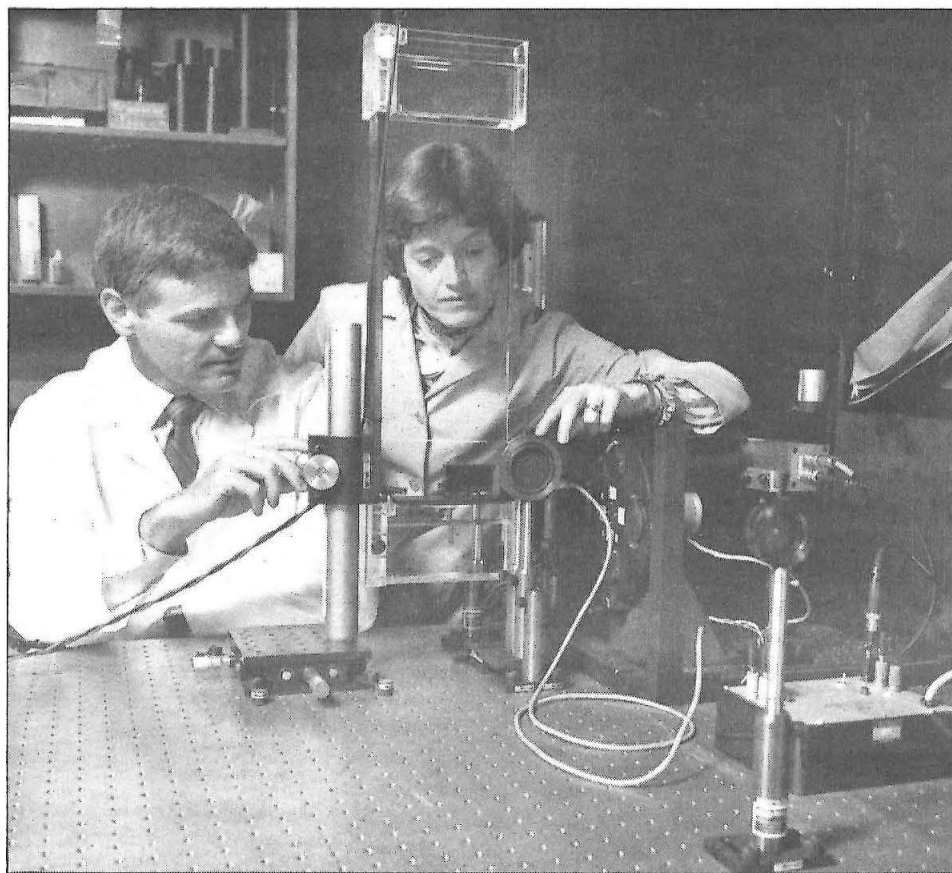
The sequenator was unveiled at press conferences at the National Science Foundation in Washington, D. C., and at Caltech. Development of the sequenator was sponsored by the NSF and by research grants from the Weingart Foundation, the Baxter Foundation, the Monsanto Corporation, and Upjohn, Inc.

"This machine will automate many of the tasks involved in DNA sequencing that are now done laboriously by hand," said Hood. "It will allow researchers to analyze the structure of DNA molecules far more quickly and less expensively than ever before."

Such analysis is vital to understanding genetic diseases and cancer, according to Hood, because often only subtle differences in DNA structure exist between normal DNA and DNA involved in pathologic conditions. To understand these diseases, researchers must discover what these subtle differences are and how they cause an illness.

The DNA sequenator consists basically of a long thin tube, inside of which is a gel of the type commonly used to separate DNA fragments. A low-power argon-ion laser shines through a bottom segment of the glass tube, and a photomultiplier tube detects and amplifies light emitted from within the tube at that segment.

Then the signal from the photomultiplier tube is transmitted to a



Leroy E. Hood and Jane Sanders with the DNA sequenator. The machine will allow biologists to contemplate for the first time the task of analyzing all human genes — a total of three billion chemical units called bases.

## DNA sequenator termed "enormous aid" to cancer, genetic-disease research

computer that interprets it to obtain the DNA sequence.

DNA consists of a string of four kinds of units called bases—adenosine, guanosine, cytosine, and thymidine. These are abbreviated A, G, C, and T, and their order along the DNA strand determines the genetic information they contain.

To analyze an unknown DNA molecule, the researchers use standard genetic engineering techniques to make a series of fragments of the DNA, each one unit longer than the next. The scientists use the unknown DNA as a template to create these fragments, so that the fragments exactly match the unknown.

This method of DNA sequencing by fragment generation was pioneered by Fred Sanger of Cambridge University, who shared the Nobel Prize for his work.

In the version of the Sanger method developed for the automated sequenator, the Caltech researchers chemically manipulate the fragments so that each one ending in A, G, C, or T is marked by one of four different colored dye molecules—green, yellow-green, orange, or red.

The mixture of dye-labeled fragments is then injected into the top of the gel column, and an electric field is applied to the top of the column. This separation technique, called

electrophoresis, is widely used to separate charged organic molecules. The DNA fragments are driven down the column by the electric field, with the smaller fragments traveling faster through the gel than the larger ones. Thus, the fragments separate themselves into bands, with each band representing a fragment one unit larger than the one below it.

As these bands pass through the segment of the tube intersected by the laser beam, they fluoresce with a color that corresponds to the identity of the end base. Using filters and a photomultiplier tube, the instrument can detect the fluorescent glow, determine the color, and transmit the signal to the computer. The computer interprets these signals using a sophisticated program to arrive at the sequences of bases in the original DNA molecule.

Thus, by reading off the colors one by one, the instrument obtains the sequence of DNA along the strand. So far, the Caltech researchers have been able to automatically interpret the sequence of a DNA molecule for several hundred bases in a single run, and they expect improvements to allow sequencing of up to 1,000 DNA bases. Since genes, the basic units of heredity, are about 1,000 bases long, this means that the machine could sequence many entire genes automatically.

## Dervan, five alumni elected to NAS

Peter B. Dervan, professor of chemistry at Caltech, and five Caltech alumni have been elected to the National Academy of Sciences "in recognition of distinguished and continuing achievements in original research." Dervan's election brings to 61 the number of NAS members currently at the Institute.

The new alumni members are Bradley Efron (BS '60), professor, the department of statistics, Stanford University; Ira Herskowitz (BS '67), professor and vice chairman, the department of biochemistry and biophysics, School of Medicine, UC San Francisco; Susan W. Kieffer (MS '67, PhD '71), geologist, U.S. Geological Survey, Flagstaff, Arizona; David N. Schramm (PhD '71), professor, astronomy and astrophysics center, University of Chicago; and Donald L. Turcotte (BS '54, PhD '58), department of geological sciences, Cornell University.

Dervan, 40, and his colleagues are developing organic compounds able to "read" DNA molecules to seek out a specific sequence, attach to that sequence, and cleave the DNA. Such powerful chemical tools would enormously increase the ability of genetic engineers to manipulate DNA.

The chemicals could also serve as diagnostic reagents to recognize specific diseases by the organism's DNA. Finally, such compounds could be tailor-made to treat a disease by specifically attacking only that organism's DNA.

Dervan received his BS in chemistry from Boston College in 1967 and his PhD from Yale in 1972. He became a member of the Caltech faculty in 1973.

## Two on faculty elected to AAAS

Two members of the Caltech faculty have been elected to the American Academy of Arts and Sciences, a national honor society that annually recognizes leading scholars, scientists, artists, and public figures. The organization, based in Cambridge, Massachusetts, was founded in 1780 by John Adams and other leaders of the American Revolution.

The newly elected faculty members are Roy J. Britten, Distinguished Carnegie Senior Research Associate in Biology; and Alan Donagan, professor of philosophy.



## \$400,000 GM grant funds lab to study organizational decisions

A laboratory where Caltech researchers can conduct experiments on the processes by which organizational decisions are made will be established at the Institute with a five-year, \$400,000 grant from General Motors Corporation.

Director of the Laboratory for Experimental Economics and Political Science will be Charles Plott, professor of economics and a pioneer in the relatively new field of experimental political economy.

The results of experiments at Caltech—such as those to be conducted in the laboratory—have already been used to aid in widely varied tasks, including evaluating methods of setting freight rates and allocating precious airport landing rights.

Until recently, economics and political science had been considered descriptive and theoretical. Now researchers turn to laboratory methods to understand economic and political phenomena.

"Economists often are faced with extremely difficult tasks," says Plott. "One example would be understanding the effects of deregulation on the airline industry. This effort involves as many complexities as sending a man to the moon.

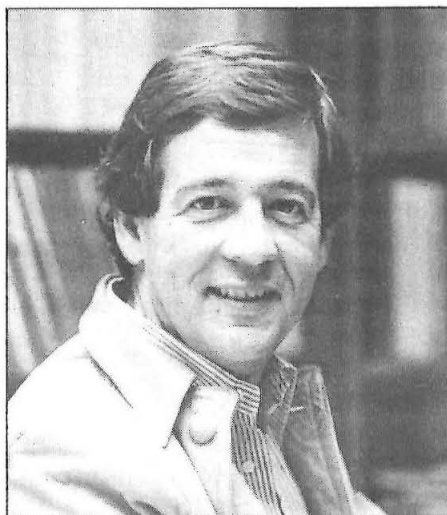
"Economists develop theories to help themselves understand these complicated phenomena, but only recently did they notice that it might be useful to test the theories under very simple circumstances. If the theories don't work in simple situations, why should we expect them to work in complex ones?"

In a typical "simple" economics experiment, a group of volunteer subjects—most of them ordinary people with no economics training—are divided into "buyers" and "sellers." The experimenters create abstract "goods" that have no intrinsic value to buyers and sellers other than as a means of making a profit.

To motivate the volunteer subjects, the experimenters give them real money to use in trading. Sellers buy goods from the researchers and sell them for whatever price the market will bear.

At the end of the experiment, the buyers resell the goods to the researchers at a predetermined price. In this way, experimenters control the costs to sellers as well as the motivation of buyers. All the participants keep any profits they make—amounts that can involve hundreds of dollars.

Within this framework, the researchers can vary the rules to study the effects of different market organizations and different pricing



Charles Plott

structures.

Some of Plott's laboratory studies have already had an important influence on real-world economic pol-

icy. In an article in the May 9 issue of *Science* magazine, Plott describes experiments designed to evaluate two types of market organization—the "oral double auction" and the "posted price institution."

The oral double auction is used by most commodity markets to set prices, and both buyers and sellers are active. Buyers tender bids to buy, and sellers tender offers to sell, and the most recent bids and offers are publicly displayed.

Buyers are always free to increase their bids and sellers to decrease their offers. In this way, competitive bids and offers converge until buyers and sellers agree to make a formal contract.

On the other hand, in a posted price institution, each seller submits a sealed bid without consulting with other sellers. Then the prices are

publicly posted and cannot be changed. Thus, further price competition is not possible.

In comparing the two markets, Plott's laboratory experiments revealed that prices tend to be higher for the posted price markets than for the oral double auctions. Also lower for posted price markets are efficiencies—a term used to describe the total benefits and costs that emerge from the market process.

This study was used to help set policy when the railroad industry proposed to the Department of Transportation in 1977 that freight-weight posting be required for dry-bulk, inland-water barge traffic. The industry practice was set for prices to be negotiated privately. But Plott's study indicated that, contrary to the railroads' claims, a posted price institution would cause prices to go up, efficiencies to go down, and small barge owners to be disadvantaged. The proposal was dropped.

The laboratory can also be used for experiments in political science. For example, in another series of experiments, Plott studied how the procedures used by committees shape decisions.

These studies of committees have also influenced real-world policy. In the past, airline industry allocated airport landing and takeoff rights in a committee process. Plott and Caltech colleagues David Grether and Mark Isaac recommended in 1979 that this procedure be changed to a process in which these rights could be bought and sold on an open market.

Their proposal raised an international furor in the airline industry, and the idea was dropped. But in following years, a version of the proposed change resurfaced, worked its way through the bureaucracy, and was finally enacted this year.

So far, all of these experiments have been done using minimal equipment in simple classroom laboratories. The grant from GM will allow the researchers to set up more complex experiments using larger numbers of experimental subjects.

It will also allow them to evaluate more complex theories. For example, some researchers would like to perform experiments that require precise timing, coordination, and control of information—an effort requiring a network of computer terminals as well as the software to run them. The GM grant will help acquire this equipment and develop the software. It will also enable Caltech to bring economic and political theorists to campus for short periods to help develop experiments to test their own theories.

### James Bailey elected to NAS

A faculty member and two alumni are among 73 engineers elected to membership in the National Academy of Engineering. They are James E. Bailey, Caltech professor of chemical engineering; Anthony J. Iorillo (BS '59, MS '60), group vice president and manager, Space and Communications Group, Hughes Aircraft Co.; and Chiang C. Mei (PhD '63), professor of civil engineering, MIT.

Bailey was elected for research leadership in kinetic models, and for innovative basic measurements of genetically engineered cells and immobilized enzyme biocatalysts.

Iorillo's election is for invention and application of the gyrostat prin-

ciple, which made it possible to lift limitations on the size, complexity, and capability of spinning satellites.

Mei was chosen for his application of the theories of wave hydrodynamics and elasticity to problems in coastal and ocean engineering.

Bailey came to Caltech in 1980 from the University of Houston where he was professor of chemical engineering. He earned his PhD and BA degrees at Rice University. Among his honors are the Allan P. Colburn Award from the American Institute of Chemical Engineers and a Camille and Henry Dreyfus Teacher-Scholar Award.

### Caltech sets nationwide Sigma Xi record

Caltech has set an all-time nationwide record in the percentage of its undergraduate student body initiated into Sigma Xi, the national honorary research society.

Nine percent of the Caltech undergraduates (71 students) were initiated this spring as associate members,

based on successful completion of an independent research project. Previously, the highest percentage to be initiated by any school was eight percent of the undergraduate student body.

Fredrick H. Shair (professor of chemical engineering), president of the Caltech Sigma Xi chapter, explained that the Institute's Summer Undergraduate Research Fellowship (SURF) program created research opportunities that enabled such a large number of undergraduates to qualify for the honorary society.

The national Sigma Xi organization gives awards to young investigators. The Caltech chapter presents a \$750 award annually to the graduating senior who has completed the most outstanding piece of research.

### We're sorry!

The name of Norman Davidson (the Norman Chandler Professor of Chemical Biology) was omitted from a list in June *Caltech News* of Caltech faculty members who have been named California Scientist of the Year. Davidson received this honor in 1980. We regret the omission.



## Enterprise Forum: Rx to help young companies grow

By Winifred Veronda

Where can the president of a young technology-based company find free management advice from a panel of experts, plus a chance to meet venture capitalists, bankers, potential customers—and potential members of a management team?

If the entrepreneur is willing to risk a round of probing criticism of his business plan and corporate strategies, he or she can find just such an opportunity through the MIT Enterprise Forum, a one-night session presented monthly by the Caltech Industrial Relations Center and the MIT Alumni Association.

A similar program was begun by MIT in 1978 and since then has spread to 11 cities. All programs are open to the public.

Designed to help young companies grow and prosper, the Enterprise Forum has been compared to being given a "board of directors for a night." In Pasadena, many of its presenters have been Caltech alumni, and a recent show of hands at a Forum revealed an approximately equal number of Caltech and MIT alumni in attendance.

Gary Clinard (BS '65, MS '66), president of Monitor Dynamics, Inc., of Upland, California, presented at the May program. Monitor Dynamics designs and manufactures a line of computer-based security and monitoring equipment for use in fire, burglary, access, and environmental control. Among his customers are major military and defense establishments, retail corporations, and theme parks. Corporate sales have doubled each year since 1981, and last year were in excess of \$2,300,000.

Clinard seeks advice on whether the company should change or diversify its channels of distribution or its manufacturing methods, and on how to give minority stockholders a liquid return on their investment. Most of all, he hopes for insights on how to move the company through its next phase—from start-up to growth company.

Several weeks before the session, Clinard gave the panelists a business plan, summarizing his background, company operations, products, customers, product distribution, finances, past performance, goals, objectives, and business strategies.

Now the panelists, who have reviewed the plan and have chatted with Clinard at dinner, are ready as he makes a 20-minute presentation on the perceived merits and shortcomings of his company, and his

goals for growth and expansion. His company, he says, is ten years ahead of its competition, and has been able to offer a competitive edge because its systems are versatile and flexible in adapting to a wide variety of customer needs.

The questioners want to know how he will financially support the next round of growth. "You've had

constructive parts of the experience was preparation of the business plan. He compared the presentation itself to "the final in a hard course at Tech."

"It forced us to evaluate what we're doing and to write it down," he says.

"We learned a lot. It's easy to get caught up in the day-to-day struggle

on the right market, and penetrate it quickly."

"Focus is critical and I don't get it from your presentation," says one.

Another believes he is devoting too much energy to international ventures. "The largest market is here; the investors are here," he tells De Mari.

Observing that a lot of emphasis in marketing will be necessary to achieve the goals outlined by De Mari, a panelist suggests finding a strategic partner—one who has "tremendous marketing potentials."

"You have tremendous technical expertise, but you don't have the expertise on board for marketing, distribution, and sales," he cautions.

De Mari says that through the experience "we got some good business advice and good exposure, and the exercise helped to clear our train of thought—even though I wish the panelists could have met with me ahead of time so that I could have cleared up some misconceptions that grew out of their reading of the business plan."

"We're taking some of the advice. We know that we must be more precise in our product range. We spread ourselves thin because we didn't know how the market was going to react. But we're not taking the advice about pulling back our efforts to penetrate foreign markets. If we're going for the international market, we have to do so now, or it will be too late. Someone from Europe is in my office right now, signing a contract."

David Strand (MS '78), president of Dynamic Solutions Corporation, a Ventura computer company, made his presentation in 1984. The firm produces laboratory work stations based on microcomputers for chemical testing operations.

Strand found that the panelists' unvarnished insights paid off. He narrowed his product line after forum panelists suggested he was broadening it too soon. He says the narrowed focus allowed him to perfect his technology more rapidly and to have it ready when a larger company came looking for a licensing agreement. That deal, he says, will add \$2 million to his revenues.

Strand says he was somewhat nervous about giving his presentation. "Receiving advice from five different

*Continued on page 7*



Ready for his Enterprise Forum presentation, Andy De Mari consults with Eugene J. Moscarel, forum moderator.

easy sales; the tough round is ahead," one tells him. And how will he create and maintain the dealer network necessary in the next growth phase? One panelist suggests that he seek out a partner with a strong distribution network.

The need for a strong board of directors and for other experienced people in the management picture is stressed by a panel member. "Too much of the company fabric is interwoven with you," this spokesperson says.

Clinard is also urged to do a better job of "getting across the story" of what makes his company different: "You're the leading innovator in the market. You're doing state-of-the-art work. This should be said."

A panelist observes that, as CEO, Clinard is "fiscally conservative, and has been so in building the company." This conservatism, Clinard is cautioned, could be a block to growth if he is unwilling to go after venture capital—capital that could help him to take advantage of his lead in innovation and "slingshot ahead of the competition."

Later Clinard says he found the panelists helpful (although one had not read the business plan until dinner time), but that one of the most

and not look at the big picture."

But perhaps most valuable of all was the "flood of contacts" after the forum from people interested in positions with the company, Clinard observes.

"We had been looking for a strong number-two man with the abilities to guide us through the next stage of our growth process," he says, "and hadn't wanted to go to a headhunter. We've found several good prospects as a result of the presentation."

Andy De Mari (MS '64, PhD '68) made his presentation to the Enterprise Forum in March. De Mari's company, Retix, of Santa Ana, is in the business of networking and inter-networking of computer systems. It manufactures and markets network controllers, getaways, and communications software.

Among the topics addressed are financing alternatives, including strategic partnerships, venture capital and the public market; distribution channels; and overall business and marketing strategy.

De Mari is hit by the panel for "wanting to go in many different directions with limited resources in a highly competitive field." He is advised to "narrow his options, focus



## Research groups join forces in better-materials quest

Stronger and lighter materials for automobiles and planes, materials that don't corrode, materials made of inexpensive and easily accessible substances, so that our supply of raw ingredients is never limited and can never be shut off by a political crisis—these are some of the promises of modern materials science.

A better understanding of the nature of materials—and how to create them—can lead to everything from stronger skyscrapers to better computer chips. And in a world of shrinking natural resources, such knowledge becomes increasingly essential.

To further the efforts of scientists and engineers at the Institute, research groups from three disciplines—engineering, chemistry, and physics—have formed the Caltech Materials Group (CMG)—a unique alliance that utilizes both experimental techniques and theoretical insights.

The five principal investigators include William A. Goddard III (the Charles and Mary Ferkel Professor of Chemistry and Applied Physics), William L. Johnson (professor of materials science), Marc-Aurele Nicolet (professor of electrical engineering), Thomas A. Tombrello (professor of physics), and Thad Vreeland, Jr. (professor of materials science).

Other participants are Brent T. Fultz (assistant professor of materials science), David L. Goodstein (professor of physics and applied physics), Richard C. Flagan (professor of environmental engineering science and mechanical engineering), and Thomas C. McGill (the Fletcher Jones Professor of Applied Physics).

"All of these people work together," says Goddard. "In many instances we share postdocs and graduate students, and we write joint papers. We collaborate in many ways. Because Caltech is small, we've known each other for years. This means that we can easily redefine boundaries and share equipment and research personnel."

The CMG has already secured a \$2.3 million, three-year grant from the National Science Foundation (part of a new program for materials research groups), and \$400,000 in matching funds from the Institute. With this funding, the group has been able to buy major equipment items, including a scanning transmission electron microscope and a new computer graphics facility. An ultra-

high vacuum facility for preparing thin film samples is being constructed at the Institute.

The transmission electron microscope, a 300,000-volt "state of the art" instrument, replaces an electron microscope that was purchased in 1960. It provides access to much new information about the structure and chemistry of materials created in the laboratory. With the microscope it is possible to resolve dimensions as small as  $1\frac{1}{2}$  angstroms (an angstrom

posited in combinations where unique compositions can be predicted and analyzed.

Other research has focused on the use of ion erosion and ion-beam mixing to enhance adhesion and to modify the surface of materials. The characterization of materials and how thermodynamics and kinetics determine their microstructure has also been under investigation.

Since the days of the late Professor Pol Duwez, Caltech has been world-

more exciting problems to investigate. Each one of these ideas gives us a lot more ideas—and most of them are workable. Each year brings possibilities that make what we did in the previous year seem dull, and it's going to be like this for the next 20 years."

As CMG scientists and engineers learn more about the chemical, mechanical, and electrical properties of materials, they will learn to manipulate and adapt new materials to suit the needs of many industries—automotive, aerospace, and manufacturing, for example, as well as computers and electronics.

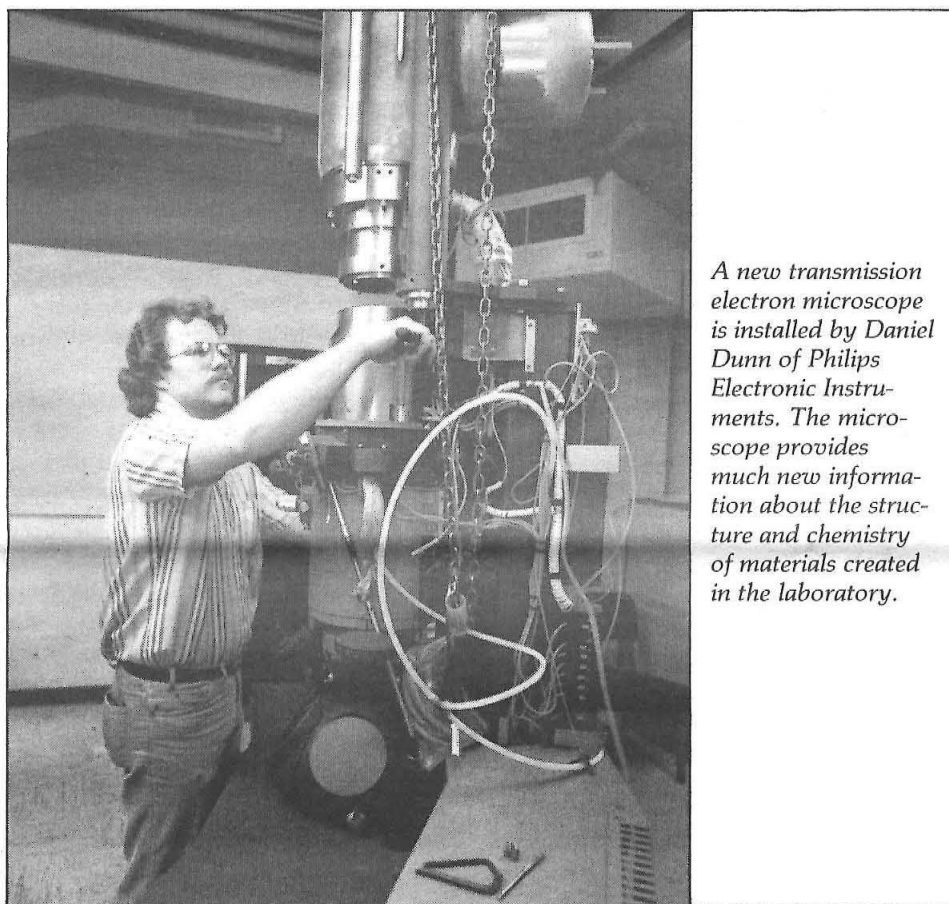
## Enterprise Forum helps young companies grow

*Continued from page 6*

people at the same time can be an adjustment," he says. "The experience makes you realize that the way you've explained your business plan may not make your strategies come across clearly. Then you recognize that if the panelists didn't understand your concepts, your banker may not understand either; unless you're talking to bankers, you should be able to communicate the heart of your idea within three or four minutes."

Along with the insight to narrow his product line, Strand came away with some new concepts concerning funding. "I realized that the time wasn't appropriate for venture funding," he says. "After the forum presentation, we focused less on raising money and more on forming technical partnerships. We got the money we needed, but in a different way than I had initially anticipated."

"You get information from the forum panel that you wouldn't get from a banker who was turning you down and who wouldn't say what he thought," Strand concludes. "These people are blunt and impartial. They tell you what they really think. And this helps a great deal, even if at times the process can be uncomfortable."



*A new transmission electron microscope is installed by Daniel Dunn of Philips Electronic Instruments. The microscope provides much new information about the structure and chemistry of materials created in the laboratory.*

is approximately one hundred millionth of a centimeter).

The ultra-high-vacuum facility will provide an environment in which super-thin layers of metal film can be created under special conditions where all the impurities can be excluded without removing the sample from the vacuum chamber. Researchers can study the structure and characteristics of the experimental metal specimen through x-ray diffraction.

The new computer graphics system makes it possible to simulate the creation of a new material, allowing researchers to interactively use three-dimensional representations of the details of the dynamics of the atomic level as the material is formed.

The synthesizing of new materials through ion implantation is another strategy utilized within the group. In the laboratory, ions are accelerated to super-high levels of energy through exposure to a semiconductor, and de-

renowned for its accomplishments in synthesizing amorphous metals—those with glasslike rather than crystalline structures. A recent breakthrough in this area has been the synthesis of bulk samples of such materials. Such amorphous metals can be stronger and more wear- and corrosion-resistant than their crystalline counterparts. They can also have superior electrical and magnetic properties, and their use in transformers could save hundreds of dollars per year in electrical costs.

Research on materials is also critical for the development of the computer industry. Novel semiconducting materials, for example, form the potential basis of a new generation of computer devices. Computer circuits made of such new semiconducting materials could send information faster and more efficiently.

"This is a wonderful time to be in materials science," says Goddard. "We can do so many things we could only have dreamed about a few years ago. We continually find more and



## Faculty committee recommends changes in core curriculum

The majority of Caltech's undergraduates would reap greater personal and intellectual benefits from a less stringent workload, more exposure to a wider range of scientific disciplines, and greater opportunities to appreciate the liberal arts.

These were among the findings made by the faculty ad hoc committee on the core curriculum which has presented the results of its nine-month study in a 120-page report to the faculty board.

The committee noted that the core curriculum is "fundamentally sound" and "offers the best preparation for . . . a career in science and engineering." It went on to suggest that "the curriculum should be adjusted to reflect the massive explosion of knowledge in many scientific fields and to accommodate the increasingly interdisciplinary nature of our science and technology, and . . . to make learning of the material more manageable and to allow students more time to think and explore."

To accomplish these goals, the core curriculum committee made detailed recommendations in five major areas of concern. Among those highlighted in the report summary were:

- *The overall curriculum:* Scale down the material in core courses and term course loads to allow students to "get exposed to the diverse range of scientific cultures." . . . Reduce the number of core courses taken by freshmen and sophomores from five to four. To discourage freshmen and sophomores from overloading, require them to obtain approval from the dean of students to carry more than 51 units.

Encourage faculty to distribute work loads evenly during the term, and to refrain from giving homework during midterms. Consider shortening the school year by a week to create a two-week break between spring and winter terms. Introduce more flexibility into the core and the schedule of courses during the freshman and sophomore years to allow students more time to sample without overloading.

Encourage all options without introductory courses to create them to provide students with opportunities for exposure to a diverse range of scientific cultures, problems, and endeavors.

- *The humanities and social sciences:* Many introductory courses are too specialized. Offer a more coherent, balanced exposure to disciplines within the humanities by making the core courses better integrated and more interdisciplinary, by

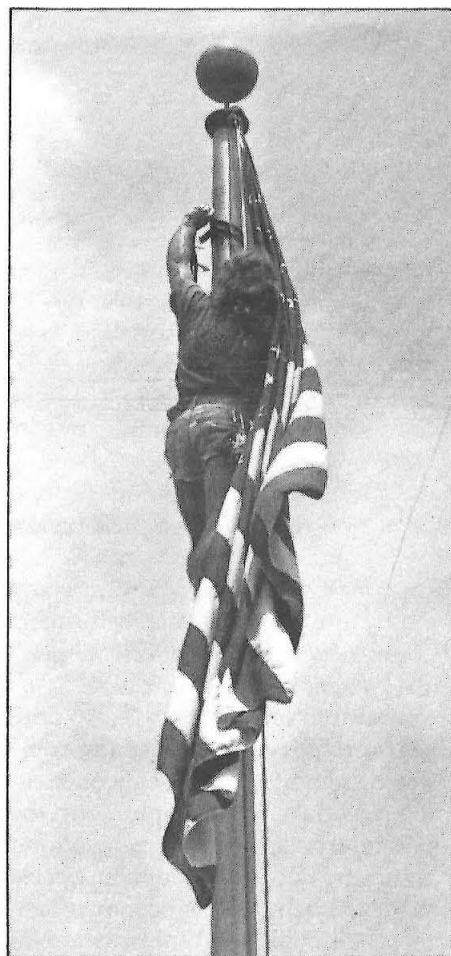
offering more introductory courses and including an "across-the-curriculum adjunct writing program"—and opportunities for a more broadly based exploration of human culture and society.

- *Core courses in mathematics, physics, and chemistry:* Dovetail the mathematics taught in mathematics, physics and chemistry, and reduce the workload in sophomore physics.

- *Computing requirement:* Establish a proficiency requirement in computer programming and institute a programming course for students not meeting the requirement. Integrate the teaching of computer programming across the curriculum.

- *Undergraduate research:* Provide more research opportunities during the academic year, particularly for juniors and seniors. To allow students time for that research, decrease the minimum graduation requirement from 516 to 480 units, and make independent research one of the principal criteria for graduation with honors. Create an honors program within the various options, and also between options, to encourage interdisciplinary programs of study.

"Faculty response to the report in general has been very positive," said Sunney Chan, the core curriculum committee chairman.



Ditch Day means high times for Steve Waltman, at left, who ascends the campus flagpole to leave a message at the top — one of the requirements for breaching a particular stack. Right — In Millikan Pond, Fleming House students, coached by Harry Gray off camera, replicate a particular molecular structure as they earn points toward a finesse stack entry. One of the most insidious challenges at Ditch Day this year was a cornucopia stack — a solid tunnel of food to be eaten through, no hands. Challengers breached sheet cakes and marshmallow-mortared Rice Krispies, but turned back when they encountered a wall of baklava, a sweet and sticky Middle Eastern dessert.

Serving with Chan were David Goodstein, Hans Liepmann, Jerome McGann, David Stevenson, and David Wales. The recommendations were based on discussions with students, faculty, alumni, and administrators.

Committee members also made visits to MIT, Princeton, Harvey Mudd, UC Berkeley, and several other universities that share Caltech's educational aims and have an interest in the same pool of applicants.

## Federal funds for student aid drop

Funds from the federal government to Caltech for student financial aid for the 1986-87 academic year are down 16.7 percent from 1985-86. According to Verna Hazen, director of financial aid, this represents a reduction of \$182,236—money that Caltech will have to contribute in order to continue meeting the full financial need of all qualified students who are accepted.

Meanwhile, the costs of attending Caltech this year will rise 5 percent, said Hazen, who stressed that the Institute is strongly committed to meeting its students' full financial needs.

Over the last six years, the Institute has increased its student aid contribution substantially to compensate for a growing gap between student need for assistance and traditional government funding. This year, for example, Caltech is contributing more than twice as much scholarship and fellowship aid as it was five years ago.

During the past five years, federal financial aid to Caltech students has increased by 25 percent, Hazen notes—but the cost of attending Caltech

has increased by 38 percent during the same interval.

Hazen points out that 75 percent of the Caltech student body will receive some financial aid in 1986-87. Across the country, one out of four students receives financial aid. But at private colleges and universities with steep tuition costs, the percentage is much higher.

Of the Caltech students receiving aid, virtually all are offered loans and part-time jobs as part of their aid package. Typically, the first \$3,100 of a Caltech student's financial need is met through loans and part-time job opportunity—\$2,200 in loans and \$900 in income through the federal work-study program.

Fifty-five percent of Caltech undergraduates hold part-time jobs—either under the work-study program or in privately funded positions on or off campus.

This year, the percentage of funds offered as loans and part-time job income is slightly higher than last year, but still generous in comparison with that offered by similar institutions. At MIT, for example, the work-and-loan component of an aid package is \$4,900, compared with Caltech's \$3,100.

"We're still doing a much better job of meeting students' financial needs without imposing excessive loan burdens than are most other institutions," says Hazen. "We've made a strong commitment to do so. We're very much aware of the negative consequences of large loan burdens for young graduates."

If a loan burden becomes too large, students who had planned to go on to graduate school may feel that they cannot because of the loans they are carrying. If they make such a decision, the result is a drain on the academic community at a time when





young people with graduate educations in engineering and the sciences are badly needed.

A third source of aid available to high achieving students—in addition to Caltech and the government—comes through scholarships from sources outside the Institute.

This year, Caltech is changing its financial aid policies to encourage more students to seek such support.

When a student with financial need receives an outside scholarship, Caltech reduces the amount of aid it offers the student. Part of the reduction is in the "self help" part of the financial aid package (loans and part-time job opportunity), and part is in direct grant money. This year, the Institute will use a more generous formula, awarding students who receive outside scholarships more of their Caltech aid as grant money, and less as "self help" funds, than before.

## Letters

Dear Editor:

I've received sad news. Had Nicholas Weinstein graduated from Caltech, he would have been a member of the class of 1933, my class. He died on March 27, 1986, just one day short of his 75th birthday. He was a wonderful man, and many who knew him at Caltech will remember him and be saddened.

Nick's father was a communist who fled Hungary when the Bela Kun regime collapsed shortly after World War I. Nick grew up as a communist. When he was left with little money after the death of his father, he used what he had to go to the Soviet Union, rather than trying to continue at Caltech.

Over many years, others and I kept in touch with Nick, writing, sending books, visiting him when we chanced to be in Moscow, as my wife and I did in 1973. Others of his and my close friends were Harold Pearson, Donald Poulson, and Lee Carleton. I am sure that a host of others knew him well and remember him fondly, for Nick was wonderfully friendly, with an ever-youthful charm. When my wife and I went to his apartment in Moscow, I wondered if, after 40 years, I would meet the Nick I had known. I needn't have worried. It was as if we had parted the day before.

A few years later, Nick and his wife came to the United States where they visited relatives and friends, and of course when they visited Caltech, they stayed with us. They brought with them about a thousand rubles, which no one would let them spend.

I think that the United States astonished Nick. He said that some of his relatives were doing well, and

added that even those who weren't were doing pretty well.

Nick enjoyed visiting the United States, but the trip didn't change him. Happily, nothing could. After, as before, the topics of his always-cheerful letters were his wife, his two sons, his grandchildren, his vacations, his illnesses. But above all, he wrote of the American and English books that he read, and the American and European movies he had seen—far more than I read and saw. And he sent me many, many books.

Some of these were English translations of Russian novels and short stories. But some were his own translations of Russian books in physics and mechanical engineering—a few profound, more intended for a wider audience.

For many years Nick translated for the publishing house Mir. This suited him admirably. He could work at home. As a member of the writers' union, vacation resorts in southern Russia and special medical attention were accessible to him. More important, he loved reading and writing, and getting things truly right.

Sometimes he wrote to me for help; I remember reading through the poems of T. S. Eliot to find the original of a garbled quotation. Sometimes he did better than I. I couldn't find an obscure work by Lewis Carroll in the Stanford Library; Nick found it by writing to the British Museum.

Nick is survived by his wife, Mary Hirshberg, his two sons, and grandchildren—the number, I don't remember. They must miss him sorely. And so will all of those who came to know him, at Caltech and elsewhere.

Sincerely yours,

John Pierce, BS '33, MS '34, PhD '36

To the Editor:

Writing about the Caltech Stock Company in the June 1986 issue of *Caltech News*, editor Winifred Veronda rightly praises the enduring popularity of the witty song "The Richter Scale," composed by J. Kent Clark and Elliott Davis. The song was performed in 1966 in "Lee and Sympathy," a musical tragi-comedy written to celebrate Lee DuBridge's 20th anniversary as president of Caltech. In recalling seismologist Charles Richter's reaction to the composition at that time, Kent Clark said: "He loved it." Maybe and maybe not.

Four years later, at Richter's retirement party, a number of his colleagues sang the song, much to his dismay. As he told a member of the department at the time, "You had, of course, no reason to suspect what a repeated source of annoyance the song has been to me. Innocuous

enough in itself, I would have been very happy, from the beginning on, to shrug it off and forget. But well-intentioned persons will not do so. They insist that, because they like it, I must like it and applaud, again and again." We hear you Charlie (from the Charles Richter Papers).

Judith R. Goodstein  
Institute Archivist

Dear Editor:

On Sunday night, June 1, ABC showed a two-hour feature about President Theodore Roosevelt.

During the school year of 1939-40, Kermit Roosevelt, a young man who was said to be TR's grandson, taught European history at Caltech to sophomores. Overcritically, a couple of students in Section F thought his teaching to be soporific (sleep-inducing).

Before a lecture by him to the entire sophomore class, one of the lads hid an alarm clock in the lecture room of Dabney Hall. During the lecture the clock rang. Mr. Roosevelt, who did not have the physical robustness of his famous grandfather, appeared undisturbed and kept on with his history lecture.

I hope that Mr. Roosevelt realized that this rude act was a prank by teen-age college boys.

Naomi Kashiwabara, BS '49

## Track team finishes fifth in conference

This year a resurgence in participation marked track and field activities at Caltech. In addition to the 27 men on the team, Tech was able to field a women's team of six dedicated athletes—the first Tech women's team to compete.

In dual-meet competition, the men finished at .600 with six wins and four losses and a fifth-place finish in the SCIAC conference. The women, on the other hand, finished without a win due to lack of depth.

On the men's team, a combination of fresh new talent with a few veteran performers produced some highly respectable marks. Freshman John Haba was a scoring leader with a best effort of 6'2" in the high jump and a fourth-place finish in the conference finals. Alex Athanasopoulos, another versatile freshman, shined in the sprints and middle distance events, running the 100 in 11.60, the 200 in 24.05, the 400 in 51.80, and the 800 in 1:58.56. He also anchored both the 400 and 1600 relays.

Sophomore distance standout John Gehring recorded season bests of 4:10.07 in the 1500, and 16:12.40 in

the 5000. Senior Robby Dow contributed heavily in throws and jumps with 146'8" in the javelin and 113'6½" in the discus. He triple jumped 36'6½" and high jumped 5'8".

Once again, sophomore Dave Gates turned in excellent performances in sprints and vertical jumps despite a nagging hamstring strain throughout the season. He triple jumped 45'0", somewhat off his school record of 45'11¼". He also long jumped 22'1¾" at the SCIAC championships. In the 100 and 200, he turned in times of 11.5 and 23.38, leading all Tech sprinters.

Junior Chris Schofield provided much needed leadership and competed in seven different events—from 100 meters to 400 meters, both vertical jumps and relays. Pole vaulters Brian Burk and Dave Gallup continued their excellent progress, although both had to deal with minor injuries throughout the season. Burk cleared 15'0" several times in practice to improve his previous best of 14'0", while Gallup cleared 13'6", exceeding his personal best of 13'0". Burk was healthy only once during conference competition, vaulting 13'1" to a fourth place finish at the conference championship meet.

Despite their overall performance, several Caltech women made marks in the school record book. Junior Jarita Holbrook set records of 4'8" in the high jump, 14'2½" in the long jump, 14.21 for the 100 meters, and 19.15 for the 100-meter hurdles.

Junior Clea Bures made her mark with times of 2:33.90 for 800 meters, 5:25.61 for 1500 meters, 11:57.37 for 3000 meters, and 20:40.61 for 5000 meters. Bures captured fourth place in the 5000 meters and sixth place in the 1500 meters at the SCIAC finals.

Freshman Dee Morrison dominated field events, establishing records of 81'8" in the javelin, 29'4" in the shot put, and 93'7" in the discus. Junior Trina Juzang set records of 30'6" for the triple jump and 30.06 for 200 meters. Along with each of those individual marks, the women shared in the 400 and 1600 relay records of 60.27 and 5:03.67.

At the track awards dinner, Robby Dow was recipient of the M. T. Davis Outstanding Field Athlete award, and John Gehring received the Goldworthy award as outstanding track athlete. This award is earned through sportsmanship, team spirit, and excellence at several events, including the 1500 meters and 5000 meters.

Clea Bures was named outstanding female track athlete for her versatility with school records in the 800 M, 1500 M, and 3000 M, and for sharing in the 400 relay and 1600 relay records. Dee Morrison received the award for outstanding female field athlete.



## Alumni term Seminar Day "a first-rate show"

Alumni and their guests flocked to the campus for Seminar Day in May in near-record numbers (1,473, compared with 1,088 the year before) to hear a general session address by Murray Gell-Mann on superstrings, and to sample a cornucopia of other tempting attractions. The weather cooperated, turning bright and sunny after a cool, damp week.

Ed Stone's seminar on "Voyager 2 at Uranus" was a popular favorite among the lectures, as was Dan Kevles's on "God, Man, and Genetics: Historical Reflections," and J. L. Beck's on "Damage Caused by the Mexican Earthquake."

SURF (Summer Undergraduate Research Fellowship) students Diana Foss, Ara Kassabian, and Tracy Petersen made research presentations to a standing-room-only audience, and some alumni said they were the best speakers of the day.

Caltech's award-winning physics course for television, "The Mechanical Universe," was shown throughout the day in the East Bridge library. The room was consistently packed as alumni watched selected programs including "The Electric Field," "The Lorentz Transformation," "Velocity and Time," and "Resonance."

Alumni enjoyed the scale models of Voyager and Galileo spacecraft that were part of a JPL exhibit. A scale model of the W. M. Keck Observatory, under construction on Mauna Kea, Hawaii, arrived at 11 a.m. and was rapidly assembled by Alumni Association staff for viewing.

Alumni packed the Distinguished Alumni session to see five of their fellow graduates honored. "Being in-

volved with Caltech is like being attached to a silver string. When you leave, the string keeps pulling you back," said distinguished alumnus Eugene Shoemaker, formerly Caltech professor of geology who is now with USGS in Flagstaff.

Visits to student houses at lunch time met with varying responses—from highly successful mixers to gatherings of alumni with virtually no students, and clusters of students

with virtually no alumni. For the visitors who chose to eat on the Olive Walk, the Caltech Brass Quintet provided entertainment.

Several high school students who have been admitted to next year's freshman class came to Seminar Day, some of them bringing friends, in the hopes of broadening their perspective on what the Institute is all about.

The bookstore was open for several hours and drew throngs of customers, although several alumni protested that they didn't have enough time to browse there.

At the end of the day's program, alumni flocked to a wine and cheese reception at the Alumni House, on to dinner at the Athenaeum, and then to the annual Glee Club concert in Beckman Auditorium.

Several alumni complained because no chocolate doughnuts were served during the morning. But more typical was the remark that "this was one of the best series of alumni lectures in years."

Another even more exuberant alum commented, "This was excellent! A first-rate show!" And with that, he summed up the feelings of most of his fellow adventurers for the day.



Caltech conferred its highest honor—the Distinguished Alumni Award—on five graduates at Seminar Day on May 17. Recognized were the prime minister of Iceland, Steingrímur Hermannsson; a professor of chemistry, Martin Karplus; an Indian aerospace engineer, Roddam Narasimha; a former Caltech division chairman and professor of geology, Eugene Shoemaker; and an Oregon businessman, Douglas Strain.

Distinguished Alumni Awards were first presented in 1966 and have been given annually on Seminar Day since then. This year's recipients bring to 91 the number of graduates who have been so honored.

Steingrímur Hermannsson (MS '52), the prime minister of Iceland, worked as an engineer both in Iceland and the United States before beginning a career that led to his present role.

He was elected to parliament in 1971, and served as minister of justice and ecclesiastical affairs, minister of agriculture, minister of fisheries, and minister of communications before becoming prime minister. From 1957 to 1978 he was director of the National Research Council of Iceland. He was elected secretary of the Progressive Party in 1971 and became party chairman in 1979.



Distinguished Alumni honorees with Marvin L. Goldberger, from left: Martin Karplus, Steingrímur Hermannsson, Dr. Goldberger, Eugene Shoemaker, and Douglas Strain. Roddam Narasimha was not present for the award ceremony.

Martin Karplus (PhD '54) is the Theodore William Richards Professor at Harvard. In his research he has been a pioneer in several areas of chemistry. Two have involved the development of theoretical methods for simulating biological macromolecules, and work in classical trajectory calculations and their use in interpreting modern experiments on chemical dynamics. Recently he has focused on studies of molecules important in living systems.

His work has formed the foundation for a number of other groups who are using methodologies that he developed to predict the principles and behavior of biological molecules. A potential spinoff of such studies would be a new approach to the design of drugs that would have fewer side effects.

Roddam Narasimha is director of the National Aeronautical Laboratory of India and professor of aerospace engineering at the Centre for

Atmospheric Sciences of the Indian Institute of Science.

Narasimha is internationally known for his turbulence research and his work in geophysical fluid dynamics and the atmospheric sciences. He is now at Caltech as the Clark B. Millikan Visiting Professor and in 1982-83, he was at the Institute as a Sherman Fairchild Distinguished Scholar. An honorary fellow of the Aeronautical Society of India, he has received many honors for his work.

Eugene Shoemaker (BS '47, MS '48) is a geologist with the U.S. Geological Survey in Flagstaff, Arizona. He was professor of geology at Caltech from 1969 to 1985, and division chairman from 1969 to 1972.

He has been a leading figure in the development of lunar and planetary science for more than 25 years, and he initiated important work on paleomagnetic stratigraphy, planet-crossing asteroids, and continental deep crust drilling. His mapping of the Meteor Crater in Arizona is generally considered the finest piece of work to be done on such a feature.

From Ranger to Voyager, he has been an active participant in lunar and planetary exploration. His many

*Continued on page 11*



## Gell-Mann: are superstrings key to unified field theory?

By Heidi Aspaturian

Superstring theory is a "fantastically promising" candidate for the long-sought unified field theory, but only observation and experiment can ultimately validate it, theoretical physicist Murray Gell-Mann told Caltech alumni in the Seminar Day keynote address "Is Everything in the Universe Composed of Superstrings?"

Superstrings were developed at Caltech during the last 15 years by professor of theoretical physics John Schwarz and three principal European collaborators. Although strongly endorsed by Gell-Mann and a few others, their work went almost unnoticed by the larger physics community until 1983, when superstrings suddenly emerged as leading contender for a universal fundamental theory, with implications for everything from the nature of the cosmos in the earliest moments of its expansion to the annihilation of protons and anti-protons in particle accelerators.

Elementary particle theory originated in the physics revolution of the 1920s, which established quantum mechanics and relativity as the guiding principles of modern physics. Together with causality—the axiom that a cause precedes an effect—they form the basis of quantum field theory, which attributes nature's four known fundamental forces (electromagnetism, gravity, and the strong and weak nuclear forces) to the activity of force-carrying particles called quanta.

In its earliest version (Neveu and Schwarz, 1971), superstring theory was invented to describe just the nuclear particles (such as neutrons and protons) and the strong nuclear force, which binds the atomic nucleus. It was a model of self-consistency but it failed to describe these nuclear phenomena correctly. In particular, it predicted a neutral particle, always traveling with the velocity of light, that had no counterpart among the nuclear particles. Besides, the theory of quantum chromodynamics (QCD) was introduced around that time (by Gell-Mann, among others), and it is now generally accepted as the correct theory of the strong force and the nuclear particles.

"In 1974, studying superstring theory more closely," said Gell-Mann, "Schwarz and the late Joel

Scherk found that it contained a quantum version of Einsteinian gravitation (based on general relativity) as



*Is everything in the universe made of superstrings? Murray Gell-Mann probes this question in the Seminar Day keynote address.*



an approximation, and that the mysterious predicted particle was none other than the graviton, the quantum that carries the gravitational force. They then reached the startling conclusion that they were dealing with a possible unified field theory of all the elementary particles and all the forces of nature."

Superstrings seems to offer a solution to the long-standing mystery of why quantum field theory requires the existence of so many fundamental particles. "The word 'string' appears in the theory's name," Gell-Mann said, "because the particles are described not as mathematical points (as in usual quantum field theory),

but as tiny ( $10^{-33}$ cm) loops of 'string.' Analyzing such a string into modes, like a violin or piano string with its harmonics, we get the equivalent of an infinite number of point particles. Thus in superstring theory, the number of particles is infinite. But they are described by a single elegant 'master equation'."

The name superstrings contains the prefix "super," Gell-Mann added, because the theory possesses a broken symmetry called "supersymmetry" between the two basic classes of subatomic particles, one containing the quanta and the other containing such particles as the electron. According to the theory, for each particle of one class, there must be a new, so far unobserved, heavier particle of the other class. If the symmetry were not broken, the corresponding particles of the two classes would have equal masses.

The most remarkable feature of superstrings, Gell-Mann told the alumni, is that it only works in a universe that has ten dimensions—nine of space and one of time—rather

than four. The six additional dimensions, each no larger than a "string," are described as collapsed or condensed into a tiny structure at every point in spacetime.

"We can get some idea of these extra spatial dimensions," he said, "by imagining that we are all 'Flatlanders' with only two dimensions, and that one day some flat savant announces to us that he has good news and bad news. The good news is that we all have a new dimension, called height, that we never knew about before. The bad news is that no Flatlander and no place in Flatland has a height greater than around  $10^{-33}$ cm."

Superstrings began to attract wide-

spread attention as a mathematically consistent approach to unified field theory in 1983 when Schwarz and Michael Green of the University of London demonstrated that it had the unique property of being entirely free of infinities—which had plagued all previous attempts to reconcile quantum mechanics with general relativity. In the following year, they discovered that unlike all previous field theories, which could be described by systems of any number of particle symmetries, superstrings are structurally limited to only two such systems, with 496 symmetries each, a figure that has important implications for the number of elementary particles that have low enough masses to be observed.

In conclusion, Gell-Mann emphasized that no matter how appealing superstring theory is, it must be tested by solving its equations in some good approximation, extracting predictions, and comparing those predictions with the vast body of information already available about the elementary particles, as well as with the results of new experiments. "In our science," he said, "no amount of eloquence can save a wrong theory."

## Distinguished alumni

*Continued from page 10*

students have known him as a stimulating, inspirational teacher.

Shoemaker has received three medals, four awards, and several honorary doctorates—among them, the Day Medal of the Geological Society of America.

Douglas Strain (BS '44) is vice chairman of the board of directors of Electro Scientific Industries, Inc., a manufacturer of precision instrumentation and laser fabrication systems. He founded the company in 1953.

He has long been an advocate of management practices that emphasize identifying employee relationships and meeting employee needs. These practices have given his firm a reputation as one of the most successfully run companies in Oregon.

He has received 16 awards for his professional and community accomplishments—among them, the Pacific University Service Award, the Lutheran Family Service Award, and the Instrument Society of America Honorary Member Award. Among his memberships are those on the Board of Overseers of the Oregon Health Sciences University and the state of Oregon Governor's Advisory Council.



By Winifred Veronda

Can Ricketts House students and alumni find happiness climbing Mount Lowe together on a hot smoggy day? Or sharing binoculars for a 3 a.m. look at Halley's Comet from their high desert camp site? Or making grand slams as partners in a bridge tournament?

The answer seems to be a resounding "yes," as Ricketts House alumni from the '30s to the '80s have mixed and mingled over the past year with Ricketts House students in a series of activities sponsored by the Alumni Association Student-Faculty-Alumni Relations Committee.

The committee's goal, according to chairman Rhonda MacDonald (BS '74) is, as its name would imply, to increase both professional and social contacts among Caltech students, alumni, and faculty. Socially, one major thrust has been a project to involve students and alumni in activities on the basis of house membership.

Ricketts House was selected as the pilot house for the house project

students; 25 alumni and 15 students had to be turned away.

Meanwhile, both alumni and students have broadened their breadth of information and experience. Alumni have learned how to play "four-square," a form of ball popular in Ricketts that combines features of kickball and volleyball, and students have learned about brakedrum riots and the history of the Millikan pot. The latter still sits in the Ricketts courtyard, its history partially forgotten.

"The students have a strong sense of history," says Workman. "They're interested in the way things used to be, in the pranks we pulled, in how hard or easy the workload was for us, and in whether we had fun. We've shared a lot of war stories with them."

Noting that students no longer dress for dinner, Tom Trilling (BS '55) stirred interest by modeling his Ricketts House dinner jacket—not the one he wore to dinner every evening that long ago disintegrated, but the spare one that he saved for special occasions.

In a more pedestrian but practical vein, students have gained insights

Blacker and Page. Chairman MacDonald asks that any alumnus who is interested in taking part in one of these groups (or in still-to-be-formed groups pairing students and alumni in the other houses) contact Alumni Association staff member Karen Natwick at 1-97, Pasadena, CA 91125, or call (818) 356-6593.

MacDonald hopes that, through friendships such as the house program is creating, there will evolve tangible benefits for students: con-



Rhonda McDonald and her committee members seek ways to strengthen ties between alumni of the student houses and current house members.

## Class of 1936 recalls \$100 tuition, 5-cent gasoline

Tuition was \$100 a semester when the class of 1936 enrolled at Caltech—but the country was in the depths of the great depression and a \$100 tuition bill could pose a formidable challenge. Gasoline sold for 5 cents a gallon for students fortunate enough to own Fords; others walked or took the streetcar.

Engineers dominated the class, as 26 of its 120 members graduated with options in mechanical engineering and 23 in electrical engineering, for example, compared with the six who chose chemistry, the five who picked biology, the one who opted for applied physics, and the one who majored in math.

Graduates found jobs paying \$110 and \$115 a month (one lucky individual was hired for \$125). Those were some of the recollections of Victor Veysey (BS '36), master of ceremonies at the Half Century Club reunion where 48 members of the class came back to reminisce and update themselves on what's happening at Caltech today.

Veysey, who noted that he was chosen master of ceremonies because he was president of the senior class of 1936, said that election to that particular office "seemed to set up a pattern that's irreversible."

President Marvin L. Goldberger welcomed the class and told its members that, in its fundamentals, Caltech has not changed, and will not. "A *Time* magazine reporter recently asked me why Caltech is so unusual," he said. "I told him our only object is to be the very best. That's all we will accept."

The Half Century Club luncheon was only one of approximately a dozen events during a vigorous four-day 1936 class reunion that may go on record as the most intensive 50-year convocation ever held by a Caltech class.

Dinner at the Athenaeum on Thursday, with Mr. and Mrs. Hugh Colvin (BS '36) as hosts at cocktail hour, launched the weekend celebration. On Friday, after breakfast at the Alumni House, the reunion class heard presentations by Leroy Hood, chairman of the Division of Biology, and Edward Stone, chairman of the Division of Physics, Mathematics and Astronomy. The group toured the campus that morning, and after

## Ricketts House alumni, students explore friendship ties

(largely because several Ricketts House alumni are members of the committee), and a bridge tournament involving alumni and students was organized in the spring of 1985 as the first activity.

Since the committee had never run a bridge tournament, the campus Bridge Club stepped in to help. Eleven alumni came to play (John Nairn, BS '56, was the champion) and several other alumni joined the group afterward for barbecue. According to James Workman (BS '57, MS '58), the tournament was a very relaxed event—not at all cutthroat, as bridge tournaments can be.

A walk up Mount Lowe on a hot October day drew out about 30 alumni and students, as the group hiked up a steep mountainside following part of the old Mount Lowe Railway. Among the alumni contingent were several well-toned hikers who set the pace up the trail, according to Doug Rothnie (BS '75).

A gathering during winter term for an on-campus video viewing of the Voyager-Uranus encounter, drew 20 alumni. Barbecue at the house concluded the event. Most ambitious of all was a two-day camping trip in April to Joshua Tree National Monument to see Halley's Comet. The trip could accommodate 35 alumni and 35

into the value of a Caltech education in the marketplace, and what several major corporations, for whom the alumni have worked, have to offer as potential employers.

They've also been offered bits of practical wisdom. "I tell the students that computers are wonderful but that people need to look beyond computer results in making decisions," says Millard Barton (BS '32). "I tell them to check the results by what the seat of their pants tell them, and to ask whether the computer conclusions make sense or not."

Alumni, meanwhile, have enjoyed a firsthand perspective on student life in the mid 1980s. ("There's one vast improvement in the house since I was a student," says Barton. "Today there are women members.")

"Caltech is such a small institution that there's an instant bond between everyone who's ever been a student here," says Trilling.

Workman concurs. "The experience of being—or having been—at Caltech is always a common ground for friendship," he says. "And of course, through our connection to science and technology, students and alumni share a lot of interests. This is why events like Halley's Comet and the spacecraft flyby became the basis for activities."

The Ricketts House "pilot project" having proved successful, similar groups are being organized for

tacts helpful to future careers, for example, or invitations to homes, or off-campus trips to the beach or the desert.

("I took a group of students to the Getty Museum," she says, and I was surprised at how many of them had never been to Venice, or Malibu, or Santa Monica.")

By making students familiar with the Alumni Association, the project may also bring more young alumni into the organization.

The committee has also been active in ways to involve alumni and students on a non-house basis. This year Sports Day—traditionally for students and faculty—was also opened to alumni, and, during lunch break on Seminar Day, alumni visits to the student houses were arranged.

In the professional arena, the committee is organizing a "Day on the Job" program, which will solicit invitations from alumni to students to spend a day at their companies. Here the students can get a feeling for the daily work life of a scientist or engineer.

Additionally, the association is seeking help from alumni who may be able to offer Caltech students summer jobs with their companies. Persons with positions available are asked to contact Karen Natwick at the address or telephone number given above with a list of possible openings.



lunch, toured JPL.

That evening they had a barbecue at the home of Mr. and Mrs. John Waddell (BS '36), and on Saturday, before the Half Century Club luncheon, heard research presentations by SURF (Summer Undergraduate Research Fellowship) students. After lunch, they heard a talk by Paul MacCready, known for his Gossamer Condor that made the first sustained, controlled human-powered flight. MacCready (MS '48, PhD '52), who has created a prototype replica of the giant prehistoric flying reptile, spoke on "From the Gossamer Condor to the Pterodactyl."

The class held its reunion dinner that evening at the Pasadena Hilton, and concluded its round of festivities with a champagne brunch at the Annandale Country Club as guests of Mr. and Mrs. Richard L. Hayman (Ex '36).

Recognition for traveling the longest distance was given Hisayuki Kurihara (BS '36, MS '37, MS '38) from Tokyo, and Chao Ying Meng (PhD '36) from Peking, who took advantage of the occasion to visit his grandson, Wen J. Meng, a Caltech graduate student in applied physics.

Forty members of classes graduating more than 50 years ago joined the class of 1936 at the Half Century Club luncheon. Members of the class of 1926 and the class of 1931 joined ranks for a reunion dinner the evening before the luncheon. Robert Allen of the class of 1916 was honored as the oldest alumnus present at the Half Century Club.

After the luncheon, class representatives presented reunion gifts to the Institute. The class of 1936 gave more than \$40,000, to be used for the creation of a series of portraits of Caltech leaders that will be hung on campus. Hugh Colvin, who made the presentation, noted that total class giving to the Institute during the academic year amounted to approximately \$420,000.

Sam Eastman of the class of 1932 presented a gift of \$29,951 to the Institute from the class of 1931, and Ted Coleman, representing the class of 1926, gave a check for \$15,175. Coleman also noted that The Friends of Caltech Libraries (FOCAL) are dedicating three new books in the library to the reunion classes, with a commemorative plaque for each.

Other classes that graduated five years ago, and at five-year intervals before that, came back to campus to reminisce—and to be brought up to date on news of the Institute. Their programs included campus tours, and social hours and dinner in the Athenaeum—except for the class of 1981, which opted for a picnic in the backyard of the Alumni House. Each of the classes participated in a reunion gift for the Institute.

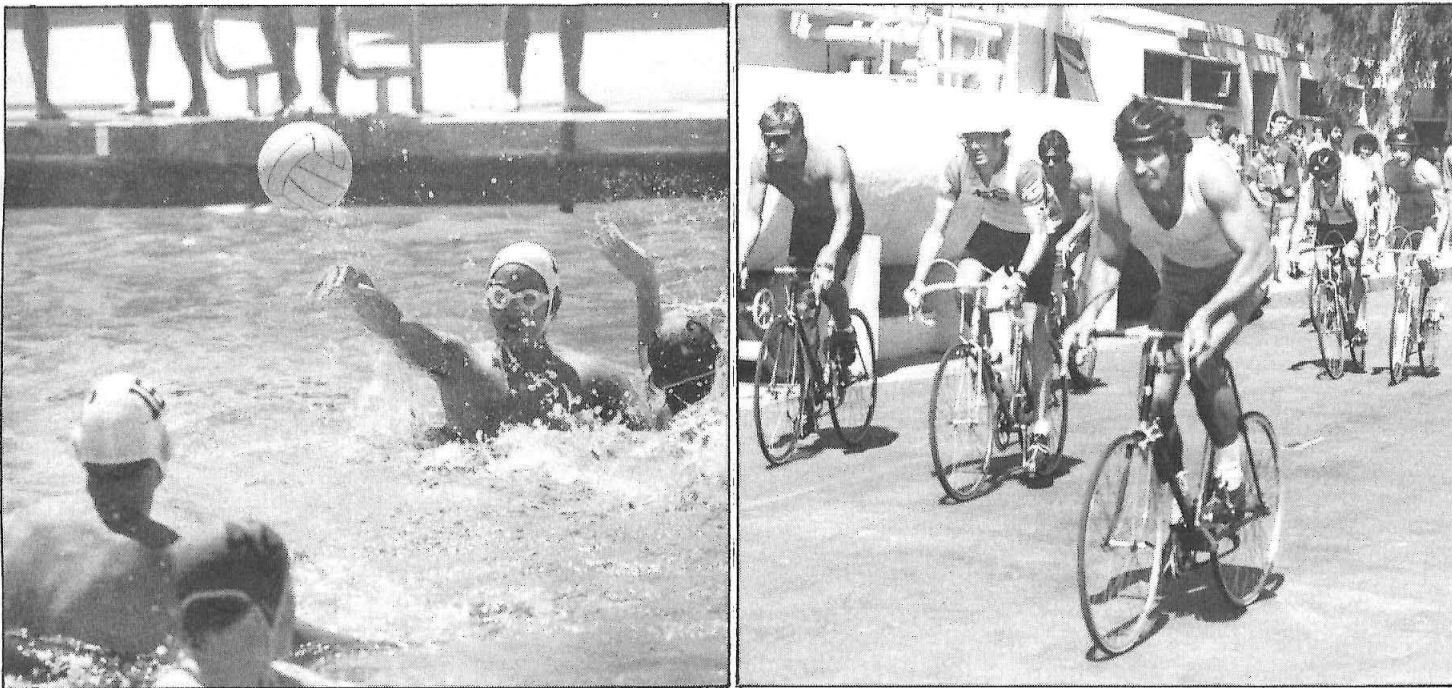
## Reunions bring old friends together



Chao Ying Meng from Peking with William A. Fowler at the Half Century Club luncheon, at upper left. Upper right: A guest at the reunion dinner for classes of 1926-1931 locates himself in an old photograph. Center left: Vito Vanoni greets friends at the 1926-1931 dinner. Center right: A new member of the Half Century Club reflects on his certificate of membership. Lower left: Former classmates reminisce at the 25-year reunion of the class of 1961. Lower right: The 1961 Big T claims attention at the 25-year reunion dinner.



## Sports Day attracts students, faculty, alumni



Annual Sports Day contests pitted alumni and faculty against students in tests of sports skill. Alumni were invited to join in the annual event this year for the first time, and about 100 came to the campus to test their prowess in games ranging from tennis to tug of war. Left: Innertube water polo attracts spirited competitors. According to rules of the game, doughnuts were to be consumed during play. Right: Triathlon participants speed up their pace.

## Fred Shair, David Smith: honorary alumni

The Caltech Alumni Association welcomed two faculty members as honorary alumni at its annual dinner on June 19.

Fredrick H. Shair, professor of chemical engineering and chairman of the Summer Undergraduate Research Fellowship (SURF) administrative committee, and David R. Smith, professor of literature, and master of student houses from 1969 to 1975, were honored for their contributions to students and campus life, and to academic programs at the Institute.

Elected as officers for 1986-87 were Paul H. Winter (BS '44), president; David J. D. Harper (MS '77), vice president; Charles H. Holland, Jr. (BS '64), treasurer; and Rhonda L. MacDonald (BS '74), secretary.

New directors elected at the meeting were Edward L. Krehbiel (BS '58), chapter representative; William M. Pence (BS '65, MS '67); Lynette D. Schneider (BS '81); Gary W. Stupian (BS '61); Victor V. Veysey (BS '36); and Donna Mae Wolff (BS '77).

## Two seniors receive Donald Clark awards

Two Caltech seniors are recipients of Donald S. Clark awards for outstanding leadership and scholarship. They are Randy Brown and Pamela

Feldman, both of whom are majoring in electrical engineering.

Brown has been a member of the swimming and men's water polo teams, and coach of the women's water polo team. He was Fleming House social chairman, and is a member of the Caltech-Occidental College orchestra.

Feldman is treasurer of the Society of Women Engineers student chapter and a member of the women's tennis and water polo teams, and has served as both chairman and secretary of the Board of Control, which has responsibility for Caltech's honor system.

Clark Awards were established by the Alumni Association and are given annually to two Caltech students, with preference to those in engineering. They are in memory of the late Donald S. Clark, who was associated with the Institute for more than 50 years as a student, faculty member, and secretary of the Alumni Association.

## Seminar Day: can it meet broader campus needs?

The Alumni Association is taking a thorough look at how Seminar Day may help to meet the needs of other departments on campus.

Edward M. Boughton (BS '55) is the chairman of an ad hoc committee to explore this area with selected department directors. The first meeting was with Ted Hurwitz, vice president for Institute relations. Committee

members also plan to meet with representatives of The Associates, the undergraduate admissions office, and the Alumni Fund.

Boughton stressed that any changes made in the Seminar Day format in response to the meetings will be modest ones. "We conducted a poll a year ago to learn whether people wanted any changes in the traditional format," said Boughton, "and everyone's reaction was, 'don't tamper with it. We like it the way it is'."

Members of the committee, in addition to Boughton, are Gary Stupian (BS '61), Donald P. Wilkinson (BS '48), Charles H. Holland, Jr. (BS '64), Leval Lund, Jr. (BS '47), and Joseph A. Dobrowolski (BS '49).

## Second Zion - Cedar Breaks trip scheduled

The response to the Alumni Association's first offer of an alumni trip to the Zion-Cedar Breaks area of southern Utah was so overwhelming that a second trip has been scheduled for October 13-18, 1986. A few spaces for this trip are open. The cost is \$650 per person, double occupancy, and \$750 per person, single occupancy. If you wish to join other alumni in experiencing the fall majesty of southern Utah, guided by Robert P. Sharp (the Sharp Professor of Geology, Emeritus), please call Janet Davis at the alumni office, (818) 356-6594.

## Personals

### 1914

VIRGIL F. MORSE, Caltech's oldest alumnus, celebrated his hundredth birthday with friends and family on March 27 at Granada Hills Convalescent Hospital where he and his wife, Stella, have lived for the past six years. He taught mathematics at Occidental College for 13 years before working in the Los Angeles City Engineer's division. The Morses, who have been married for 71 years, have 13 grandchildren and 16 great-grandchildren.

### 1930

H. RICHARD CRANE, PhD '34, professor of physics, emeritus, at the University of Michigan was awarded the National Medal of Science in March for his work in nuclear physics. His research areas include measuring the spin of free electrons and positrons, accelerator design, atomic structure, biophysics, radio-carbon dating, and geomagnetism. Among his many activities, he has served as a member of the policy advisory committee of Argonne National Laboratory and chairman of the board of governors of the American Institute of Physics. He has received many honors, including the Davisson-Germet Prize from the American Physical Society, the Distinguished Service Award from the University of Michigan, and Caltech's Distinguished Alumnus Award.

### 1935

ADRIAN H. GORDON, MS '36, recently received his PhD in earth sciences from The Flinders University of South Australia.

### 1939

EDGAR L. ARMI, MS, PhD '41, and his wife, Erita, celebrated their 50th wedding anniversary in January, at a party hosted by their sons. The couple live in Pasadena where Armi is retired from Hughes Aircraft.

CHARLES TOWNES, PhD, was a speaker at the first Oregon Nobel Laureate Symposium, at Linfield College in February. He joined three other Nobel laureates at what is to become an annual event. Townes was awarded the Nobel Prize for Physics in 1964. He has been University Professor of Physics at UC Berkeley since 1967. His current research is in astrophysics.

### 1941

GRICE AXTMAN was honored recently by friends and associates for his eight years of service as executive manager of the South Pasadena Chamber of Commerce. To commemorate his retirement, he was given a plaque from the Chamber, a certificate of appreciation from the city, and a congressional proclamation. Before joining the chamber in 1978, he worked in the engineering field for almost 20 years and as a management consultant for numerous universities and non-profit organizations for more than 25 years.

RALPH W. SPITZER, PhD, of British Columbia, has been elected to senior membership in the Canadian Medical Association. He is currently the chemical pathologist at Royal Columbian Hospital and clinical professor at the University of British Columbia. He has written many publications and is a member of the Academy of Clinical Scientists and Physicians and is a Fellow of the Royal College of Pathologists.



1948

DAVID E. METZLER, professor of biochemistry and biophysics at Iowa State University has been named a Distinguished Professor in Sciences and Humanities, the university's highest faculty honor. His research involves studies of the chemical basis for the action of vitamins and coenzymes and the study of inhibitors. Before joining the Iowa State faculty in 1953, he was a research scientist with the Biochemical Institute at the University of Texas. His book, *The Chemical Reactions of Living Cells*, is considered a standard textbook and has been translated into several foreign languages.

T. A. WILSON, MS, has retired as chief executive officer of the Boeing Co. but will continue as chairman of the board, a position he has held since 1972. Wilson was named president of Boeing in 1968 and served in that capacity until last year.

ROBERT L. WINCHESTER writes, "I retired at the end of last year after 37½ years with General Electric Co.—most of it in the steam turbine-generator business. My last job was manager-generator advance engineering. My wife and I plan to remain in the Schenectady area—but will be spending a lot of time at our newly built (all-year-around) camp in the central Adirondack mountains."

1949

DICK BOERA, MS, is dean of business affairs at Lyndon State College in Vermont. He joined the faculty there in 1971 after serving as business manager of Staten Island Community College.

1950

GEORGE E. SOLOMON, MS, PhD '53, has received the 1986 Robert H. Goddard Astronautics Award of the American Institute of Aeronautics and Astronautics for his "outstanding contributions to aeronautics and astronautics programs and reentry system development." He is an executive vice president and general manager of TRW Electronics and Defense Sector in Redondo Beach. He directed functional engineering management of Pioneer I, the first spacecraft to be built for NASA, and supervised the system design of the Pioneer interplanetary spacecraft and the VELA Nuclear Detection Satellite.

1955

ALLEN E. FUHS, MS, PhD '58, chairman of the Naval Postgraduate School's space systems academic group, was installed in May as president of the American Institute of Aeronautics and Astronautics. A member since 1957, he will serve a one-year term. He joined the NPS faculty in 1966 as chairman of the mechanical engineering and aeronautical engineering departments and was named distinguished professor in 1974. His research covers jet propulsion, gas dynamics, laser technology and combustion and re-entry physics.

1956

RICHARD A. JOHNSON, MS '60, an employee of Rockwell International since 1960, has been named director of site strategic planning for Rockwell Hanford Operations. He will be responsible for integrating strategies and for immediate and long-range planning of Hanford projects.

1958

LLOYD R. WELCH, PhD, USC professor of engineering, has been elected a Fellow of the IEEE for his "outstanding contributions to techniques for encoding, decoding and synchronizing digital information, for generating binary signals and for obtaining

important theoretical bounds on their performance." He joined the USC faculty as a visiting associate professor in 1965 and became full professor in 1968. He has also acted as a consultant to the Institute for Defense Analysis and for Cyclotomics. He is a member of the National Academy of Engineering.

1959

ANTHONY J. IORILLO, MS '60, has been elected vice president of Hughes Aircraft Company in Los Angeles and group president of the company's Space and Communications Group. A 26-year employee at Hughes, he will oversee a 10,000-employee organization responsible for the development and production of communications satellites and other space vehicles, spacecraft instrumentation, earth terminals, and terrestrial communications equipment. In his new capacity, he also becomes a member of the Hughes policy board and management executive committee.

1961

DONALD E. FAHNLIN, associate professor of physics at the Altoona campus of the University of Pennsylvania, has received the 1986 Christian R. and Mary F. Lindback Award for Distinguished Teaching. The \$1,000 prize is given annually to faculty members whose primary teaching responsibilities are with undergraduate students. In his classes, he captures students' attention with unusual demonstrations illustrating physics principles. He is involved in research in theoretical physics and has published many papers in research and educational journals. He has twice won first place in the Apparatus Competition of the American Association of Physics teachers.

1965

JAMES J. DUDERSTADT, MS '65, PhD '68, has been named provost and vice president for academic affairs at the University of Michigan where he has been dean of U-M's College of Engineering since 1981, and professor of nuclear engineering since 1976. He serves on the National Science Board and on the executive board of the National Engineering Deans' Council.

STEPHEN A. ROSS, the Adrian C. Israel Professor of International Trade and Finance and professor of economics, has been named Sterling Professor of Economics and Finance at Yale School of Management. He joined the Yale faculty in 1977 after serving on the faculty of the University of Pennsylvania. At Yale he has been the Edwin J. Beinecke Professor of Economics and Finance. He is also a partner in MRR, Inc., a consulting firm.

VIRGINIA TRIMBLE, MS, PhD '68, professor of physics at the University of California, Irvine, has received the NAS 1986 Prize for Scientific Reviewing.

1980

CYNTHIA FLANAGAN PLATENAK has completed a master's degree in chemistry at the University of California and is working on another at the University of Texas.

1981

WILLIAM L. OBRICHT, PhD, has been named associate professor of chemical engineering at Cornell University in New York. He is carrying out research on viscous fluid mechanics with applications to flow through porous media, and the motion of red blood cells in the microcirculation. He received an IBM faculty development award for 1984-1986.

## Obituaries

1918

KENNETH J. HARRISON, of Huntington Beach on January 27. He is survived by his wife, Margaret.

1924

REX SCRIPPS CLARK, Ex, of La Jolla, on April 17. He worked on the family-owned *Detroit News* until 1936. He was active in the National Multiple Sclerosis Society and the National Model Railroad Association. He is survived by a son and two grandchildren.

1925

C. G. McPROUD, of Lehigh Acres, Florida, on March 17. He began his career as an audio engineer for Paramount Pictures where he worked for 13 years. After the war, he joined *Audio Engineering* magazine (now *Audio*) and eventually became the editor, publisher, and part owner. After he retired in 1971, he started the Justimeter Corporation which manufactures and markets one of his inventions, an accessory for use with the IBM Executive typewriter. He was one of the founders of the Audio Engineering Society and was also a life member of the IEEE. He is survived by his wife, Helen, a son, and a daughter.

1927

THOMAS L. GOTTIER, of Laguna Hills, on April 28.

BORIS N. SAMMER, Ex, of Whittier, in May of 1985. He is survived by his wife.

1929

WILLIAM B. HINCKE, PhD, of Kingsport, Tennessee, on February 28. He is survived by a son and a daughter.

1930

JOHN WILLIAM TOWLER, of Hemet, California, on March 17. He is survived by his wife, Marian.

1931

CARL C. LINDEGREN, PhD, of St. Louis, Missouri, on January 19. He had retired as director of the biology research laboratory of Southern Illinois University in Carbondale, Illinois. He is survived by his wife, Zella.

1932

GRANT D. VENERABLE, whose obituary appeared in the June 1986 issue of *Caltech News*, is being honored by a memorial fund which has been established in his name at Caltech. Contributions may be sent to Caltech, in care of the Venerable Memorial Fund.

1934

ROBERT A. DIETRICH, MS '35, of Los Angeles, in April. He is survived by his wife, Betty.

1937

WILLIAM P. ELLERY, of Lompoc, California. He retired in 1982 from Elco, where he had been president. He is survived by his wife.

1939

JAMES RAINWATER of Hastings-on-Hudson, New York, on May 31. He shared the Nobel Prize in physics in 1975 for determining that the atomic nucleus is not always round but can also be egg-shaped. He began his work on the theory of the shape of the nucleus in 1949 at Columbia University where he became a professor of physics in 1952. He received the Ernest Orlando Lawrence Award for Physics in 1963 and was a

fellow of the American Physical Society, the Institute of Electrical and Electronic Engineers, the New York Academy of Sciences, and the AAAS.

PHILIP ERNEST SMITH, of Wilmette, Illinois, on March 6. He is survived by his wife, Betty.

1940

PARK H. MILLER, Jr., PhD, of La Jolla, on May 14, after a long illness. A renowned physicist in the field of conversion of heat to electricity, his most recent work was on fusion and research for the Strategic Defense Initiative. He began his career as professor of physics at the University of Pennsylvania in 1939 where he stayed until 1956 when he joined AC Technologies. He served as head of the physics department at U.S. International University in San Diego from 1969 to 1974. He started his own consulting company, Extragalactic Enterprises, in 1981. The holder of 17 patents, he was a fellow of the American Physical Society and the American Geophysical Union and one of the founders of the San Diego Hall of Science. He is survived by his wife, Patricia, two daughters, a son, a stepson, a stepdaughter, and ten grandchildren.

BERNARD M. TOBIN, MS '41, of Endicott, New York, on March 13, of cancer. He is survived by his wife.

1941

ROBERT E. FISHER, MS '42, of Tarzana, on April 18. He was the president of Amercom Inc., a high-tech materials development firm located in Chatsworth. He is survived by his wife. A memorial fund has been established in his name at Caltech. Contributions may be made to the Office of Memorial Funds.

1944

GREGORY ODD YOUNG, MS '47, of Sugarloaf, California, on March 22. He was a radar systems engineer for TRW in San Bernardino. He is survived by his wife.

1948

HARVEY H. LATSON, Jr., MS, of Cibola, Texas, on October 16, 1985.

1949

DANIEL T. FINKBEINER, II, PhD, of Gambier, Ohio, on March 28. He had retired as professor emeritus of mathematics at Kenyon College in Ohio in 1984; he had served as chairman of the department and professor of mathematics since 1956. He wrote several textbooks in linear algebra and was a member of many professional organizations, including the Mathematical Association of America. He is survived by his wife, Mary, and four daughters.

1956

DONALD JAMES HARNEY, MS, Eng '57, of Xenia, Ohio, in August, 1985. He was a self-employed aerospace engineer.

1961

J. ERIC NORDLANDER, PhD, of Cleveland, Ohio, on March 20, from cancer. He had been dean of the College of Arts and Sciences and professor of chemistry at Cleveland State University for 15 months until he resigned last year for health reasons. Prior to joining CSU, he was a professor of chemistry at Case Western Reserve University. A noted chemist, his research interests included mechanistic and synthetic chemistry. He was a Fulbright lecturer at the Rudjer Baskovic Institute in Zagreb, Yugoslavia, last May. He belonged to the American Chemical Society and the Chemical Society in London. He is survived by his wife, Ruth, a son, and a daughter.



# CALTECH NEWS

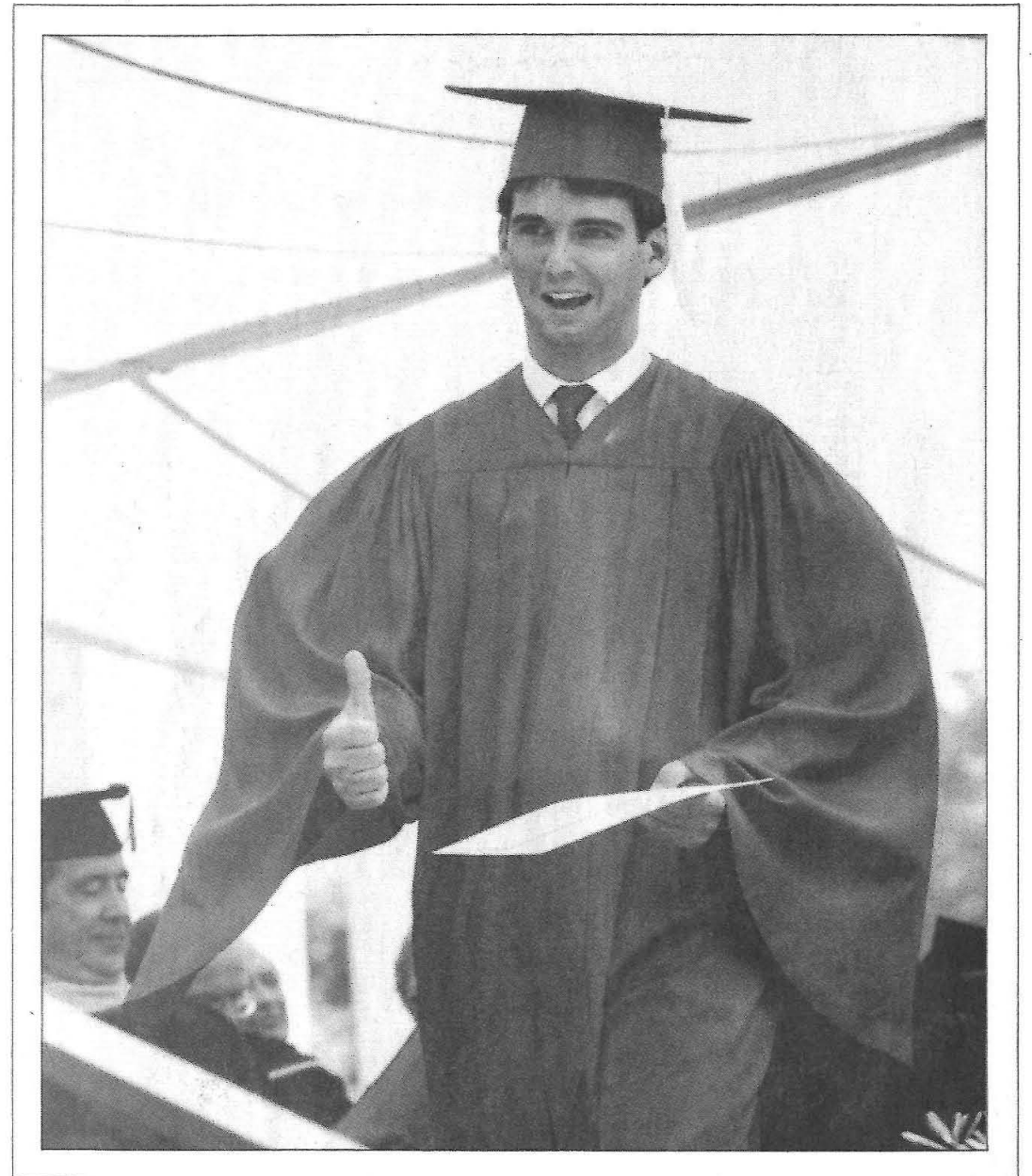


*Her car packed, Blacker House member Dawn Meekhof prepares to leave campus for summer vacation.*

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*Michael Graham celebrates his entry into Caltech alumni ranks.*

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