CALTECH NEWS

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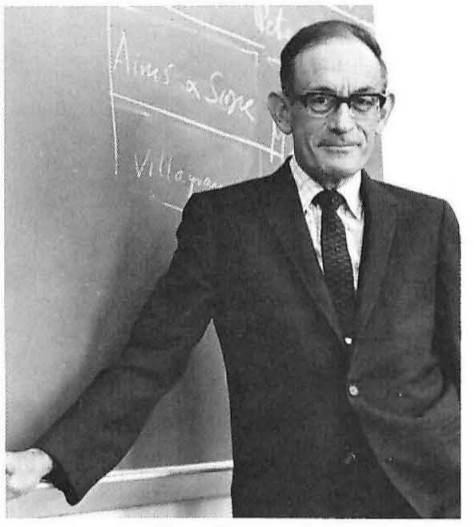
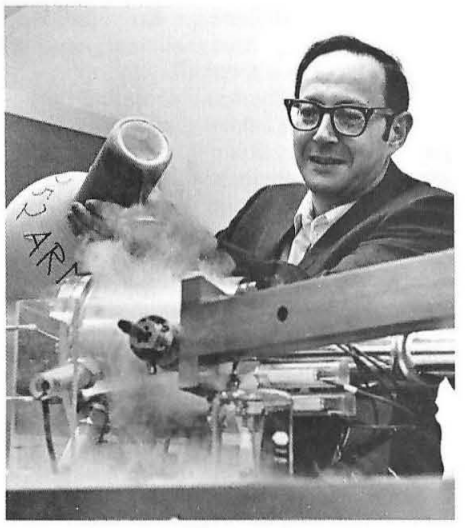
Harry Gray

Arie Haagen-Smit



Hans Liepmann



Gerald Wasserburg

Four Caltech men elected to NAS...

Four members of the Caltech faculty have been elected to the National Academy of Sciences in recognition of distinguished and continuing achievements in their chosen fields of research.

They are: Harry B. Gray, professor of chemistry; Arie J. Haagen-Smit, professor of bio-organic chemistry emeritus; Hans W. Liepmann, professor of aeronautics; and Gerald J. Wasserburg, professor of geology and geophysics.

The Academy, established in 1863 by an Act of Incorporation passed by Congress and signed by Abraham Lincoln, was set up to serve the federal government as an official adviser on matters of science and technology. At its annual meeting on April 27 in Washington, D.C., the Academy named 50 new members. The election of Gray, Haagen-Smit, Liepmann, and Wasserburg brings Institute faculty membership in the NAS to 39 and gives Caltech a higher percentage of Academy members in relation to the size of its faculty than any other institution.

Harry Gray, called "one of a very small number of genuinely creative chemistry teachers," by George Hammond, chairman of Caltech's division of chemistry and chemical engineering, has contributed to the understanding of the importance of iron atoms in living things. Gray is studying how iron binds and releases oxygen in blood, and how iron stores and transports proteins in humans. He is also studying the structural arrangement of simple compounds containing two or more iron atoms.

His other research interests have included studies of inorganic reaction mechanisms, the preparation and characterization of new inorganic substances and the interpretation of spectral and magnetic properties of transition metal complexes in terms of modern quantum mechanical theories of electronic structure.

Born in Woodburn, Kentucky, on November 14, 1935, Gray received his BS from Western Kentucky University in 1957 and his PhD from Northwestern University in 1960. He spent the next year at the University of Copenhagen as a National Science Foundation postdoctoral fellow, and in 1961 joined the Columbia University faculty as an assistant professor. By 1965, Gray was a full professor—youngest in the history of the university. He joined the Caltech faculty as a professor of chemistry in 1966.

Gray, who has published five books

Continued on page 3

...and three to NAE

Lester Lees, professor of environmental engineering and aeronautics; Roy W. Gould, professor of electrical engineering and physics; and Charles H. Elmendorf, alumnus and assistant vice president of engineering for the American Telephone and Telegraph Company, have been elected to the National Academy of Engineering.

Lester Lees

The Academy, established in 1964 as an outgrowth of the National Academy of Sciences, elects its members on the basis of outstanding contributions to engineering theory and practice, and for pioneering research in new and developing fields of technology.

Lees, who came to Caltech from Princeton University in 1953, is honored for his work in the field of supersonic and hypersonic phenomena. He has been involved in aeronautical research since his graduation from MIT in 1940 and is considered an authority in the fields of high-speed flight, the physics of gases, and combustion and kinetic theory. His work has included a study of the reentry problems experienced by space vehicle nose cones, and research on the possibility of identifying objects—by their characteristic wakes—that streak through the atmosphere at very high speeds.

He has served on the combined space science and technology panels of the President's Science Advisory Committee and the Lunar and Planetary Missions Advisory Board of NASA.

The emphasis of Lees' work has shifted in recent years, and he is now director of

Continued on page 2

Roy Gould

Charles Elmendorf

Development drive steams toward goal

Contributions to Caltech's five-year fund drive have now reached $57 million —80 percent of the campaign's revised goal of $70 million, according to President Harold Brown. The campaign ends in November 1972.

"It is a tribute to the combined efforts of Caltech's alumni, trustees, and friends that we are within $13 million of reaching our goal despite the setbacks in the economy and the widespread questioning of higher education and of the value of science and technology," Brown said.

Under the national chairmanship of Simon Ramo (PhD '36) and the general chairmanship of Arnold Beckman (PhD '28)—both Caltech trustees—the Science for Mankind campaign was launched in November 1967 to raise funds for three vital areas: physical facilities, endowment for faculty positions, and operating funds for programs in education and research.

Total alumni contributions in the three and a half years since Caltech began its campaign—including $5 million contributed by alumni who are trustees—

Continued on page 4

A new twist to particle physics—phenomenology

The physics division sponsored the first conference specifically devoted to phenomenology on March the 25th and 26th. You are alarmed, I can tell, but please don't give up here; reach not for your dictionary; make no vain efforts to pronounce phenomenology; I will come clean and explain all.

Science is noted for a competitive and helpful interaction between theorists (thinkers) and experimentalists (doers). Unfortunately in almost all developing sciences, the moving hand of time drives a widening wedge between theory and experiment. Thus theorists are fully occupied in the mathematical and philosophical intricacies of their latest ideas. Again, experimentalists must concentrate on the design of their apparatus to insure they will get the best possible results current technology will allow. Phenomenology seeks to unite these once close friends. It can suggest the most relevant experiments to be done to test the latest theories. This is especially important in these barren days of limited funds. Further, it can pinpoint unexpected experimental observations and so suggest areas where new theoretical ideas are needed. The basic tool of phenomenology is first the construction of simple models that embody important theoretical ideas and then the critical comparison of these models with all relevant experimental data. It is applicable in many sciences, but the Caltech conference was devoted to particle physics, an area where Caltech is noted for very strong experimental and theoretical groups.

Caltech Nobel laureate Murray Gell-Mann, Robert A. Millikan Professor of Theoretical Physics, opened the meeting on March 25. Attended by 200 physicists from all over the world, the program covered many aspects of the rapidly advancing field of particle physics. Notable theoretical talks included a report by Richard Feynman, Nobel laureate and Richard Chace Tolman Professor of Theoretical Physics at Caltech, on the quark model. Quarks continue to escape detection by experimental apparatus of amazing sensitivity, but Feynman showed that models that build the observed particles from these elusive constituents give startlingly good predictions. On the experimental side, we welcomed a notorious prodigal particle back into the fold. It was over five years ago that the physics world was shocked by experimental reports that the much loved A_2 meson was not simply one particle but really split into two. This result, inexplicable in the quark model, was refuted by three experimental groups who presented new data at the conference.

The conference was followed on March 29 and 30 by a smaller workshop organized jointly with the Lawrence Radiation Laboratory at Berkeley. At this aftershock, some 50 physicists discussed the best experiments to be performed at intermediate energies (less than five billion electron volts). Representatives from the accelerators at Berkeley, Stanford, Argonne, Brookhaven, Rutherford Laboratory (England), and CERN (Geneva) were exhorted by phenomenologists to improve their experimental programs. Bearded wonder Claud Lovelace, professor of physics at Rutgers, pungently declared that haphazard planning of experiments, "untouched by human brain," should be replaced by a program at least partly based on the phenomenological work reviewed at the two conferences. Such a sweeping change cannot occur overnight, but a useful consensus was reached on the importance of development work on polarized targets. In these, particle spins are all neatly aligned in the same direction and not, as in normal targets, like unto some cosmic chaos and randomly distributed in all directions. These targets were demonstrated phenomenologically to be of great utility in distinguishing the current rash of theoretical models.

Caltech hopes to set up a small group working in the phenomenology of particle physics. A proposal for funds for this has been submitted to the National Science Foundation. Rumor has it that this includes a request for a rotating department building which would travel continuously between the theoretical and experimental floors of the high energy physics laboratory at Caltech. Officials denied this but noted that phenomenologists would become healthy, wealthy, and wise by walking from floor to floor discussing physics with theoretical and experimental incumbents.

Geoffrey C. Fox, Robert Andrews Millikan Research Fellow in Theoretical Physics

Informal discussions with the Y's executive and associate directors, Wes Hershey and Jerry Glashagel (center right and left), play an important part in the Y's efforts to help students.

Caltech Y celebrates 55th year of service to campus community

The Caltech Y celebrated two anniversaries on April 15 when 200 friends of the Y attended a dinner party in the Athenaeum honoring the Y's 55th year on campus and Wesley Hershey's 25th year as its executive secretary.

Caltech's president Harold Brown was on hand to pay tribute to the Y's contributions to student life—both on and off campus—and to Hershey for his contributions as the Y's leader since 1946. Hershey responded with reminiscences of his early days at the Institute.

Since it was founded on April 16, 1916, the Caltech Y has undergone a succession of changes, both in the size of its membership and the nature of its program. Eleven students of Throop Polytechnic Institute originally set up the Y as an organization for welcoming new students, establishing a student employment bureau, and being a "religious influence among the fellows."

In the 1920's, the Y sponsored Bible study and discussions on world religions and on men and women's relations, organized the first Freshman Camp, and began publishing the freshman information booklet now known as the *little t*. In 1924 the Y advisory board—composed of faculty, local clergy, and Caltech alumni—recruited the Y's first full-time secretary, Charles Schweiso, who stayed at Caltech for 10 years. Wes Hershey took over the job in 1946, coming to the Institute from Yale University.

In the 1930's the Y's interests gradually shifted from structured Christian activities to wider humanitarian interests. After World War II the Y began working to blend the social and religious concerns of the thirties with the new prospects of scientific contributions to peacetime activities. More recently, through the Leaders of America program (made possible by a bequest from the late Robert A. Millikan), the Y has brought visitors of all political, religious, and educational backgrounds to campus each year; and it cooperates with many campus and community organizations to provide students with a wide range of experiences and opportunities for service and personal growth.

The Caltech Y doesn't fit the standard YMCA image: It doesn't have the traditional gym or swimming pool; it doesn't have rooms to rent or a summer camp for boys. It has women members. And its leadership includes people from widely different religious faiths and attitudes. But, unconventional or not, it is a major educational institution within the Caltech community.

Engineering academy elects three Caltech men

Continued from page 1

Caltech's newly organized Environmental Quality Laboratory.

Gould is recognized by the Academy for his contributions to microwave electronics and plasma physics. He is currently on leave from Caltech to head a $30-million research effort as assistant director of the Atomic Energy Commission for controlled thermonuclear research. He is looking for ways to control nuclear fusion to produce clean, unlimited power. Gould's most recent work at Caltech included research on fundamental aspects of waves, oscillations, and radiation in plasma, both on experimental and theoretical levels. His work in plasma physics has made a significant contribution toward harnessing nuclear fusion energy.

A Caltech graduate, Gould got his BS in 1949 and his PhD in physics in 1956. His MS, in engineering, is from Stanford.

Elmendorf, who got his BS in physics at Caltech in 1935 and his MS in electrical engineering here in 1936, was cited by the academy for contributions in creating high capacity communications systems.

After his graduation from Caltech, Elmendorf joined the Bell Telephone Laboratories as a member of its technical staff. In 1954 he was named a department head and later became assistant director, director, and finally associate executive director of transmission systems development at Bell Labs. He moved to AT&T in 1966.

Elmendorf and his family live in Madison, New Jersey.

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Caltech adds two new trustees

Caltech's board of trustees has elected two new members, bringing the board's membership to 44. The new trustees are R. Stanton Avery, founder, chairman, and chief executive officer of the Avery Products Corporation, and Lew R. Wasserman, president and chief executive officer of MCA, Inc.

Avery, who was recently named the California Manufacturer of the Year, started his company three years after graduation from Pomona College in 1932. Today his firm is the leading manufacturer of self-adhesive products, with 27 factories and sales operations in over 20 countries throughout the world.

A Pasadena resident for 35 years, Avery is active in southern California academic and cultural affairs. He is chairman of the Claremont University Center board of fellows, a trustee of the Claremont Graduate School, and a director of the Athenian School in Danville, Calif. He is a trustee of the Huntington Library and Art Gallery in San Marino, on the governing board of the Performing Arts Council of the Los Angeles Music Center, on the board of trustees of the Los Angeles County Museum of Art, and a director of the Los Angeles World Affairs Council.

Wasserman, who has been associated with Caltech through the President's Council, joined MCA in 1936 and was named president of the corporation 10 years later. MCA was founded in 1924 as a theatrical talent agency, but later gave up talent representation to enter motion picture production through its subsidiary Universal Pictures.

In addition to his business interests, Wasserman is chairman of the board of the Center Theatre Group of Los Angeles, a member of the board of governors of the Performing Arts Council of the Los Angeles Music Center, a member of the Radio Free Europe Committee, and a trustee of the John F. Kennedy Library in Boston, and the John F. Kennedy Center in Washington, D.C.

Exchange of ideas — *In addition to discussing first-year non-academic problems, faculty advisers from each division used the workshop to help freshmen select their majors.*

NAS picks four more Caltech men

Continued from page 1

and more than 100 scientific papers, is currently on the executive committee of the Division of Inorganic Chemistry of the American Chemical Society and associate editor of *Inorganica Chimica Acta.* Last year he received the ACS Award in Pure Chemistry, given to an outstanding young chemist doing fundamental research in pure chemistry.

Arie J. Haagen-Smit, who was just named professor of bio-organic chemistry emeritus at Caltech *(Caltech News* Vol. 5, No. 3), is honored by the Academy for his untiring efforts in the battle against air pollution. A pioneer in smog research, Haagen-Smit is credited with identifying the components of smog and the photochemical process by which it is produced. His earlier work dealt with the isolation of plant hormones and other active substances in plants and in analyzing their essential oils.

Now 70, Haagen-Smit will retire in June from the Caltech faculty and from his position as chairman of the California State Air Resources Board—a post he has held for three years. Born in Utrecht, Holland, he received his AB, AM, and PhD from the University there, and then became a member of its faculty. He lectured at Harvard in 1936 before joining Caltech's biology division the following year.

Hans W. Liepmann is recognized by the Academy for his achievements in the fields of aeronautics and fluid mechanics. A member of the Caltech faculty since 1939, Liepmann initially worked on laminar instability, transition, and turbulence, but during World War II turned to the study of problems with fast aircraft: shock wave boundary layer interaction, transonic flow, and skin friction in high speed flows. This work has had a considerable influence upon aircraft and rocket design and, in 1968, won Liepmann the Ludwig Prandtl Ring, the highest distinction given by the Deutsch Gesellschaft fur Luft-und Raumfahrt—the German Society for Aeronautics and Astronautics.

Liepmann's work in aerodynamics led him to develop graduate courses in gasdynamics and to collaborate with Anatol Roshko, Caltech professor of aeronautics, on *Elements of Gasdynamics,* and with A. E. Puckett on *Aerodynamics of a Compressible Fluid.*

His later research and teaching have explored the fields of aerodynamic noise, magnetofluidynamics, and rarefied gas flows, with an occasional return to the problems of turbulent flows. For the last two years Liepmann has focused upon the fluid mechanics of liquid Helium II.

Liepmann, 56, was born in Berlin and got his PhD in mathematics and physics at the University of Zurich in 1938. He remained there as a research fellow until 1939 and then joined Caltech's Guggenheim Aeronautics Laboratory where he worked under Theodore von Karman and, later, under Clark B. Millikan. In 1966 Liepmann was elected to the National Academy of Engineering and in 1969 he received the Worcester Reed Warner Medal of the American Society of Mechanical Engineers for his contributions in gasdynamics and turbulence. Liepmann serves on the National Space and Aeronautics Administration's research committee and is a member of Caltech's faculty board and the interdivisional committee on applied physics, of which he was named chairman last year.

Gerald Wasserburg's election to the academy comes in recognition of his outstanding contributions to geologic and geophysical knowledge through the application of physics and chemistry to the earth sciences. His major areas of research have been the determination of the time scale of the solar system, the establishment of dating methods using the decay products of long-lived radioactive isotopes, the study of geologic processes using nuclear and isotopic effects as a tracer in nature, and the application of thermodynamic methods to geological systems.

Wasserburg, professor of geology and geophysics, was one of three Caltech principal investigators for Apollo 11 lunar samples. He also served, with geology division chairman Eugene M. Shoemaker, as adviser to most of the preliminary studies of lunar material at NASA's Manned Spaceflight Center in Houston. At Caltech, Wasserburg and his colleagues designed an ultra-high-precision mass spectrometer system for lunar analysis, and some of the hand tools that were used to handle the rock samples returned from the moon. Through his studies of the samples, Wasserburg determined that the moon is 4.6 billion years old, and that the lava that flowed out on the surface of the Sea of Tranquillity is one billion years younger.

For his work in examining and dating lunar material, Wasserburg was given an Exceptional Scientific Achievement Award of the National Aeronautics and Space Administration in November 1969, and the 1970 Arthur L. Day Medal from the Geological Society of America, of which he is now a life fellow. He is also a fellow of the American Academy of Arts and Sciences and of the American Geophysical Union.

Wasserburg received his SB in physics in 1951 and his SM and PhD degrees in geology in 1952 and 1954—all from the University of Chicago. He served for a year as a research associate at the university's Enrico Fermi Institute for Nuclear Studies before coming to Caltech in 1955.

Frosh workshop

An analysis of the first year

by Peter Beckman

Peter Beckman is a freshman from Stockton, Calif., who participated in the freshman workshop as a group leader.

College life can and should be a rewarding experience, but all too often it is marred by problems in student adjustment. On April 10, the Caltech Y and the Deans' office sponsored a Freshman Orientation Workshop where frosh problems and their solutions were discussed.

I, like most freshmen, have had problems adjusting to life at Caltech. The transition from home to college is a large one, and many students are unprepared for it. Those who are unable to cope either leave or are forced into those "lives of quiet desperation" that kill the mind.

This is why I welcomed the chance to participate in the workshop. Not only could I discuss my own freshman experience and compare it to others, but I could learn about those problems that affect all frosh and maybe even help formulate solutions for them.

The workshop began with an informal snack of coffee and doughnuts for those 150 freshmen, upperclassmen, YMCA trolls, and profs who had, through true interest or subtle pushing, decided to forego their Saturday morning sleep to participate.

After the group leaders had gotten their assignments and gathered their flocks together, we broke into the morning discussion groups which consisted of five to eight frosh, an upperclass "recorder" who listed the major points of the discussion, and, in some groups, a member of the faculty.

Most of what we had to say concerned our personal problems and those things that we found wrong with Caltech. Occasionally, of course, this tended to give the conversation a one-sided view.

One group was joined by two high school seniors who had just received their admittance notices and wanted to look around Caltech before making their final decision on where to go. By the time the discussion was over the two were seriously reconsidering going to MIT.

My own group went over the lack of social life and the problem of frosh classes, especially the lack of proper placement procedures. These were shown to be common problems in the summaries that each group leader gave after the discussions had ended.

Basically, it was decided that a lot of the fault for the failure of social life lies with the student himself. He is unwilling or too apathetic to make a social life for himself; instead, he relies on others to create social programs which, as often as not, he doesn't use.

One word that was used a lot in this context was "isolated." Caltech itself is isolated from the community, and the students, in turn, seem to isolate themselves from those things which do not directly apply to schoolwork. Perhaps many Techers actually prefer this isolation which, in the words of one group leader, helps create "the paradox that makes Caltech a utopia and hell at the same time."

Courses came in for their share of expected criticism from the freshmen, as did the lack of effective freshman placement. I was happy to hear that the Humanities division has decided to accept advanced placement next year. It seems ridiculous for frosh—many of whom would qualify for advanced placement—to have to go through first-year survey courses in the humanities instead of being able to take more advanced courses that they would find far more interesting.

After a lunch of Stottlemeyer's sandwiches the workshop reconvened for student-teacher discussions. This is the time of year for freshmen to choose majors, so each option had a representative on hand to answer questions and explain what students can look forward to. Other groups were formed to discuss the future of freshman courses, undergraduate research, independent studies, learning through teaching, the draft, preparing for medical school, exchanging, interning, and leaving.

I especially enjoyed this session because it was the first time that I had been able to talk to members of the faculty on an informal basis. All the talk was open and casual, and no one was uptight about saying just what he thought.

How much was really accomplished at the workshop? Some participants were a little cynical about the results. One stated, "I've been to discussions like this before, and they usually led to nothing."

I'm a little more optimistic. At the very least we had a chance to review the past two terms and compare our experiences with others. We were able to discuss our feelings with faculty members in a way that hadn't been tried before—sitting in a circle on the grass.

More important, the workshop is being followed up. One group is working on an evaluation of all classes and teachers here, to let the students know which classes are worthwhile and let the faculty know what's wrong with the curriculum. Another group is forming to find ways of giving incoming frosh a better idea of what life at Caltech is really like. Their hopeful endpoint will be a publication for prospective freshmen by freshmen, about the Caltech experience.

While no one can be certain what the final results will be, it can at least be said that the workshop gave an impulse to those people who are not too apathetic to care about the future of this Institute.

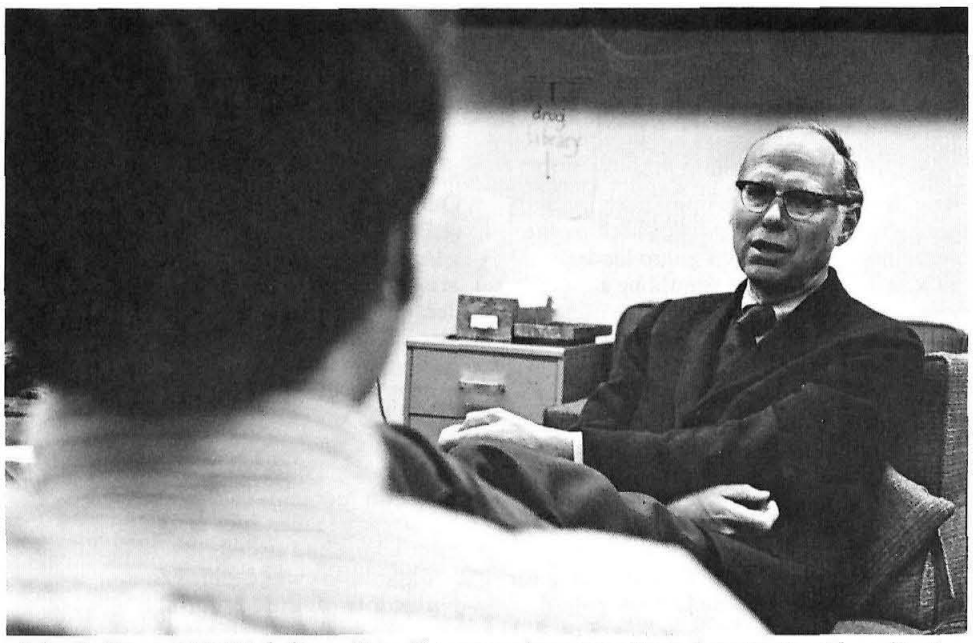
Steve Watkins

Steve Watkins elected new ASCIT president

Steve Watkins, a 21-year-old sophomore with a concern for environmental problems and what he calls a general decline in student motivation, is the new president of the Associated Students at Caltech. He succeeds Bob Fisher, a senior.

Watkins, a native of Kettering, Ohio, would be a junior but he took a leave of absence last year to travel around the United States. He came back with the decision to switch his major from electrical to environmental engineering.

Since his return, Watkins has supervised ecology studies and programs in Caltech's Saturday morning science program for high school students, and has helped several southern California high schools set up their own ecology programs. He will spend this summer as a National Science Foundation intern studying marine ecology under Wheeler North, professor of environmental engineering science, at the Kerckhoff Marine Laboratory in Corona Del Mar.



John R. Pierce, PhD '36, believes "it's all too easy for a scientist to lose touch with reality."

John Pierce: computer music and ideas for the real world

From the beginning, the seminar had an unusual flavor. It was a seminar on "20 Years of Computers and Music," held in an electrical engineering lecture hall, and attended by such diverse people as an applied math professor and a Nobel Prize-winning biology professor. The EE chef of this goulash was John R. Pierce, an executive director of Bell Laboratories and a Caltech alumnus. His seminar was one of the highpoints in Pierce's week-long (April 19-23) stay at Caltech. The visit was sponsored by the division of engineering and applied science, and also included opportunities for students to exchange ideas with Pierce at meetings arranged by the Caltech Y.

Pierce has been associated with the computer-music union from the start—in the late 1940's. At that time, it was felt that computers were simply mechanical men, able to do all the things that men could do. They could translate languages and construct words and sentences, given a few rules as guidelines. Clearly then, given a few instructions, a computer could use its ability to generate randomness and compose music.

The first attempts consisted of setting up a catalog of musical forms, picking a specific harmonic pattern, and then building a three-part song form by randomly choosing chords that fit the rules. Considering that Mozart had done almost the same thing with his dice music—musical forms that were selected by a roll of the dice—(and with much better results), it was decided that there must be another technique.

After many similar attempts at Bell and elsewhere around the country to use the computers to compose music, a new technique was developed in 1962 by James Tenney, an associate of Pierce's at Bell. Tenney would specify bounds and mean value of volume, pitch, and note duration as a function of time. The computer could then pick any value it wanted within those conditions. The computer was composing by random choice, but Tenney was directing the situation.

It was becoming obvious that the more a human was involved in composition, the better the work. But the computer was not totally disposed of. For, despite its inability to compose, it possessed great talent as a performer. When it was fed a sequence of numbers, it could form them into certain desired patterns. Then, by the use of a digital-to-analog converter, these numbers could be "smoothed" into a wave pattern, and—voila!—sound!

Many complicated wave patterns can be found easily by using this technique. A composer can obtain normal musical tones as well as ones that are impossible to get on traditional instruments. By using a wave that rises sharply but falls exponentially, a plucked sound is formed. By placing a 50-cycle-per-second vibrato over a sine wave of much higher frequency, the composer gets a chirping sound. The list of sounds and their combinations is just being formed, and composers who work with computers are still learning the "basic harmonics" of computer-generated sound.

The computer has added another dimension to music in a technical sense. With the computer, the composer is also the performer. His work is not performed over and over again by various performers, each with his own style. The work is realized, once, on tape, exactly the way the composer wants it. Also the computer allows the composer to avoid the menial work that accompanies any composition.

Asked whether he felt that computer-composed music was totally dead, Pierce answered that this music will probably only be accepted when computers become part of the audience. Later, he admitted that he said this partially in jest. But he emphasized that, to him, intelligence is not the strong point of the computer. Its task is to perform the necessary, but burdensome, computational work found in a technical society.

Reflecting on his own education, Pierce said that a student with technical leanings ought to use his undergraduate education to get as much background in math and physics as possible. Everyone should have an understanding of the physical world around them. In particular: "You should learn that the world out there is independent of your thoughts. It is all too easy for a scientist to lose touch with reality and to forget that Nature is stubborn. It isn't going to change just because man comes up with a theory."

One of the best ways to keep a finger on reality is to be aware of real world applications of scientific discoveries. Following his own advice, Pierce has amassed a sizeable number of patents. Most of the discoveries were made while considering applications of some new physical principle or device.

John Pierce graduated from Caltech in 1933 in the electrical engineering option, got his MS here in 1934, and his PhD in 1936. He was immediately snatched up by Bell Laboratories, where he started work on vacuum tubes, making many contributions to the state of the art.

As he rose in the Bell hierarchy, his fields of interest greatly increased. One area that particularly caught his attention was that of satellite communication. In 1955, he presented a paper giving plans for a satellite-balloon which could reflect microwave signals across continents. Five years later, Bell Laboratories and JPL were connected via Echo I—which was in orbit mainly through the work, both engineering and persuasive, of Pierce. After the success of Echo, Pierce became one of the main figures in the Telstar and Relay projects.

Never limited to engineering, Pierce has always been interested in literature and writing, as well as in music. Poetry especially claims him: One of his wishes is to write good poetry. He has also been reading and writing science fiction for many years. In his reading, he has developed a dislike for science fiction that portrays a false picture of science and the world. This dislike is evident in his own writings, which tend to be less science fiction, and more science extrapolation. Pierce is no longer heavily involved in computer music; he has let the professional musicians take over. However, he hasn't stopped having new ideas. Right now he is working on a new way of line and message switching using digital apparatus that is simpler than the old method—and will, he hopes, be useful to Bell Telephone. As far as Pierce is concerned, if something is to be really good, it must have a good application in the real world.

Emden Gansner '73

Five-year fund drive nears goal

Continued from page 1

have amounted to $8 million.

The alumni portion of the campaign has been successfully guided by an alumni committee headed by trustee Ruben Mettler ('44, PhD '49), who recently turned over the chairmanship to J. Benjamin Earl ('44).

More than a third of Caltech's 11,000 alumni have contributed to the campaign. Earl has now sent a special message to non-contributors to make it a 100 percent effort by November 1972.

"Caltech's need for support is as great as its promise for the future," Earl said. "The research being conducted today may well provide breakthroughs in our understanding of human life, of our environment, and of the universe. Never before have there been such bright, creative scientists and engineers in the faculty and student body."

Commenting on the campaign, Brown said that "the degree of support an institution receives from its own alumni and trustees is a critical factor that is carefully weighed by all foundations and corporations that make grants. In achieving such support Caltech has displayed a level of excellence of which we can really be proud.

"I want to thank every one of Caltech's alumni, trustees, and friends for his efforts in bringing the Science for Mankind campaign so close to success.

"We still have a difficult road ahead—in the months remaining in this current campaign, and in the years to come. Yet I am confident that those who believe in Caltech's objectives of preeminence will continue to help our faculty and students meet the challenge of the future."

Some of the outstanding achievements of the campaign so far include:

► The Bing Professorship of Behavioral Biology, held by Dr. James Olds.

► The Albert Billings Ruddock Professorship of Biology, held by Nobel Laureate Dr. Max Delbrück.

► The Lee A. DuBridge Professorship of Astrophysics, held by Dr. Jesse Greenstein.

► An Institute Professorship in Physics, held by Dr. William Fowler, funded by Institute endowment funds.

► The Arthur A. Noyes Laboratory of Chemical Physics.

► The Donald E. Baxter, M.D., Hall of the Humanities and Social Sciences, which includes the Ramo Auditorium.

► A new 60-inch telescope at Mount Palomar, funded by the Oscar G. Mayer family.

► The Earle M. Jorgensen Laboratory for Information Sciences.

► The Big Bear Solar Observatory.

According to the *Los Angeles Times*, Caltech is one of two private universities in California without a deficit budget. This was accomplished only by a long-term system of careful budgeting and recent cutbacks in the initiation of new programs to counteract rising prices and decreasing stock values.

Private gifts and grants are playing an increasing role in maintaining the Institute's financial stability. Caltech's budget in the last fiscal year was essentially $36 million. As the Institute continues to operate in the face of an inflationary spiral, the amount needed for general operating purposes increases accordingly, but without a corresponding increase in revenue from other income sources—tuition, government funding, and endowment earnings.

Among the high priority projects Caltech will begin in the near future are the Geological and Planetary Sciences Building and the Behavioral Biology Laboratory.

Caltech's geophysicists are now housed both on and off campus. Planetary scientists are scattered across the campus, while some of Caltech's astrophysicists and astronomers are located off-campus at the headquarters of the Hale Observatories.

Caltech's biologists, making great progress in their research on the biological bases of behavior, now face a crucial need for laboratory and office space.

"If Caltech is to retain its preeminence in the fields it has chosen," Brown said, "we must continue to attract and hold the outstanding faculty members in these fields. We can only do this if we are able to offer the level of income and support for research commensurate with the ability and experience of these professors."

Caltech's current goal is to establish 15 more fully endowed professorships, with a minimum endowment of $750,000 for each chair, to support the teaching and research of outstanding faculty members.

While expressing the need to complete the current campaign to move Caltech forward in its chosen fields of interest, Brown said continued unrestricted funds will especially be needed to meet day-to-day operating costs.

Math team takes fifth in contest

A three-man team of Caltech students has placed fifth in the 31st annual William Lowell Putnam Mathematics Competition, which traditionally attracts the most outstanding college mathematics students in the United States and Canada.

The Caltech team consisted of seniors Leonidas Guibas and Andrew Odlyzko, and junior David Smith. Odlyzko also placed 16th in the individual competition.

More than 1,500 students from 288 colleges and universities took part in the competition, which consisted of two, three-hour examinations given on the same day at all participating institutions.

The Caltech team, which has won the event three times—1950, 1962, and 1964—was supervised this year by David Boyd, Caltech associate professor of mathematics.

FACULTY HONORS AND AWARDS

Nancy Beakel

Nancy Beakel, one of two clinical psychologists at Caltech, has received an Achievement Award from the Soroptimist Club of Los Angeles. Five awards are presented each year to women of achievement in the professions, and in executive positions in business and government in the greater Los Angeles area.

Dr. Beakel received her BFA from the University of Texas in 1958 and worked as a professional actress in New York City before beginning her studies in psychology at UCLA in 1965. She received her MA from UCLA in 1967 and her PhD there in 1970. Her experience in clinical psychology includes studies of patterns of communication in families with a disturbed adolescent and work in family therapy at both the UCLA Psychology Clinic and at the Veteran's Administration Hospital in Sepulveda.

Felix Boehm

Felix H. Boehm, professor of physics, has been awarded a National Science Foundation Senior Faculty Fellowship to spend a year of advanced research at CERN in Switzerland.

Boehm will study the nuclear properties in mesic atoms, which are short-lived systems composed of a meson and an atomic nucleus. They can be created with the assistance of large particle accelerators at CERN, a leading research center in nuclear and particle physics.

At CERN, Boehm will join Egbert Kankeleit, who was a senior research fellow in physics at Caltech in 1964. Boehm and Kankeleit worked together in the pioneering research of the "weakly interacting" nuclear force in nature.

Harrison Brown

Harrison Brown, professor of geochemistry and of science and government, has been presented the 1971 Mellon Institute Award for work which has led to new knowledge of the earth's age and energy resources, and to a better understanding of the social and political effect of technological change.

Brown received the award—consisting of $1,000 and a commemorative medal—from H. Guyford Stever (PhD '41), president of Carnegie-Mellon University, at a special ceremony on April 23 in Pittsburgh.

Established in 1967, the Mellon Award recognizes individuals who have made outstanding contributions to science and its applications to the needs of mankind.

Brown came to Caltech in 1951 as a professor of geochemistry. Most of his recent work has been devoted to studies of population problems and the growth of science and technology.

Norman Davidson

Norman Davidson, professor of chemistry, has won the 1971 Peter Debye Award for outstanding research in physical chemistry. The $2,000 award was presented to him by the American Chemical Society at its 161st national meeting held last month in Los Angeles.

Davidson is responsible for fundamental advances in nucleic acid chemistry and for the development of new methods for solving problems in molecular biology. His recent use of the electron microscope to study the arrangements of genes in DNA molecules has provided the most accurate genetic map known to date.

A member of the Caltech faculty since 1949, Davidson is the executive officer for chemistry and has served as chairman of the Faculty Board.

Wheeler North

Wheeler J. North, alumnus and professor of environmental science, has won the James Dugan Memorial Award for 1971 from the American Littoral Society for his contributions to the study and conservation of marine animals and plants.

Working out of Caltech's Kerckhoff Marine Laboratory in Corona Del Mar, North and his group have developed ways of raising kelp spores in the laboratory for transplantation into the ocean. As a result, California's giant kelp beds are being restored as an important source of food for marine creatures and of chemicals for industry.

North, a skilled diver, underwater photographer, boatsman, and pilot, graduated from Caltech in 1944 with a BS in engineering. He earned a BS in biology here in 1950, and then got his master's and PhD degrees in oceanography and biological oceanography from the University of California. He joined Caltech's faculty in 1962.

Harold Wayland

Harold Wayland, professor of engineering science, was installed as president of the Microcirculatory Society, Inc., at the group's national meeting in Chicago on April 16.

Wayland, who is widely recognized for his research on blood flow and its interrelationship with living tissue, received his MS from Caltech in 1935 and his PhD here in 1937.

The society, of which Wayland has been a member for 10 years, was founded in 1954 to advance the knowledge of microcirculation of blood and other extracellular fluids of the body.

Wu and Chan

Theodore Wu, professor of engineering science, and Sunney Chan, professor of chemical physics, have received 1971 honor awards from the Chinese Engineers and Scientists Association of Southern California (CESASC).

Wu was presented with the CESASC Achievement Award, established in 1968 to honor a scientist or engineer of Chinese origin for distinguished contributions to science and engineering.

A Caltech alumnus, who received his PhD in aeronautics in 1952, Wu was cited for his work in fluid mechanics. His recent research has significantly advanced the understanding of the propulsion methods used by aquatic animals, microscopic organisms, and some bacteria.

Chan was given the association's Progress Award for his contributions to chemical physics. His current scientific interests include the use of nuclear magnetic resonance spectroscopy to study the structure and dynamics of biological molecules. Chan received his PhD in physical chemistry at UC Berkeley in 1960.

Coming events

Monday, May 24 Baxter Gallery
ARTISTS IN RESIDENCE: Peter Alexander, Robert Bassler, David Elder, and Helen Pashgian.
Through June 20, 9 a.m. to 5 p.m.

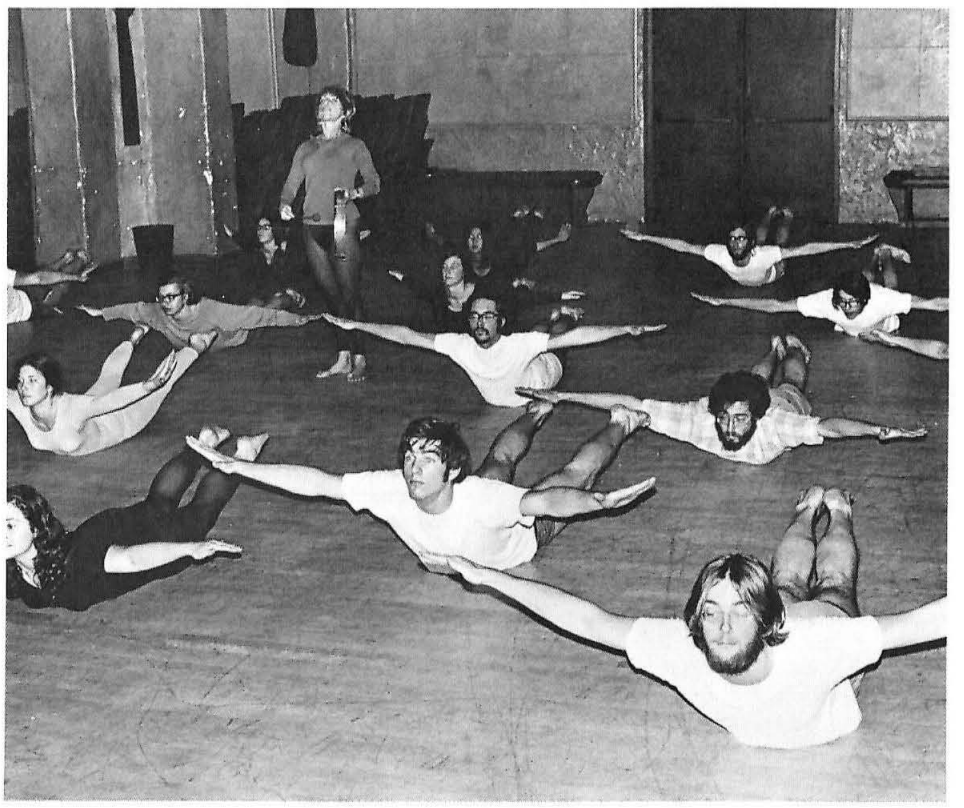
Through Tues., May 25 Baxter Hall
THE HIROSHIMA PANELS, by Iri and Toshi Maruki. Open 9 a.m. to 5 p.m.

Friday, May 21, 8:30 p.m. Beckman
EXPLORING THE LAND OF SONJO, by L. S. B. Leakey. $2.50—general admission; $2.00—students.

Tuesday, May 25, 8:00 p.m. Beckman
TUESDAY NIGHT AT THE SILENT MOVIES. "Metropolis," directed by Fritz Lang in 1926. $2.50—general admission; $2—students.

Through Fri., June 11 Athenaeum
A STROLL THROUGH CALTECH. An exhibit of water color paintings of the campus, by Hunt Lewis, instructor in English for foreign students.

Friday, June 11, 10:30 a.m. Beckman Mall
SEVENTY-SEVENTH ANNUAL COMMENCEMENT EXERCISES.



Swimmers in dry dock?

No, it's Modern Dance—one of P.E.'s new courses for credit. It's taught by Marie Marchowsky, a former soloist with Martha Graham's dance company in New York, who starts her students off with the basic techniques of body mechanics. About 30 students—equally divided among men and women graduates and undergraduates—have been signing up each term for the class, which is held in Culbertson Hall. Mrs. Marchowsky says, "Some of the students never knew their bodies were anything more than a big blob; now they're learning to use them as instruments of graceful movement, getting good exercise, and having fun doing it."

Alumni chapter activities

Easterling goes east

Mahlon Easterling, visiting professor of applied science, will be the featured speaker at three alumni chapter meetings in the east this month. The dinner meetings are set for the Detroit Chapter on May 25, the Chicago Chapter on May 26, and the New York Chapter at Tarrytown, N.Y., on May 27.

Easterling, who is regularly a staff engineer at the Jet Propulsion Laboratory, will discuss his participation in Caltech's new Environmental Quality Laboratory, and in the visiting professor program sponsored by the division of engineering and applied science. This program brings distinguished people to the campus from industry, other universities, and research laboratories to spend a year as visiting faculty members.

San Francisco elections

One-hundred and eighty members of the San Francisco Chapter of the Alumni Association elected three new chapter officers and were entertained by the Caltech Glee Club at their spring meeting, held on March 25 at Sabella's restaurant on Fisherman's Wharf.

Charles Auerbach, MS '47, ChE '48, assistant superintendent of the light oil division of the Standard Oil Co., is the new chapter president. A former Fleming House resident associate and president, Auerbach succeeds Harrison W. Sigworth, '44, a one-year member of the Alumni Board of Directors (1969-70), who is on the executive staff for western operations of the Standard Oil Co.

Other new officers are Thomas M. Menzies, '65, an engineer with Fairchild Semiconductor Research and Development Laboratory, who served as secretary-treasurer last year and is now vice president; and Robert T. Jenkins, '65, MS '66, who is the new secretary-treasurer.

The Glee Club, which was making its annual spring tour that week, sang a variety of selections including "I Left My Heart in San Francisco" and their Hawaiian Hula number. Former Glee Club members joined them in singing at the end of the program.

Placement Assistance To Caltech Alumni

The Caltech Placement Service may be of assistance to you in one of the following ways:
(1) Help you when you become unemployed or need to change employment.
(2) Inform you of possible opportunities from time to time.

This service is provided to alumni by the Institute. A fee or charge is not involved. If you wish to avail yourself of this service, fill in and mail the following form to:

Caltech Placement Service
California Institute of Technology
Pasadena, California 91109

Please send me: (Check one)

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

Name .....

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

Address .....

.....

ANNUAL ALUMNI BANQUET

Wednesday June 9
Athenaeum
6 p.m.

Featured Speaker:
Trustee Ruben Mettler

PERSONALS

1928
BENEDICT CASSEN, MS, PhD '30, professor of biophysics at the University of California at Los Angeles, has received that university's Distinguished Scientist Award for his development of the first radioisotope scanning device for nuclear medical diagnosis and for other contributions in the field of nuclear medicine. The award was accompanied by an honorarium of $5,000.

1933
ROBERT D. FLETCHER, MS '34, MS '35, has been appointed chief scientist of the Air Weather Service of the Military Airlift Command, which furnishes worldwide weather and environmental support to the Air Force, the Army, and other government agencies. He has been AWS deputy chief of staff for aerospace sciences since 1952. President of the American Meteorological Society from 1956 to 1958, he was the recipient of that society's Charles Franklin Brooks Award for outstanding services in 1970.


Fletcher, '33


McNeely, '34

1934
EDWARD B. DOLL, MS '35, PhD '38, has been appointed assistant general manager of TRW's Systems group. His assignments with TRW have been in the area of ballistic missile program management and administration.

WILLIAM H. McNEELY, PhD, has been named technical director of Kelco Company in San Diego, Calif. Formerly manager of organic and biochemical development for Kelco, a producer of alginate and xanthium gum products, McNeely will now be responsible for research and quality control covering all company activities, including food and drugs.

1936
EVERETTE E. GRIFFITH JR. is now deputy general manager for Technicolor, Inc., Florida operations.

MANFRED EIMER, MS '48, PhD '53, is now with the Department of Defense at the Pentagon.

RICHARD S. PIERCE, PhD '52, formerly at the University of Washington, has joined the faculty at the University of Hawaii as professor of mathematics.

ALLEN M. RUGG JR., MS, is managing director for Tenneco-Australia, Inc. in Sydney.

1938
PAUL C. HENSHAW, MS, PhD '40, president of the Homestake Mining Company, has been named chief executive officer of that concern. Homestake mines uranium, iron ore, silver, lead, and zinc to supplement earnings from their gold mine in Lead, S.D.

1946
JOHN J. BURKE, MS '48, formerly chairman of the board for Howmet Corp., has been named president and chief executive of Automation Industries in Los Angeles. He is also chairman of Universal Acceptance Corp. of Los Angeles and a director of System Development Corp. in Santa Monica.

1947
RICHARD C. GERKE, MS, is now working full time with the Christian Democratic Republican Foundation in Pasadena, Calif.

1949
ARTHUR R. BENTON JR., BS '50, will command the Commerce Department's National Oceanic and Atmospheric Administration ship *Surveyor* on a 6,800-mile trip from American Samoa to South America. Oceanographers on the expedition are searching the South Pacific for the earth's oldest crust.

1950
GEORGE E. SOLOMON, MS, PhD '53, has been named general manager of TRW's Systems group according to an announcement by RICHARD D. DeLAUER, AE '50, PhD '53, executive vice president of TRW Inc. Solomon was formerly vice president and director of marketing and requirements analysis for TRW Systems.

RICHARD R. DICKINSON, formerly general manager of supply and distribution for Texaco, Ltd., London, has been transferred to New York as staff coordinator of the strategic planning group in the executive offices of Texaco Inc. The Dickinsons are living in Darien, Conn.

1952
AUGUSTO L. SOUX, MS '53, formerly with TRW Systems, is civil engineering manager for Aerotrain Systems, Inc. in Chula Vista, Calif.

1954
SIMON TAMNY, MS '55, is currently chief engineer for Nordson Corporation in Amherst, Ohio. He was a member of the technical staff at Poloron Products, Inc.

1955
JOHN W. CONVERSE, a former graduate assistant at Purdue University, has become technical director for Vortex Model Engineering in Santa Barbara.

ROBERT F. MELDAU, MS, now lives in Caracas, Venezuela, where he is chief engineer of Phillips Petroleum Company's Venezuelan division. He was formerly manager of the pilot projects section, production branch, at Phillips' research center in Bartlesville, Oklahoma.

1957
ROBERT J. DEFFEYES has been elected a Fellow of the American Institute of Chemists. He is vice president of technical development for Graham Magnetics. He and his wife, Ethel, have two daughters.
GEORGE E. HALL, formerly a teacher at Palo Alto High School, is now at Esalen Institute at Big Sur, Calif.

1958
WILLIAM J. HOOKER, PhD, has become president of Xonics, Inc., in Van Nuys. He was formerly vice president and manager of Heliodyne Corp.

1959
JOHN S. BAILEY is now a senior staff scientist for ITT Gilfillan in Van Nuys.

HEROLD R. GUSTAFSON is a research associate in physics at the University of Michigan in Ann Arbor.

1960
GARY A. FLANDRO, MS, PhD '67, former JPL scientist who formulated the planetary Grand Tour concept, has been named winner of the British Interplanetary Society's award for "outstanding contribution to astronautics." Now an associate professor of mechanical engineering at the University of Utah, he is honored for the basic mathematical work he did at JPL from 1965 to 1968.

1962
COLWYN B. TREVARTHEN, PhD, formerly a senior research fellow at Caltech, is now a lecturer in psychology at the University of Edinburgh.

1963
FERNANDO B. MORINIGO, PhD, has been promoted to professor of physics at California State College, Los Angeles.

RICHARD E. PETERSON writes that after he receives his PhD in atmospheric science from the University of Missouri in June, he will take his wife and son to Norway where he will study for a year under a NATO post-doctoral fellowship at the University of Oslo.

1964
ARTHUR W. MERKL, PhD, formerly with Procter and Gamble, is now general manager for Inventron Industries, Inc., in Los Angeles.

VOLKER M. VOGT is a postdoctoral fellow at the Swiss Institute for Experimental Cancer Research. He has been a graduate student at Harvard University since leaving Caltech.

1965
MICHAEL S. GAZZANIGA, PhD, is an associate professor of psychology at the New York University graduate school. He was previously a member of the faculty at the University of California at Santa Barbara.

JOEL I. KRUGLER, PhD, is now research manager for GTE Laboratories, Inc., in Bayside, N.Y.

DeWITT A. PAYNE, who received his PhD in chemistry from the University of Texas, has joined Tennessee Eastman Co. in Kingsport, Tenn., as a research chemist.

ANSEL F. THOMPSON JR., MS, PhD '68, is project manager for Weston Europe S.p.A. in Milan, Italy.

1967
ALAN S. DUBIN, PhD, is a research chemist for DuPont Photo Products in Rochester, New York.

WADE J. WNUK, MS, is in the U.S. Army nuclear cratering group in Livermore, California.

1968
SAM DIGIROLAMO, MS, a captain in the U.S. Air Force, is a fighter bomber pilot in Vietnam.

SAURINDRANATH MAJUMDAR, AE, is now a research assistant in the department of theoretical and applied mechanics at the University of Illinois in Urbana. He was with the stress and vibrations engineering research division of the Garrett Corporation.

EARL GLEN WHITEHEAD JR. received an MA in October 1970 and will receive a PhD in mathematics in June 1971 from the University of Southern California. He will move to New York in September to take an appointment as a Courant Institute instructor at New York University.

JOHN R. WILSCHKE is an engineer-scientist for McDonnell Douglas Corporation in Long Beach.

1970
LAWRENCE L. BOGEMANN, MS, a captain in the U.S. Air Force, has graduated from the advanced computer programming course at Keesler AFB, Miss., and is being assigned to Ent AFB, Colo., for duty with a unit of the Aerospace Defense Command.

WILLIAM HOCKER, who graduated from Caltech in English, has returned to the campus to work with the Environmental Quality Laboratory as a research assistant in economics.

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Meetings: University Club, 1319 "K" St. Luncheon first Friday of each month at noon. Visiting alumni cordially invited—no reservation.

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Totem is back

Totem, Caltech's occasional literary magazine, is in print again and Alumni and friends of the Institute are invited to see the creative works of students and campus personnel by purchasing a six-issue subscription for $2 (expect to get them sporadically) or 50 cents for single issues. Just mail your requests, or contributions if you have any, to Totem, c/o California Tech, 115 Winnett Center, Caltech, Pasadena, Calif.

Obituaries

1935
OLIVER C. DUNBAR on December 30 of a heart attack. He retired from the regular army as a lieutenant colonel, Signal Corps, in 1965 after serving 26 years. Since his retirement he had been teaching computer programming in San Diego. He is survived by his wife, Elizabeth.

1960
THOMAS S. DAVIS, MS, on February 4 of a heart attack. He was a member of the Minuteman Program Office at TRW Systems in Redondo Beach. Besides his wife, Gretchen, he leaves two children, Edger and Mary Louise.