

OCTOBER 1966

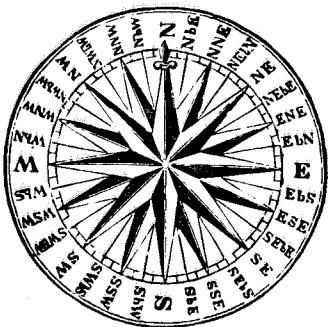
ENGINEERING  
AND SCIENCE



SEVENTY-FIFTH ANNIVERSARY  
1891-1966

# Go Westinghouse, Young Man!

*A modern fable with technical overtones.*



social welfare service, or participate in a protest movement . . . or he could enter the business world.

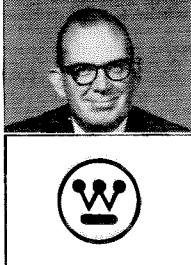
Many of Jack's friends urged him to steer clear of big industry.

"There are no challenges in air-conditioned offices," they warned.

And it was a challenge Jack wanted — the kind of challenge his forefathers faced on the frontiers.

Then he met a Mr. Greeley.

Mr. Greeley recruited college students for Westinghouse Electric Corporation. He was a kindly man to whom Jack opened his heart.



Mr. Greeley described to Jack the exciting things being done by Westinghouse all over the world.\* Jack was fascinated and asked many searching questions about the world's 21st largest corporation. At the end of an hour, Mr. Greeley advised Jack:

"Go Westinghouse, Young Man." Jack did.

The first few weeks were difficult. There was so much to learn.

Jack was to discover that at Westinghouse, learning was a way of life, that a career with Westinghouse was one long process of education and re-education.

Later Jack was permitted to decide which of six big groups he would like to join.\*\* Jack selected the Westinghouse Electric Utility Group.

With the Electric Utility Group Jack learned about water processing, about power generation, about underground distribution, and many other things. Jack had not realized how important to the survival of modern man is the world of electric utilities.

It was hard work. Sometimes after a particularly trying day Jack would get discouraged. Then he'd remember the warnings of his friends, back at college. And he'd wonder whether he had done the right thing.

Once upon a time there was a young senior in college named Jack who couldn't decide about his future.

He wanted to do something worthwhile after graduation.

But there were so many things to do, it was hard to decide. He could go on to graduate school, or join the CIA, or volunteer for



Then came Jill. Pretty, intelligent, warmhearted Jill. Jack had met Jill at the drinking fountain in the Utility Group Water Province Department.

Jill was an engineer with Westinghouse (Editor's Note: Women are welcome at Westinghouse, an equal opportunity employer).

Although the work became more and more difficult and the hours longer, Jack with Jill at his side persevered.

Then came an assignment to join a team of Westinghouse engineers and scientists. The team was being sent to an underdeveloped nation in a faraway land to help rebuild a large coastal city.

Jack and Jill's assignment: Help build a power plant that would use nuclear fuel. (Nuclear fuel lasts longer than coal or oil. And it's cleaner.) Energy from the nuclear plant was used to change salt water from the nearby sea into fresh water that the poor people of this country could use as drinking water.

Working late one evening on the job site, Jack caught someone in the act of sabotaging the construction of an extra-high-voltage distribution system. This system would bring power from the nuclear plant hundreds of miles into the inland areas of the country.

After a dramatic chase through the winding streets of the city, a chase in which the international police and CIA participated, Jack captured the subversive agent. A grateful nation presented him with its highest award.

Finally, the project was completed. It was hard work but it was good work. Thanks to the Westinghouse team, millions of people would live better.

The citizens of the country were grateful. They wanted Jack and Jill and the others to stay . . . offered them more than their present salaries as an inducement . . . but Westinghouse fringe benefits more than offset this offer.

At the airport, where a sad but affectionate crowd of citizens gathered to see them off, Jack turned to Jill and asked:

"Will you marry me?"

Jill smiled and said: "I will if you promise to let me join you on other equally important turnkey projects that Westinghouse is co-ordinating in some of the major cities in the United States."

Jack promised, and they lived happily ever after.

*Moral: Awaiting you at Westinghouse are challenges, hard work, building block education, adventure, some travel and, yes, even romance.*

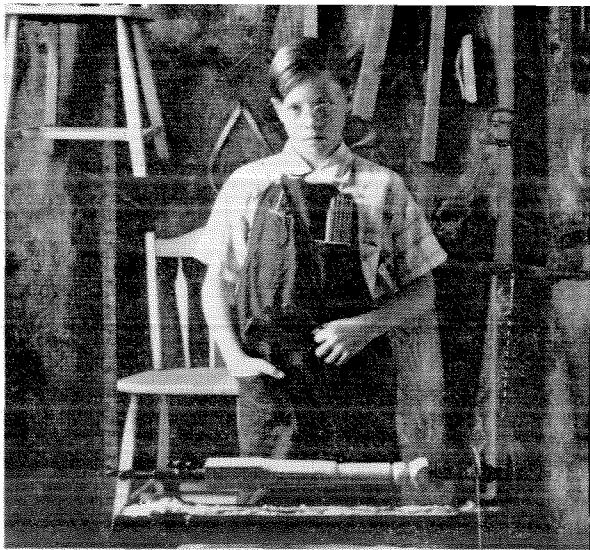
You can be sure if it's Westinghouse



For further information, please contact: L. H. Noggle  
Westinghouse Educational Center, Pittsburgh, Pa. 15221.

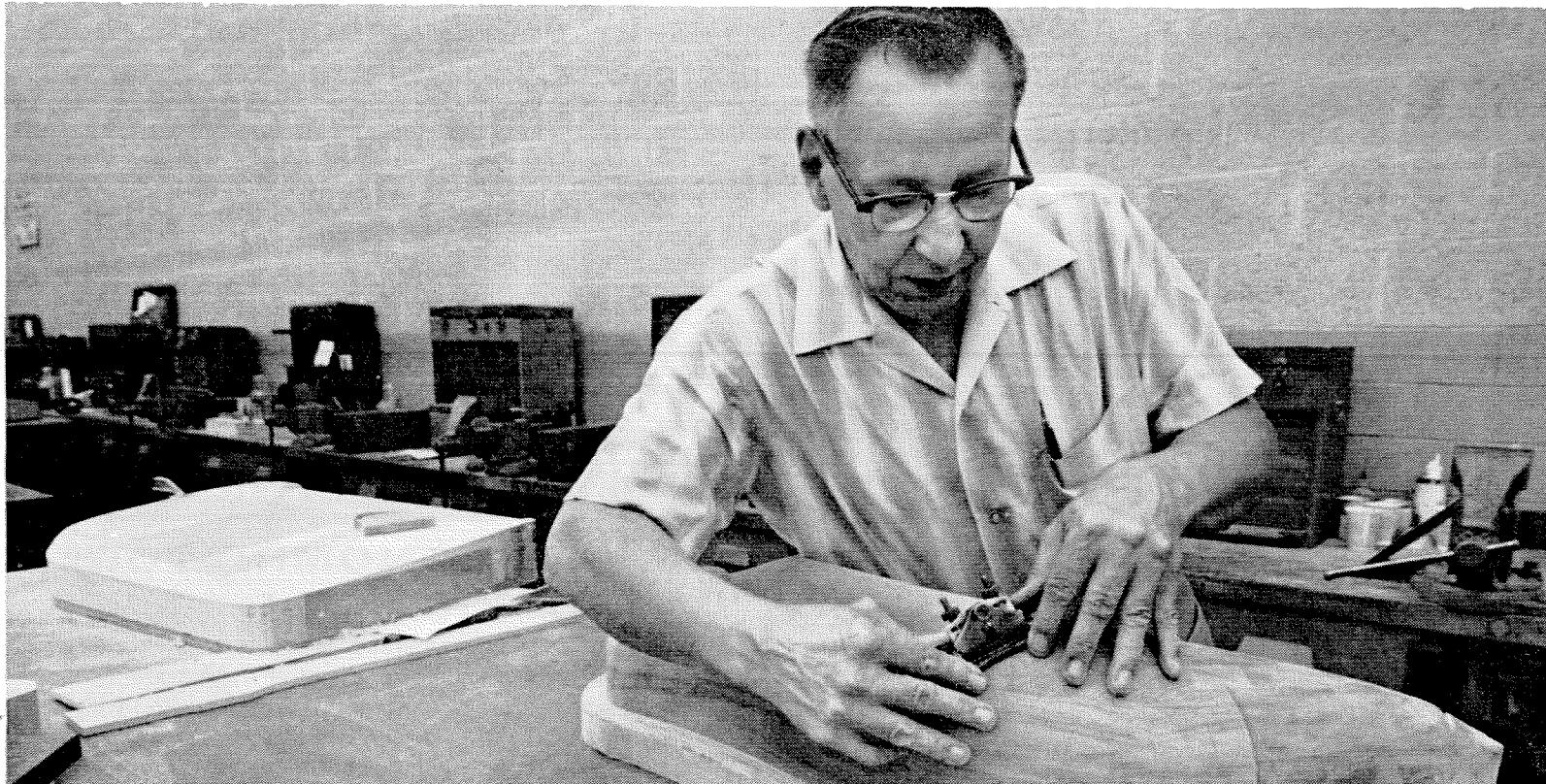
\*UNDERSEA EXPLORATION MASS TRANSIT WATER DESALTING AEROSPACE TRAVEL AUTOMATED PARKING GARAGES PROGRAMMED LEARNING TOTAL ELECTRIC CITIES

\*\*CONSUMER PRODUCTS INDUSTRIAL CONSTRUCTION ELECTRONIC COMPONENTS & SPECIALTY PRODUCTS ATOMIC, DEFENSE AND SPACE ELECTRIC UTILITY



**Leo Darga was cut out to work with wood.**

**Today he fashions tomorrow's cars.**



The hands that hold the chisel are the hands that help shape the car. And exceptional hands they are. For they belong to Leo Darga, for 35 years with General Motors, and now a skilled wood craftsman and designer at the Fisher Body Central Engineering Plant in Warren, Michigan.

Leo is really a chip off the old block,

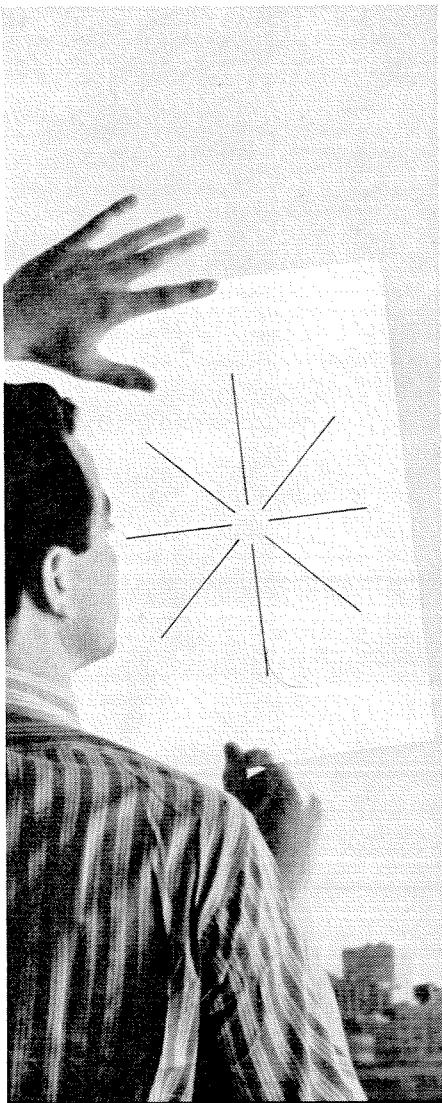
as his father was a woodworker for GM for some 30 years. In fact, as a young boy Leo became interested in working with wood by watching his father carve out his own pipes with knife and chisel. It naturally followed that young Darga showed an amazing aptitude and skill for wood shaping in manual training all through school.

Today, with all of his experience, Leo concentrates on the fine work—minute detailing of the dips, bends and flairs on the exteriors and interiors of Fisher Bodies in the initial stage of their development.

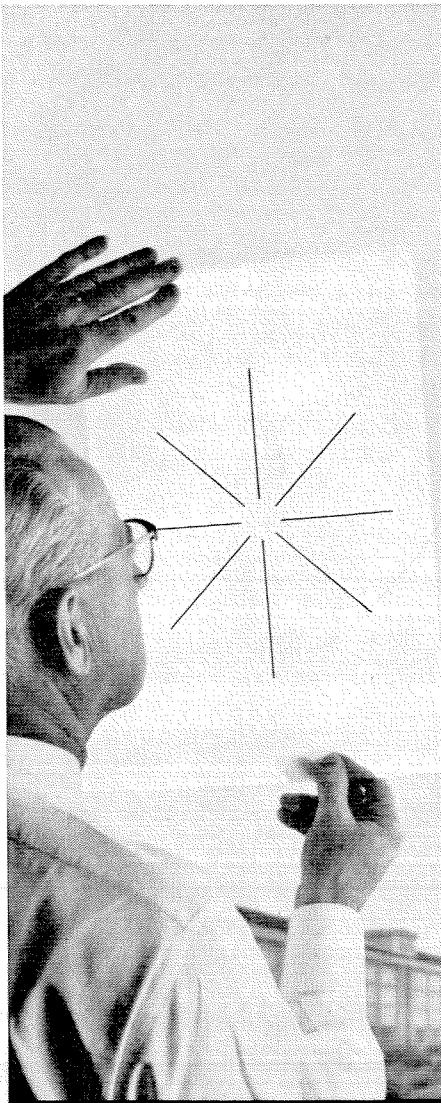
It's great to have the skill and artistry of men like Leo Darga working on the General Motors team.



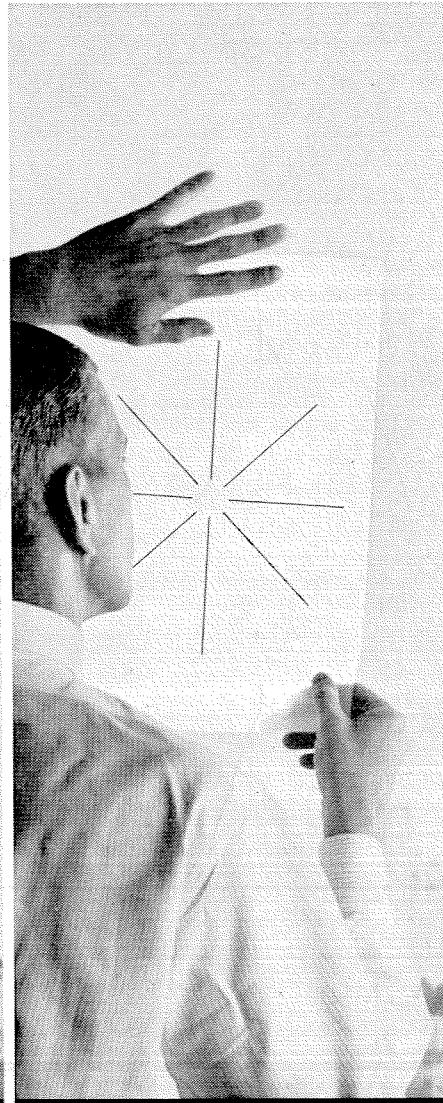
**General Motors is people making better things for you.**



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**PROFESSORS...**



**ENGINEERS...**

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# ENGINEERING AND SCIENCE

OCTOBER 1966 / VOLUME XXX / NUMBER 1

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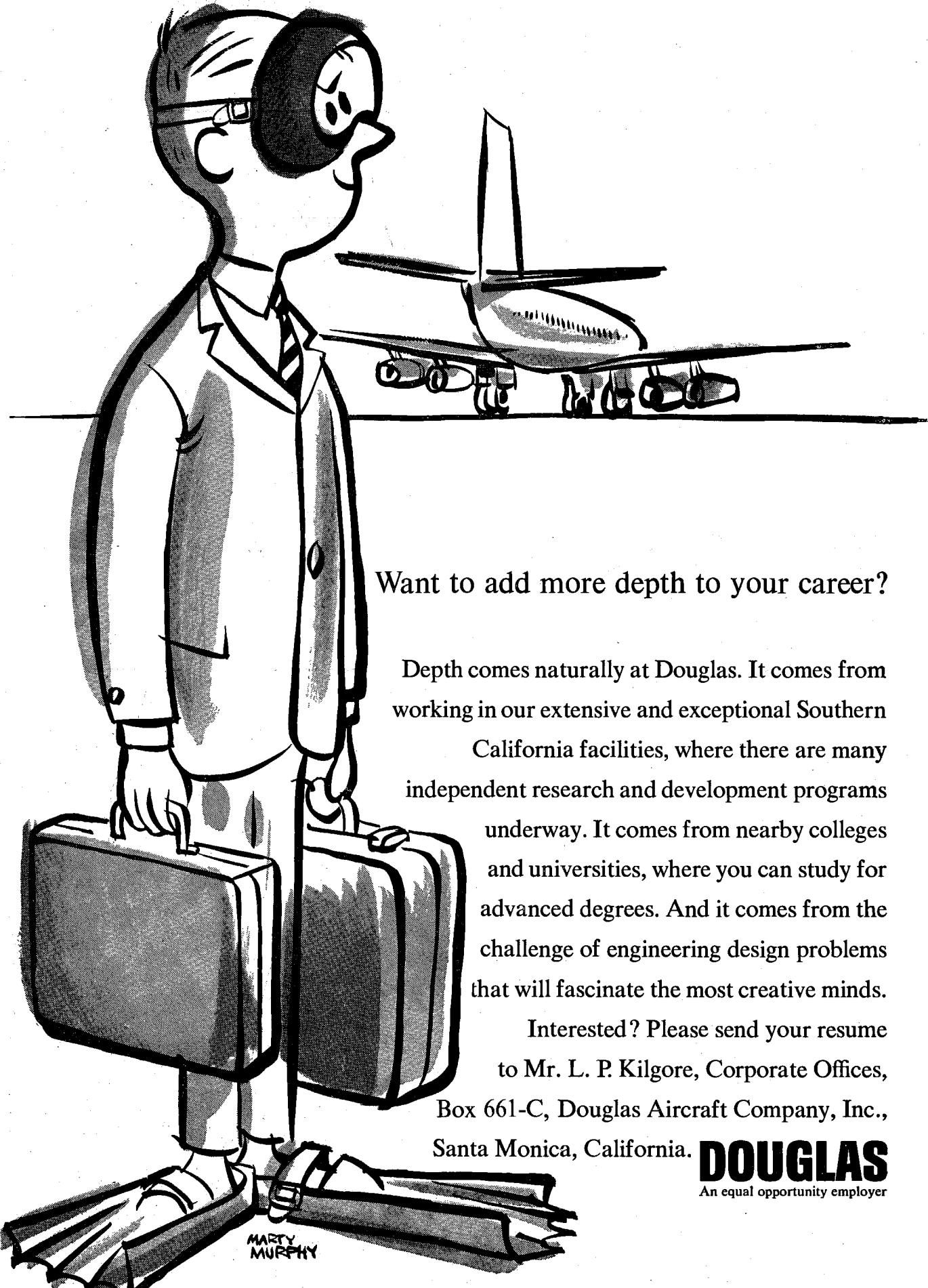
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## COVER

The emblem on our cover heralds the start of Caltech's 75th anniversary year and a year-long celebration, launched this month with a Convocation on October 24, followed by a three-day conference on Scientific Problems and Human Values (page 7) . . . On page 8, a colorful account of what Caltech was like 75 years ago by Mrs. John P. Buwalda in "The Roots of the California Institute of Technology."

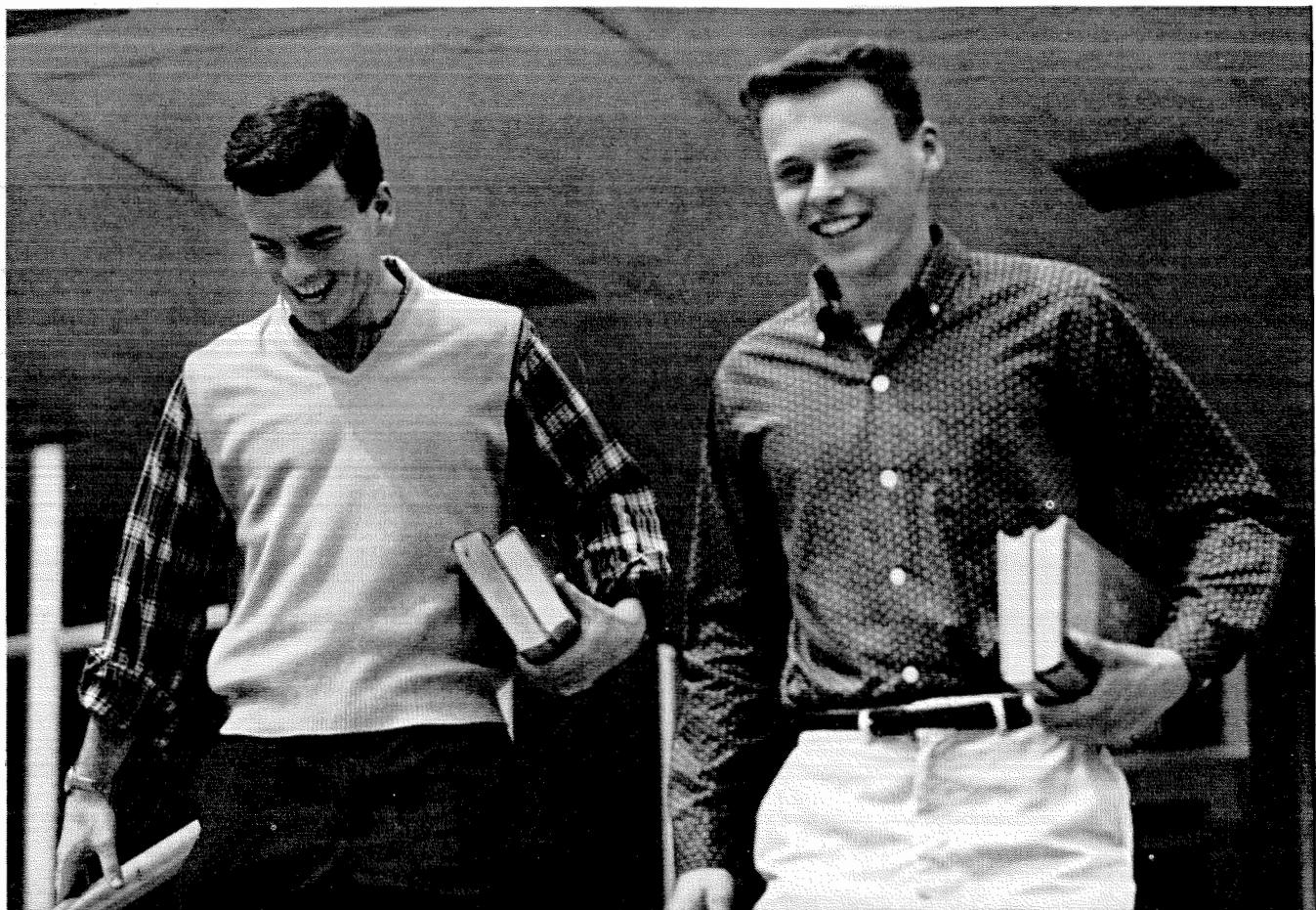


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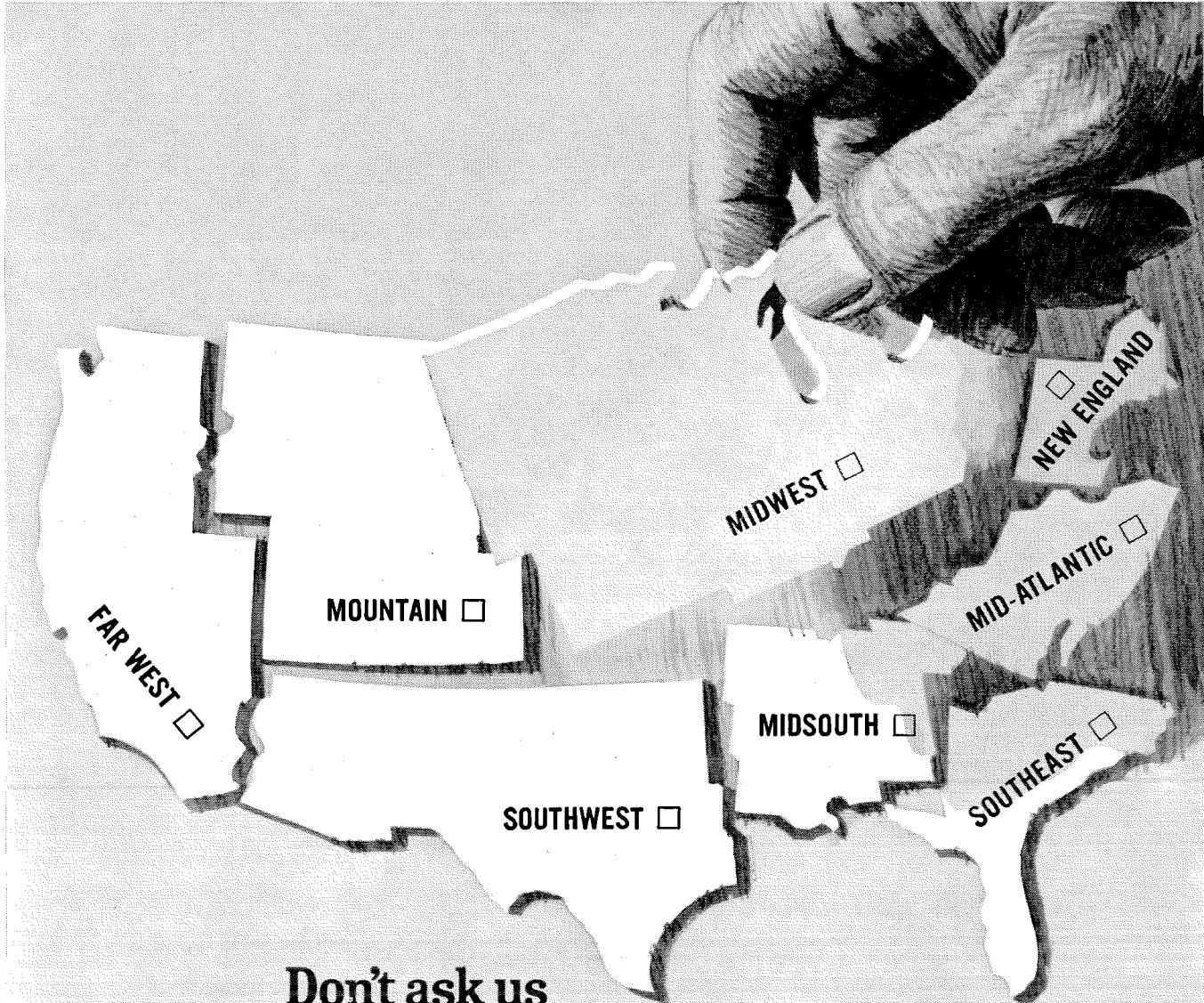
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# Caltech's 75th Anniversary

The California Institute of Technology celebrates 75 years of teaching and research this year, a distinguished history which began in 1891 when the Honorable Amos G. Throop founded Throop University, thereafter known as Throop Polytechnic Institute, Throop College of Technology, and, since 1920, the California Institute of Technology.

To commemorate these 75 years, a four-day program will be held at Caltech, beginning Monday, October 24, with the Seventy-Fifth Anniversary Convocation and followed by a Conference on Scientific Progress and Human Values.

The first day's program, on October 24, will open with a showing in Dabney Lounge of exhibits prepared by the various divisions of the Institute. That afternoon, there will be a Convocation and academic procession on the Beckman Auditorium Mall. Principal speaker will be John W. Gardner, U.S. Secretary of Health, Education, and Welfare.

The three-day invitational conference in Beckman Auditorium that follows the Convocation will focus attention on the urgent problems arising from man's rapidly advancing knowledge in science and technology.

## A CONFERENCE ON SCIENTIFIC PROGRESS AND HUMAN VALUES *Beckman Auditorium, October 25-27*

### Tuesday, October 25

#### Morning—THE SPECULATIONS OF SCIENCE

*Chairman: Robert F. Bacher*

- I. About the Elementary Particles of Physics  
*Murray Gell-Mann*
- II. About the Universe  
*Jesse L. Greenstein*
- III. About the Earth  
*Robert P. Sharp*

#### Afternoon—THE TECHNOLOGY OF SCIENCE

*Chairman: William H. Pickering*

- I. The Future of Nuclear Power as Seen from the United Kingdom  
*Sir William Penney, Chairman, United Kingdom Atomic Energy Authority*
- II. Manned Space Flights: Programs, Progress, and Prospects  
*George E. Mueller, NASA*
- III. Communication—Outlook for the Future  
*John R. Pierce, Bell Telephone Laboratories*

### Wednesday, October 26

#### Morning—NEW KNOWLEDGE IN BIOLOGY

*Chairman: Ray D. Owen*

- I. Heredity and Evolution  
*James F. Crow, University of Wisconsin*
- II. Memory and Learning  
*J. Z. Young, University College, London*

#### Afternoon—WHERE IS BIOLOGY TAKING US?

*Discussion Chairman: James F. Bonner  
Neal E. Miller, Yale University  
Robert S. Morison, Cornell University  
Robert L. Sinsheimer*

### Thursday, October 27

#### Morning—SCIENCE AND SOCIETY

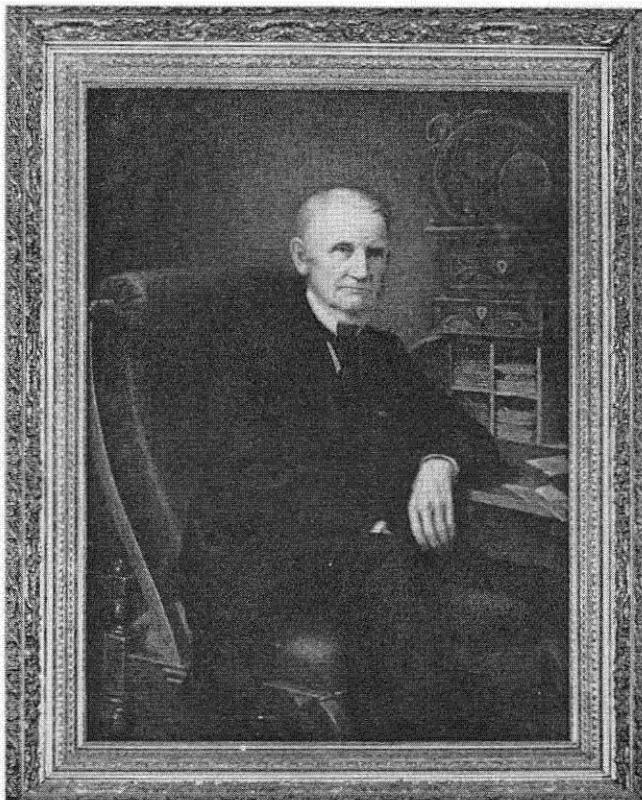
*Chairman: Hallett D. Smith*

- I. Historical Perspective  
*Asa Briggs, University of Sussex*
- II. Trends in Modern Society  
*Daniel Bell, Columbia University*
- III. Values and the Humanities: Are There Any Absolute Values?  
*Herbert J. Muller, University of Indiana*

#### Afternoon—WHAT ARE THE URGENT PROBLEMS?

*Discussion Chairman: Don K. Price, Harvard Graduate School of Public Administration  
James F. Bonner  
Murray Gell-Mann  
Carl Kaysen, Institute for Advanced Study  
Simon Ramo, TRW, Inc.*

*Evening—Chairman: Lee A. DuBridge  
The Role of the Educator in a Scientific World  
Lord James of Rusholme, University of York*



*Portrait of Amos G. Throop, founder of Throop University in 1891, was commissioned by the citizens of Pasadena in 1893, hangs in the lobby of Throop Hall at Caltech today.*

# The Roots of the California Institute of Technology

by Imra W. Buwalda

The Pasadena in which Amos Gager Throop founded Throop University in 1891 was a charming little residential community of 5,000, less than 20 years old. The town had started with the dreams of a group of Indianans who, during the bitterly cold winter of 1872-73, decided to move to California and sent agents out to select a likely site for a farming community. The site chosen was a 4,000-acre section of the great Rancho San Pasqual, located in the northwest corner of the San Gabriel Valley, at the foot of the San Gabriel Mountains.

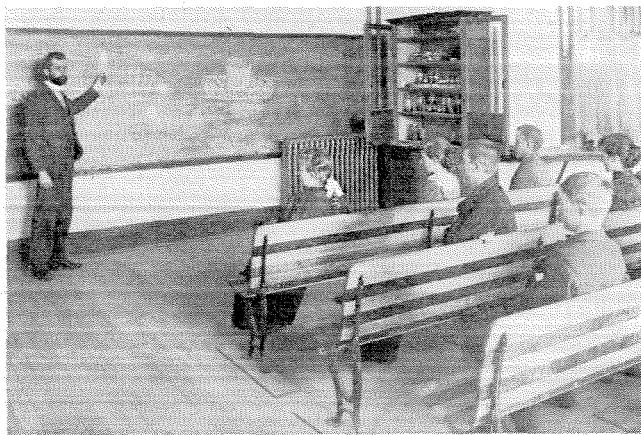
The panic of 1873 discouraged many of the original Indiana group, but on November 13, 1873,

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*Mrs. Buwalda is the widow of John Peter Buwalda, chairman of Caltech's division of geology from its inception in 1925 until 1947. In recent years Mrs. Buwalda has been working on a history of Caltech's early days. This article is a portion of that manuscript.*

27 individuals—less than half of them from Indiana—incorporated as the San Gabriel Orange Grove Association with a capital stock of \$25,000 divided into \$250 shares, each worth 15 acres. On a beautiful January day in 1874, the stockholders and their families met for a picnic and “by mutual agreement each made his selection of a tract.” At first they called the new settlement “The Indiana Colony.” Then, on April 22, 1875, they voted to adopt the name Pasadena.

The early Pasadenaans were largely middle-class business and professional men, many of them retired or health seekers, but there was a large proportion of the very wealthy, as year-round or seasonal residents. The great hotels of the 1890's—the Raymond, Green, Maryland, and Vista del Arroyo—made the town famous as a winter resort for the well-to-do.



Biology lecture room in East Hall, built in 1893 to house Throop's rapidly growing enrollment.

From the beginning, Pasadenans were deeply concerned with education. The town's first school had opened in the fall of 1874, the first library in 1882, and within ten years after its founding, both public and several excellent private schools were well established. But by 1891, Pasadena, unlike many other southern California communities, still had no college. It wanted one badly.

On a spring day in 1886, Amos G. Throop, a wealthy Chicago businessman who had retired to California at the age of 70, drove from his farm near Pico and Main Street in Los Angeles to the little town of Pasadena. With him was the Reverend Miss Florence Kollock of Chicago. Their mission was to find out how many persons in the vicinity were in favor of Universalist meetings. They found seven, and proceeded to hold services every Sunday. Throop moved his family to Pasadena and, within two months, established the First Universalist Parish of Pasadena, with 30 members and himself as Moderator.

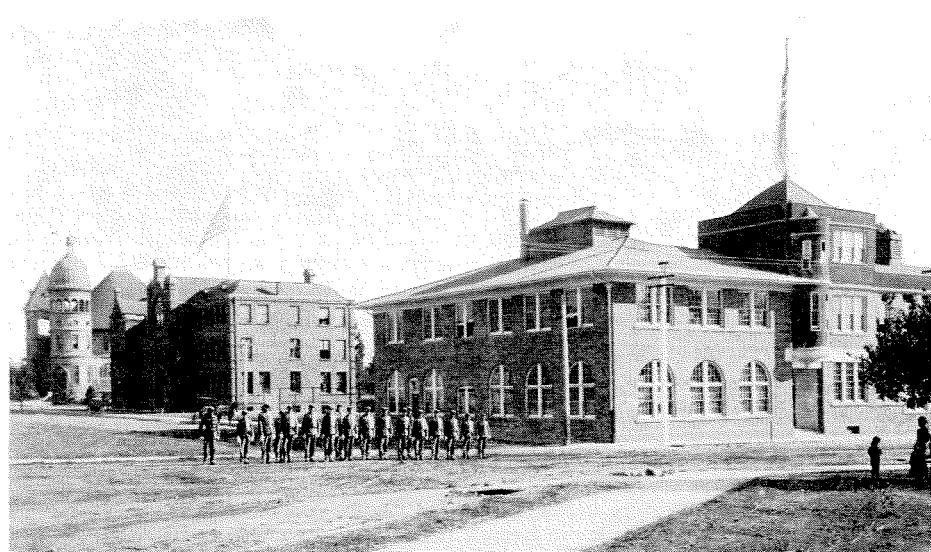
Amos Throop was 75 years old when he moved to Pasadena. He had retired after a long and active career as a businessman who had made a fortune in lumber and real estate, as a temperance leader, as an ardent Abolitionist, and as a civic leader. He brought his energy and crusading zeal to Pasadena, where he soon became affectionately known as Father Throop. In the spring of 1891, at the age of 80, he resigned as trustee of the now firmly established Universalist Parish to give his undivided attention to founding a college in Pasadena.

Father Throop had no preconceived idea of the type of school he wanted, but he was determined that it should be the best. Realizing that he needed advice, he invited a group of southern California educators to a meeting at his home on August 31, 1891. They decided to "proceed at once to open the college."

Proceed they did. A few days after the meeting Throop leased the four-story Wooster block at the corner of Fair Oaks and Kansas (Green) Streets. On September 23, 1891, The Articles of Incorporation of Throop University were filed. On November 2—only two months after the meeting at Father Throop's home—30 students appeared at the Wooster building to enroll in Throop University.

An elaborate variety of departments and courses was announced for Throop University. There was to be a College of Letters and Science, embracing a "Classical Course," "Philosophical Course," and "English Course." There was to be a Preparatory Department, a Law School, a Musical Institute, an Art Studio, and facilities devoted to Elocution, Stenography and Typewriting, and Physical Culture.

Professor M. M. Parker headed the list of six teachers, three in humanities and three in science,



The Throop campus at Fair Oaks and Chestnut in 1895. Polytechnic Hall is in the foreground, East Hall in the middle, and Father Throop's domed Universalist Church in the back.



Forging room in Polytechnic Hall was used in Throop's program "to foster a higher appreciation of the value and dignity of intelligent manual labor."

and also served as the university's vice president. Although he refused the presidency, he was in fact the institution's administrator until C. H. Keyes, one of the trustees, was chosen president on March 8, 1892, at a salary of \$2,500 a year. For this munificent sum, Keyes was also to serve as professor of civics and education.

Throop University was founded at a time when several liberal arts colleges in southern California had recently failed, and when others (such as the University of Southern California, Pomona, Occidental, and Whittier) were facing a desperate struggle for survival. At their board meeting in March the trustees and Father Throop heard a report from Professor Parker that the prospects for the success of Throop University, which had been operating for only a few months, were grim. As a result the trustees decided to make a drastic revision of the aims of the school and announced a plan to establish "a school that is sadly needed in the West—one for the teaching of those things that train the hand and the brain for the best work of life. Throop University proposes to put all its energy and all its money into building up here a Manual Training Institution that shall be second to none in the land. A university of letters is not needed here and

could not be a success, but the field of industrial training is open and wide, and we propose to fully occupy it."

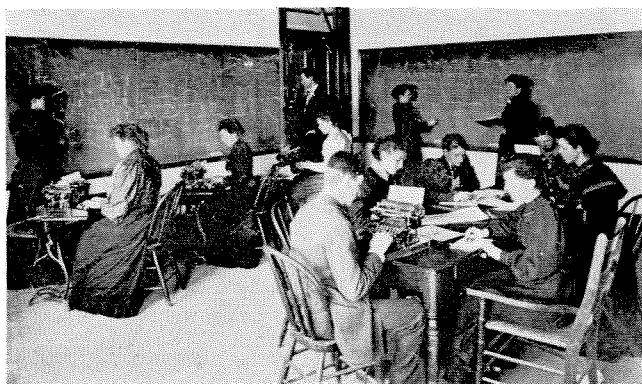
Father Throop went ahead and bought property at Fair Oaks and Chestnut for a permanent campus and commissioned a building, Polytechnic Hall, to accommodate 240 students. The following spring the board, deciding that the name Throop University was pretentious and misleading, voted to change it to Throop Polytechnic Institute.

The new school flourished. Polytechnic Hall was fully occupied within two years after it was built, and Father Throop bought a new block of land, almost doubling the size of the campus. A second building, East Hall, was built at a cost of nearly \$40,000.

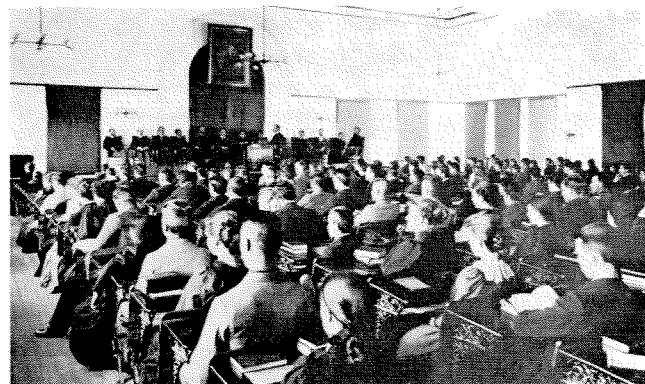
In December of 1893 Pasadena celebrated "Father Throop Day" to honor the school and its founder. As reported by Hiram H. Reid in his *History of Pasadena*:

"The forenoon . . . was devoted to visiting and inspecting the Institute buildings, the machinery being all in motion and students at work . . . Lunch was served by the cooking school in West Hall, limited to visitors from outside the city. And at 2:15 the program of exercises at the Tabernacle commenced."

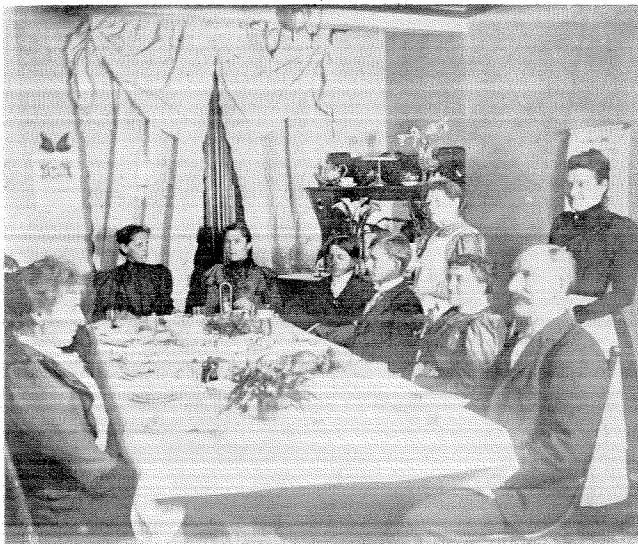
After testimonial orations, a "very fine life size oil portrait of Father Throop elegantly framed" was presented to the school on behalf of the citizens of Pasadena. Then the old gentleman "in a speech of deep earnestness and pathos" formally presented "the Throop Polytechnic Institute, with all its lands, buildings, equipments and endowments, as a free gift to the City of Pasadena and her people . . . as a sacred trust, to be fostered and sustained, and made to subserve the highest and noblest uses of thorough-going, practical, moral, self-helpful, unsectarian education for boys and girls alike, and at the lowest possible cost."



A stenography and typewriting room was used for the Commercial Course started in 1900.



East Hall's assembly room, presided over by Father Throop's portrait, could accommodate 400 people.



*Mrs. Mack's boarding house (1899) was on South Hill Street, not far from Caltech's present campus.*

Mayor O. F. Weed responded that "Father Throop's gift of the Polytechnic Institute surpasses all others . . . Other men have achieved fame, but Father Throop has achieved a glory that is immortal."

This public recognition of Pasadena's benefactor formed a fitting conclusion to Father Throop's career. He died suddenly a few months later, on March 22, 1894. His funeral was described as "the most impressive demonstration of popular sorrow that ever occurred in Pasadena."

When Polytechnic Hall was completed in 1892, the school's original building, Wooster Hall, became an off-campus, cooperative dormitory for students, housing 40 men and 30 women. In 1895, how-

ever, the Board changed its policy regarding student housing. "In so favored a community as Pasadena," they announced, "better home surroundings and more healthful social influences can be furnished for young people in the families willing to accept such responsibility than would be possible in any dormitory."

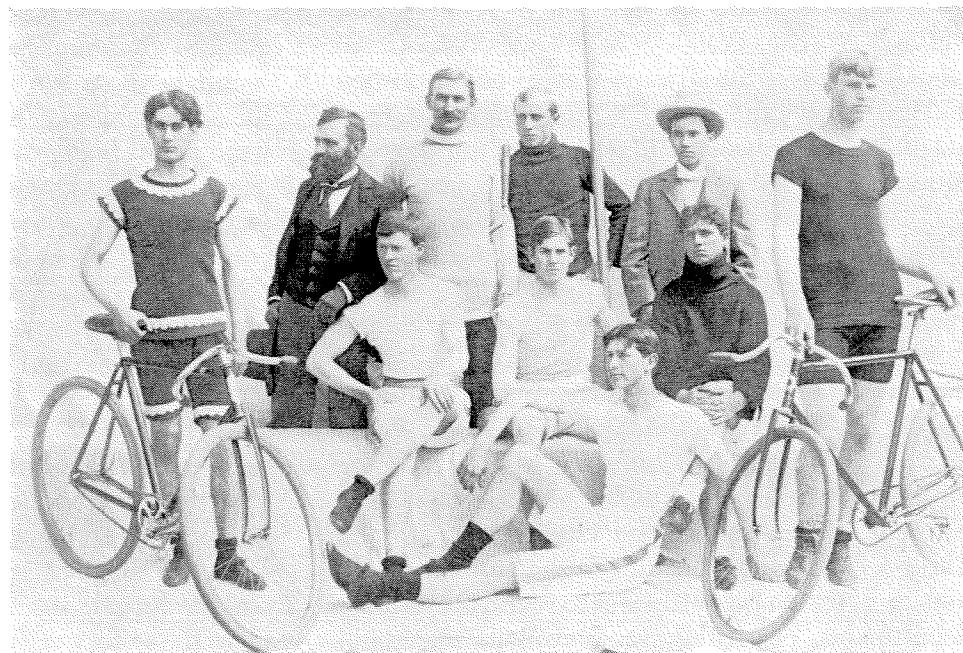
A student comment on this arrangement appeared in the *Throop Polytechnic* in 1901:

#### SOLILOQUY OF A BOARDING HOUSE STUDENT

Backward turn backward, oh time in thy flight,  
Feed me on gruel again, just for tonight,  
I am so weary of sole-leather steak,  
Petrified doughnuts and vulcanized cake,  
Oysters that slept in a watery bath, butter  
As strong as Goliath of Gath, weary of paying for what  
I don't eat, chewing up rubber and calling it meat.  
Backward turn backward, for weary I am;  
Give me a whack at my grandmother's jam,  
Let me drink milk that has never been skimmed,  
Let me eat butter whose hair has been trimmed,  
Let me once more have an old-fashioned pie,  
And then I'll be ready to turn up and die.

Apparently the trustees were not satisfied with this situation either, for in the fall of 1904 they leased Mariposa Villa as a men's dormitory. The following spring they bought the Franklin property at 289 North Los Robles and named it Throop Hall. It had 35 rooms and two adjoining cottages, a tennis court, billiard room, and playground. In 1906 the trustees obtained the Fordyce Home on North Euclid as an annex to Throop Hall.

Throop had a strong student body association and many student societies. Outstanding among them was the strictly invitational and secret Gnome Club, a social and service organization limited to



*Bike racing was a popular sport in the late 90's, and Throop had its full share of enthusiasts.*

25 men, including several faculty members and the president. The Sphinx was another secret men's club, organized in 1902. The girls had their own service club—the Phi Alpha Sigma sorority. There was a Camera Club, a Tramping Club, and a Forestry Club. (An editorial in the *Polytechnic* deplored the fact that "too few people get into the adjacent 'California Alps,'" and expressed the fear that people were losing the use of their legs.) There were purely social clubs, such as The Bachelor Girls, a self-selected group of young ladies who gave dances at the resort hotels; and the Throop Social Club, which gave such parties as one described in the *Polytechnic*.

"A more enjoyable dance was never held than that given by the Throop Social Club at Mount Lowe on May 17, 1901. Leaving the city at 7:00 o'clock, the merrymakers enjoyed a pleasant hour's ride to the dance hall, where the music soon wafted its sweet strains upon the evening air. A more ideal spot than this could never be asked for, and between dances the broad verandas and winding paths offered alluring nooks to spend the short intervals . . ."

A moonlight bicycle ride down the famous cycle-way running from the Hotel Green to the southern edge of the city was a student favorite, as indicated by an indignant reference in a student publication to "fat ladies in bloomers cluttering up the cycle-way." Bike racing was so popular in the late 90's that there was a cycling track in the northwestern part of Pasadena with a grandstand seating a thousand people.

In 1906, the senior class presented a Russian drama to benefit victims of the San Francisco earthquake, and the students of Spanish gave a light opera that received rave press notices. But Throop's star performers were its Mandolin and Guitar Club—billed as "The Troupe That Made Throop Famous." By 1903, the Troupe was so accomplished and well known that a booking agent signed it. During that year it traveled 3,000 miles and gave 86 concerts.

Between the years 1891 and 1907, Throop's enrollment increased from 30 to 529. A great deal of this growth was the result of the work done by Walter A. Edwards, who was Throop president from 1897 to 1907. By this time Throop had a national reputation as "the most thoroughly equipped Polytechnic School on the West Coast," and 300 of its students were from out of state, including 3 from foreign countries.

Much of the strength and vitality of the young Throop Polytechnic Institute came from the willingness of the board of trustees to revise the school's departments, curriculum, and even its major ob-



The girls' basketball team of 1904, off the court.

jjectives in order to meet the challenge of the rapidly changing times. Through it all the school remained faithful to the concept of "learning through doing." Instead of being a separate department, manual training was soon integrated into the College, the Normal, and especially the Preparatory (renamed the Academy). Even the Sub-Preparatory department (renamed the Grammar School) featured manual training under the title of "sloyd," the Swedish system of teaching the use of tools and materials while providing mental and physical development.

The most significant change came following the turn of the century when the trustees became increasingly aware of the potential importance of the College. Some college-level courses were given almost from the beginning, for Throop was considered to be a polytechnic college as well as a manual training institute. But in the early years when the little school was struggling to survive, it seemed necessary to downgrade the college and concentrate on the departments that brought in the most income. The Academy was by far the most thriving department, both in numbers of students and prestige.

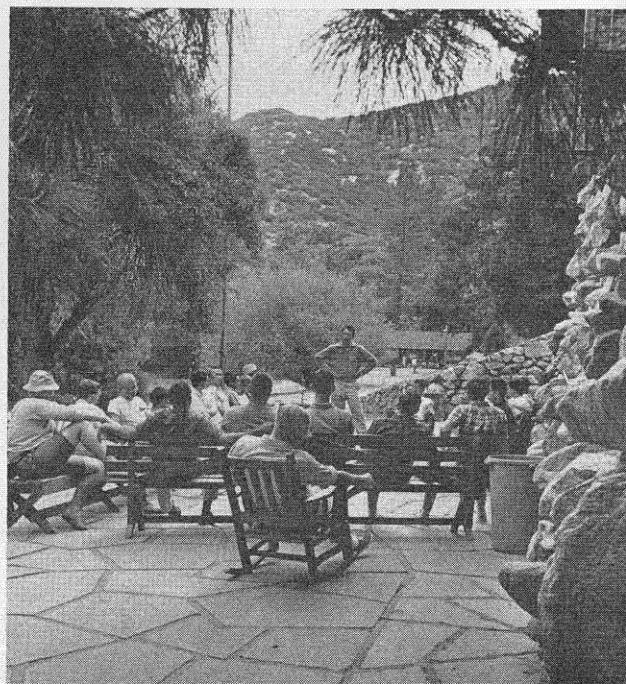
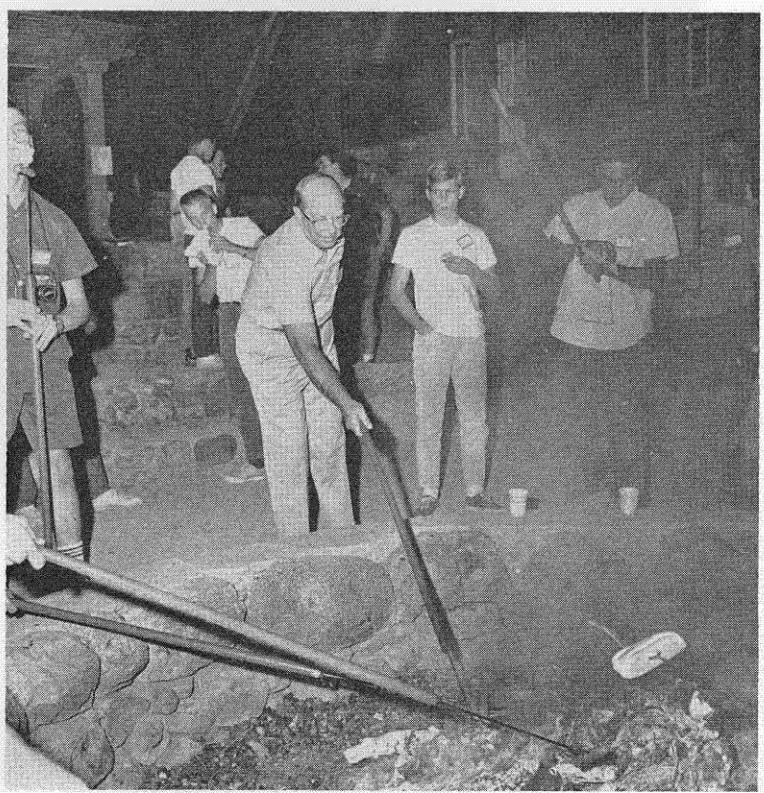
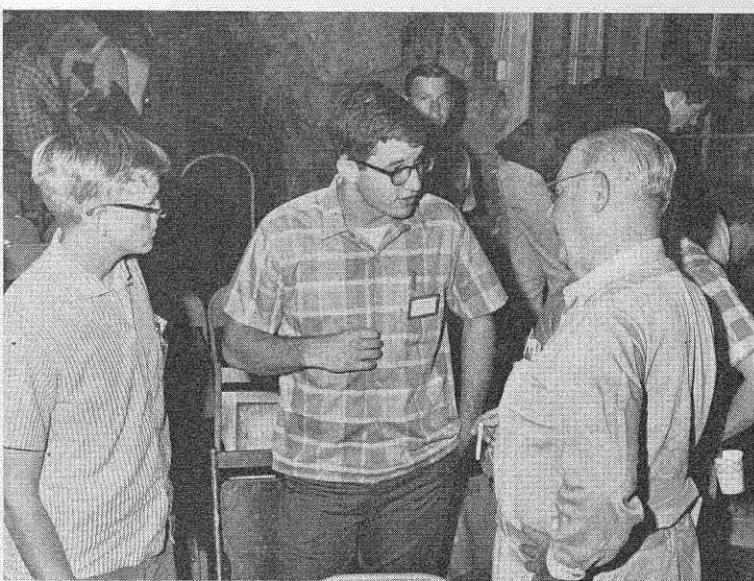
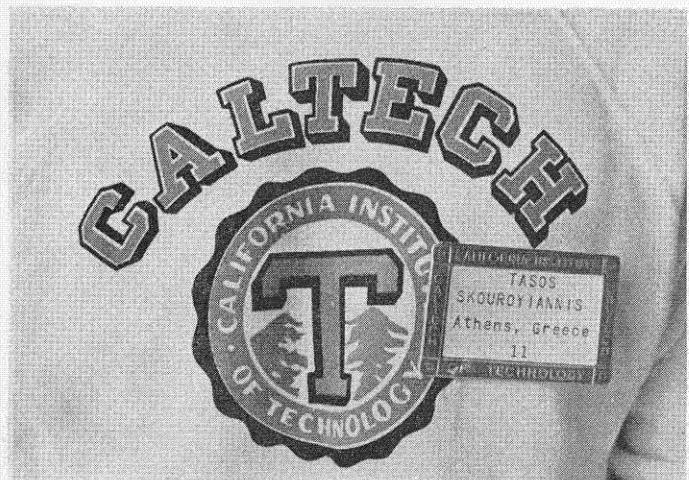
But by 1905 the trustees, recognizing the need for an engineering school in southern California, were again ready to shift the Institute's direction. They decided to feature a College of Science and Engineering "for the purpose of offering thorough courses in engineering which should be both scientific and practical." The college had a faculty of 17, most of whom also taught in the normal school and the academy.

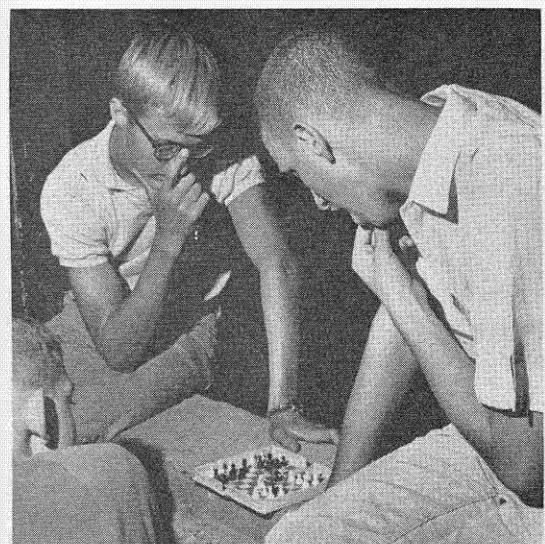
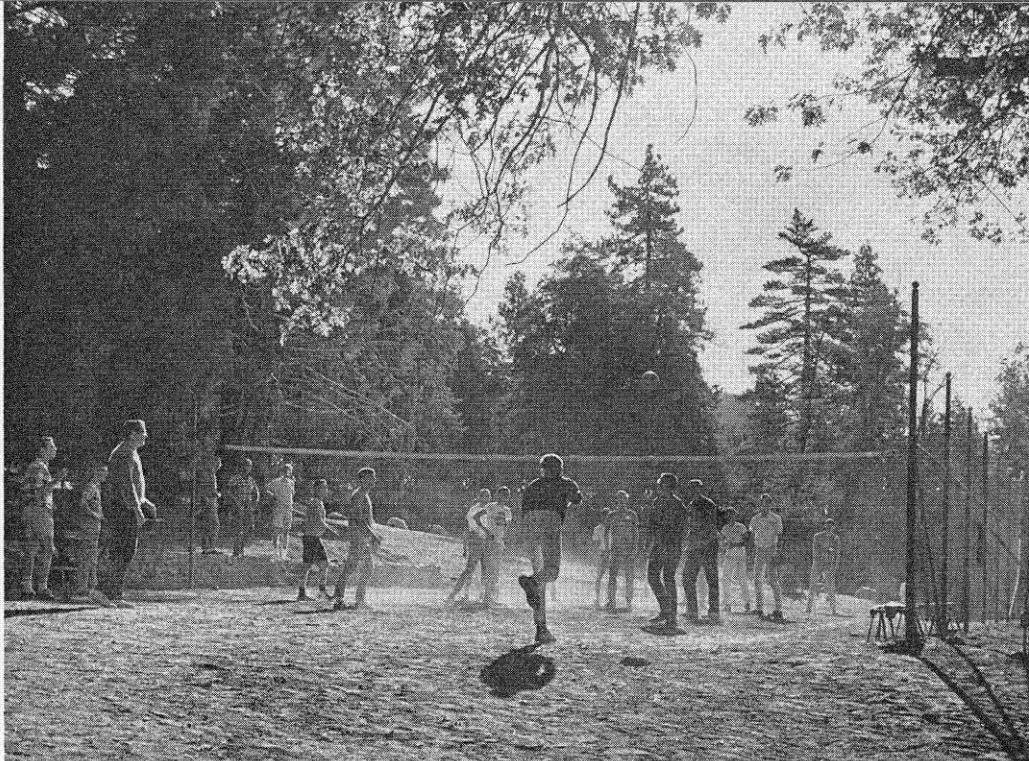
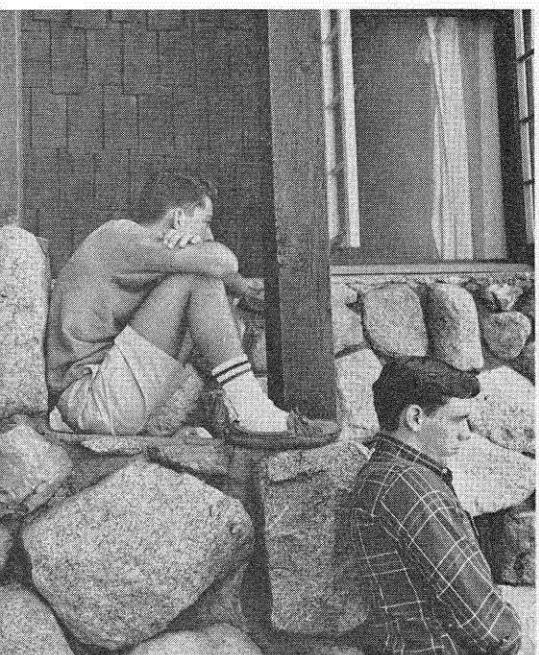
By 1908, Throop had conferred the degree of Bachelor of Arts on only 7 graduates, and Bachelor of Science on 14. But it had survived its early years of struggle, and it was financially solvent. It had the support of the community and the backing of an able and imaginative board of trustees. The school was ready—and the time was ripe—for a new chapter in the history of Throop Institute.



## Freshman Camp

As a last, brief pause before classes begin, Caltech freshmen are eased into college life with advice, admonishment, encouragement, and entertainment by faculty and upperclassmen at the annual three-day freshman camp in the San Bernardino Mountains. Some of their activities are shown on these pages.





# Research Notes

## TEMPERATURE OF A COMET

When the comet Ikeya-Seki passed the earth and whipped around the sun in October 1965, two Caltech scientists had a telescope trained on it from Mount Wilson. Their measurements, the first ever made of a comet's temperature, resulted in some valuable new information. Eric E. Becklin, graduate student in physics, and James A. Westphal, senior research fellow in planetary science, found that variations in the comet's temperature (which was constant from head to tail) were entirely dependent on its distance from the sun, indicating that the comet is essentially a "cold body," generating no heat of its own. They also concluded that this particular comet is composed primarily of metallic material, not ice and dust as has been suggested for comets in general.

This was not Ikeya-Seki's first close pass of the

sun, which may account for its unexpected composition. It may be that the lighter-weight elements were "boiled off" in a previous pass. Apparently Ikeya-Seki is part of a larger comet that long ago passed by the sun on the same orbital path and was broken apart; six fragments of that large comet have been observed since 1843, and all have been in the same orbit as Ikeya-Seki. On this latest pass the comet was broken into two pieces and lost about 65 percent of its mass.

## BLINKING MICROSCOPE

Borrowing a technique used by astronomers to locate exploding stars, Caltech engineers have developed a microscope that detects small changes in metallic crystals. The unique microscope, which may have wide research applications, can either superimpose one image on top of another or rapidly alternate the images. Normally, similar specimens have been viewed side by side in a split field.

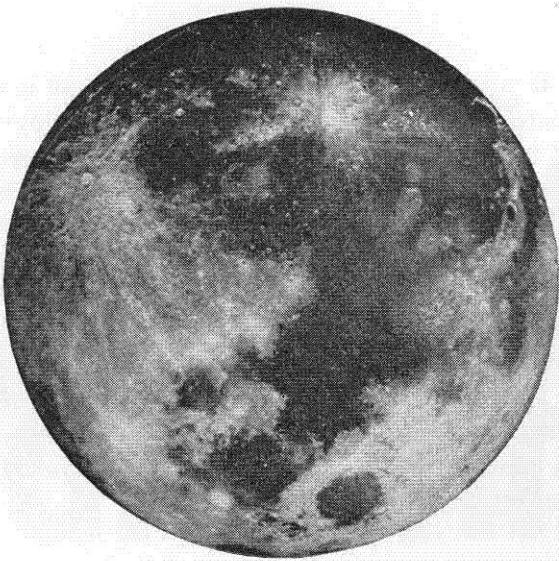
The new microscope was assembled by three materials science engineers—professor David S. Wood, associate professor Thad Vreeland, Jr., and graduate student David P. Pope. They are using it to study the stress-induced movement of dislocation lines in metallic crystals and the ways in which this movement contributes to metal deformation.

Astronomers searching for exploding stars, comets, and asteroids compare pictures of large portions of the sky photographed at different times. By "blinking" two negatives under a low-power viewer (looking at them alternately for a second or less), they can detect small changes in the position or size of objects. Those that have changed position seem to jump back and forth as the images are alternated, and objects that have changed in size seem to pulsate.

The same illusion can now be created when comparing metallic crystals before and after stress is applied. In their work, the engineers compare small x-ray negatives or plastic molds of the crystal surfaces under a magnification of 50 to 500. Disloca-



Comet Ikeya-Seki, first to have its temperature taken



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## Research Notes . . . *continued*

tion lines that have moved appear to shift back and forth as the images are alternated.

### GRAVITY SURVEY

A hidden branch of the San Andreas fault, extending more than 60 miles from the Salton Sea to the Mexican border, has recently been traced by a gravity survey of southern California made by Caltech's Seismological Laboratory. The survey, designed primarily to learn more about the geologic structure of southern California and about variations in the thickness of the area's crust, involved about 30,000 measurements of the force of gravity over the area.

The data were obtained with a gravimeter, a portable device that detects very small differences in the force of gravity. Because denser rocks or minerals produce a greater gravitational pull than lightweight material such as porous sand, a gravimeter moving over an area can delineate structural features many miles beneath the surface.

The survey, which incorporated readings made by scientists at Caltech and elsewhere, showed that one of the southern branches of the San Andreas fault—the Banning-Mission Creek fault—continues southeasterly from the Salton Sea area. Geologists have suspected that the fault did extend in that direction, but were unable to find its trace on the surface. The hidden segment was detected by gravity variations indicative of fault structure.

It was also found that the earth's crust is unexpectedly thin beneath the Imperial Valley—only 13 to 16 miles thick compared to an average over the continent of 20 to 25 miles. The valley, which was once part of the Gulf of California, appears to be a transition zone between the crustal structure that is found under the continent and that which is found under the ocean where the crust is only four to five miles thick.

The survey was coordinated by Shawn Biehler, Caltech research fellow in geophysics, who is now an assistant professor of geophysics at the Massachusetts Institute of Technology.

### STRUCTURE OF PAULINGITE

In 1963 Sten Samson, Caltech senior research fellow in chemistry, determined the structure of the most complex inorganic molecule ever to have its atomic arrangement figured out—a compound of sodium and cadmium. The job of locating each of the compound's 1,192 atoms took more than a year. Now Dr. Samson and graduate student E. Kent Gordon have used the same technique to determine the structure of Paulingite, the mineral having the largest known basic structural unit of any inorganic material—nearly 3,000 atoms.

Dr. Samson's success in this work is due in large part to his intuitive grasp of the architecture and geometry involved in the groupings of atoms. He

*continued on page 22*



*The oasis of Biskra Palms, north of Indio, results from damming of groundwater along the Banning-Mission Creek fault, a branch of the San Andreas. Caltech geophysicists have now traced the fault to the Mexican border.*

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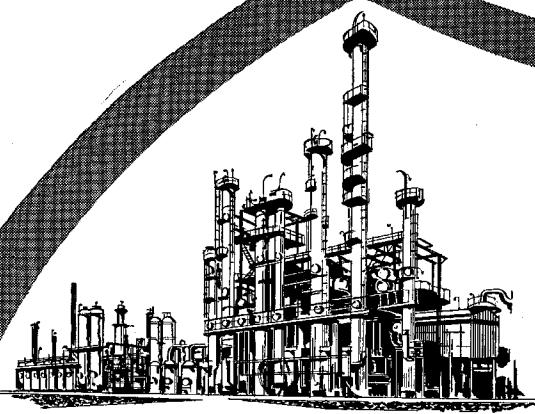
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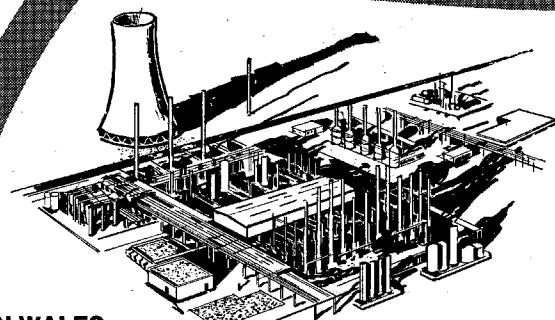
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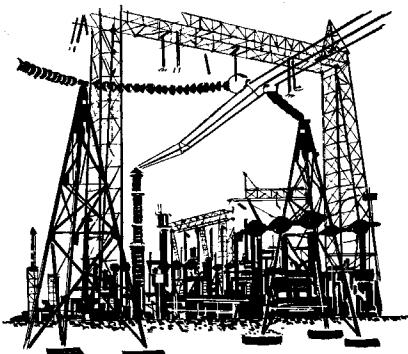
## IN JAPAN

High Purity Ethylene Plant for Kasei Mizushima Petrochemical Company Limited, a Subsidiary of Mitsubishi Chemical Industries Ltd., at Mizushima, Japan.



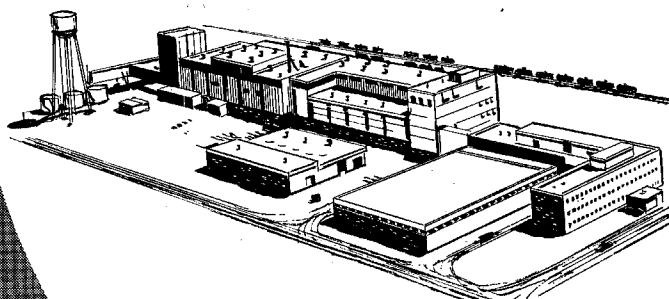
## IN WALES

Petrochemical Complex for British Hydrocarbon Chemicals Limited, Baglan Bay, South Wales.



## IN VIRGINIA

A 375 mile, 500 kv Transmission System for Virginia Electric and Power Company.



## IN CANADA

Titanium Dioxide Plant at Tracy, Quebec for British Titan Products (Canada) Limited.

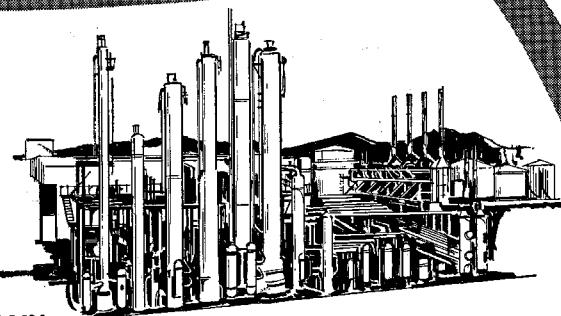


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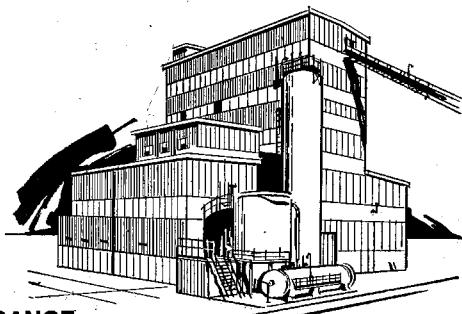
#### IN SPAIN

Spain's first Ethylene Plant for E.N. Calvo Sotelo  
at Puertollano, Spain.



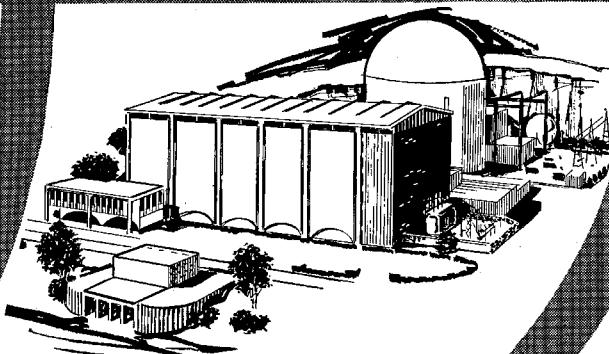
#### IN BRAZIL

Steam Power Generating Station for  
São Paulo Light Co., a Subsidiary  
of Brazilian Traction, at São Paulo, Brazil.



#### IN FRANCE

Chemi-Groundwood Facility for  
Société F. Béghin, S.A.



#### IN CONNECTICUT

Nuclear Powered Generating Station  
for Connecticut Yankee Atomic Power  
Company, Haddam Neck, Connecticut.



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uses a two-step technique, first taking an x-ray diffraction photograph of the material to find the size of the basic unit and get a general picture of the symmetry of the atomic arrangement. He then combines the x-ray information with unique "symmetry charts" he has devised, painstakingly working out the exact arrangement of atomic groupings.

The basic unit of Paulingite is a framework of 2,106 silicon, aluminum, and oxygen atoms, with about 800 positively charged metal atoms and water molecules distributed within the framework. The mineral was discovered several years ago by Barclay Kamb, Caltech professor of geology and geo-physics, who named it after his father-in-law, Caltech research associate Linus Pauling, chairman of the division of chemistry and chemical engineering from 1936-58.

### THE ICE CAPS OF MARS

The planet Mars is a tantalizing subject for astronomers, close enough for photography of its surface features, but too far away to reveal those features very clearly. As a result, what one man sees, another doubts, and one interpretation is refuted by another. But observers have been fairly well agreed on at least one Martian feature—the ice caps on the poles. Many photographs show them, and spectroscopists have confirmed the presence of water in the ice. Now two Caltech scientists have raised some doubts about *this*; they propose that the ice in the polar caps is actually composed of carbon dioxide (dry ice) rather than water.

Robert Leighton, professor of physics, and Bruce Murray, associate professor of planetary science, have come to this conclusion after completing a study of what the behavior of volatile materials ought to be on Mars. The men think that any water that does exist there, except for a little bit in the ice caps, is probably contained in the form of permafrost under the polar regions and possibly under the temperate regions as well. They also suggest that volatile organic compounds, if they exist on the planet at all, may tend to concentrate in the polar regions.

The Caltech study involved the application of available data to a simple thermal model of Mars. It utilized results of last year's spectacular Mariner IV flight to Mars, primarily the value for atmospheric pressure (about 0.5 percent that of the earth) and the inferred composition of the Martian atmosphere (mostly carbon dioxide).

The scientists first devised a thermal model of the planet's surface. Then, using Caltech's 7094 computer, they evaluated the heat balance for a sample period of several years, computing nightly and annual temperature variations for the surface at various latitudes. With little atmosphere to transport heat energy on Mars and no oceans to equalize temperatures over the planet, it is probable that the surface temperatures there are governed almost entirely by latitude and time of day.

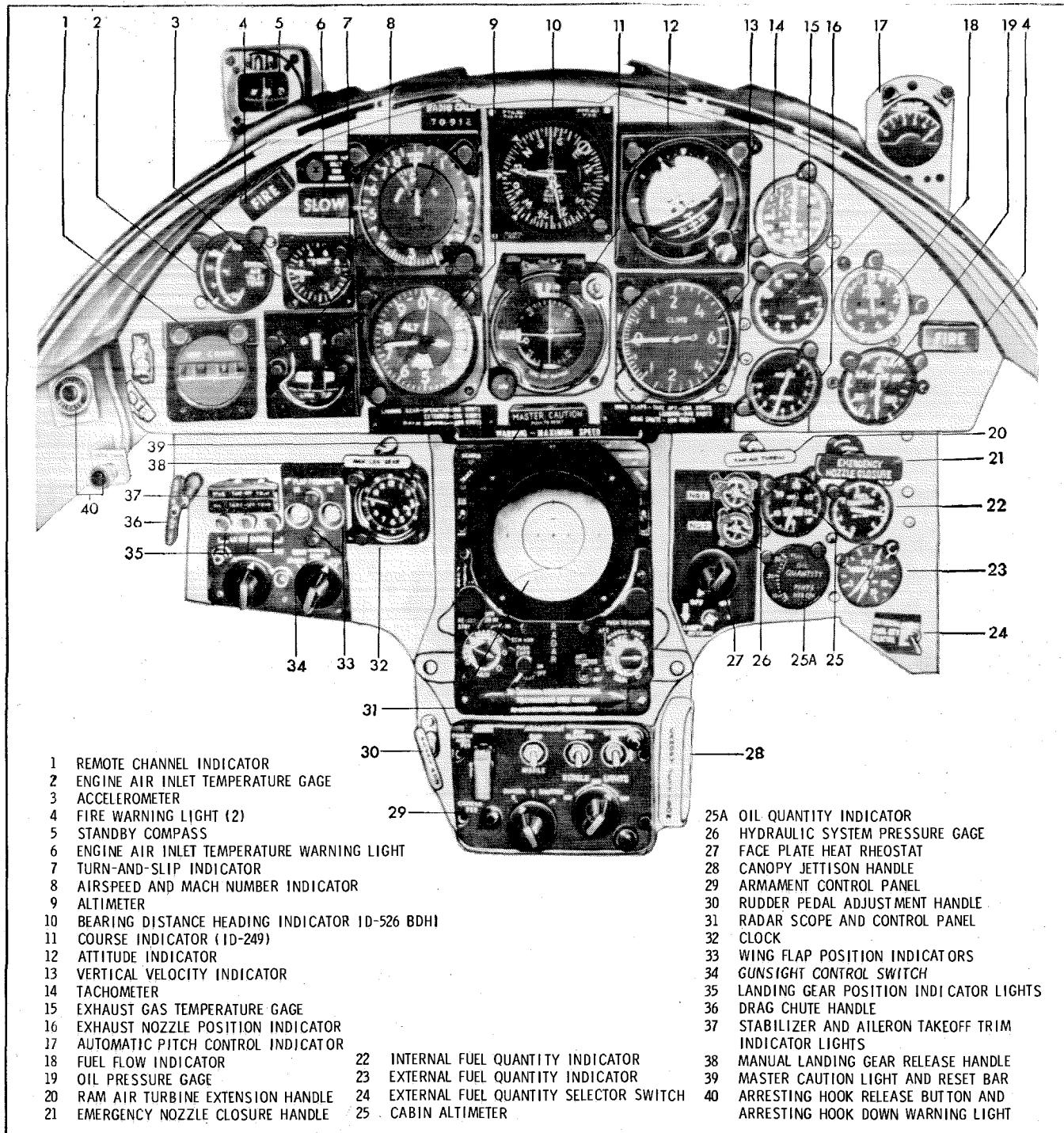
It was found that the minimum nighttime temperature near the equatorial latitudes would remain above 145°K (the freezing point of carbon dioxide on Mars) at all seasons of the year, but would drop considerably below that temperature in winter at subpolar and polar latitudes. Thus, carbon dioxide, the dominant constituent of the atmosphere, would precipitate and accumulate at the higher latitudes during the Martian winter. As for reports of water in the polar caps, there may be a very thin coating on the top which remains as the carbon dioxide underneath evaporates.

Confirmation of these conclusions may come from earth-based observations during the 1967 opposition or from the scheduled 1968 flight of a Mariner spacecraft to Mars, at which time high-resolution measurements of the temperature at the polar caps and on the dark side of Mars are planned.

### POLLUTANT DISPERSION IN RIVERS

Engineers now have a reliable and practical way to predict the dispersion rate of a sudden dose of pollutants in a river as a result of work done by Caltech graduate student Hugo Fischer, now assistant professor of hydraulic engineering at Berkeley. He did the research under the direction of Norman Brooks, professor of civil engineering, in Caltech's Keck Engineering Laboratories.

Dr. Fischer has found a theoretical method for predicting the extent of danger to water supplies from accidental spillage of pollutants. Up to now, such risks were evaluated experimentally by dumping dye into the river and then analyzing how it became diluted as it spread downstream. This method is time-consuming and expensive; it must be done separately for each river, and it is impractical for large rivers. The Fischer method makes use of a mathematical formula that simply requires knowledge of how the depth and currents vary across a section of river—information that is already on file for many rivers.



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*Once an isolated boathouse, Caltech's marine lab is now an academic stronghold among residential high rise.*

## Renovation of An Old Shell

Caltech's William G. Kerckhoff Marine Laboratory—where Thomas Hunt Morgan once studied self-sterility in the hermaphroditic ascidian, and many other distinguished Institute scientists of the past did research—has now been treated to an eight-month, quarter-million-dollar rejuvenation. Work was begun in November 1965 on the 40-year-old Spanish-style building which stands at the entrance to Newport Harbor in Corona del Mar. In July 1966, when all but a few details were completed, biologists moved their research projects back into a completely renovated laboratory.

The lab was built in 1926 as a boathouse and bathhouse for the exclusive Palisades Club. Four years later it was bought by Caltech with funds given by William Kerckhoff. Today, after its first major overhaul in 36 years, its outer shell remains the same, but the interior has been totally revamped. Now eight individual laboratories, a common laboratory with centrifuges and other equipment for cell physiology and biochemistry, one large laboratory used for instruction and seminars, and miscellaneous supporting rooms offer working facilities for a dozen researchers. Aquarium tanks of continuously circulating seawater have been enlarged to triple the lab's storage capacity. A four-unit apartment built next to the lab offers accommodations for the staff and visiting researchers.

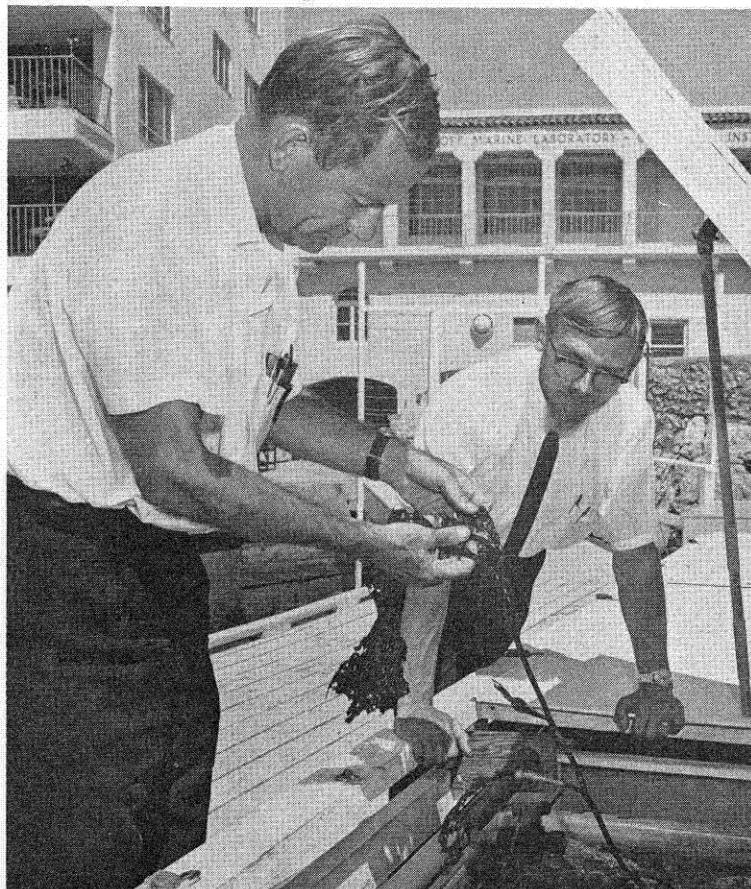
Among the major projects resumed when the reconditioning was complete is the work of Charles Brokaw, Caltech associate professor of biology, whose team is studying the swimming mechanisms of spermatozoa. Sea animals used in the research are abundant in the area and are gathered with the aid of the lab's sea-going fleet—a 24-foot inboard launch and a 12-foot skiff.

Other divisions of the Institute also maintain research teams at the lab. For example, Wheeler

North, associate professor of environmental health engineering, is conducting studies of the ecology of kelp in polluted water. George Clark, graduate student in geology, is studying the changes in the chemistry and form of the scallop shell in response to changes in its environment; and Heinz Lowenstam, professor of paleoecology, is setting up a project to catalog the types of scratches that chitons and tippets make on the rocks with their teeth.

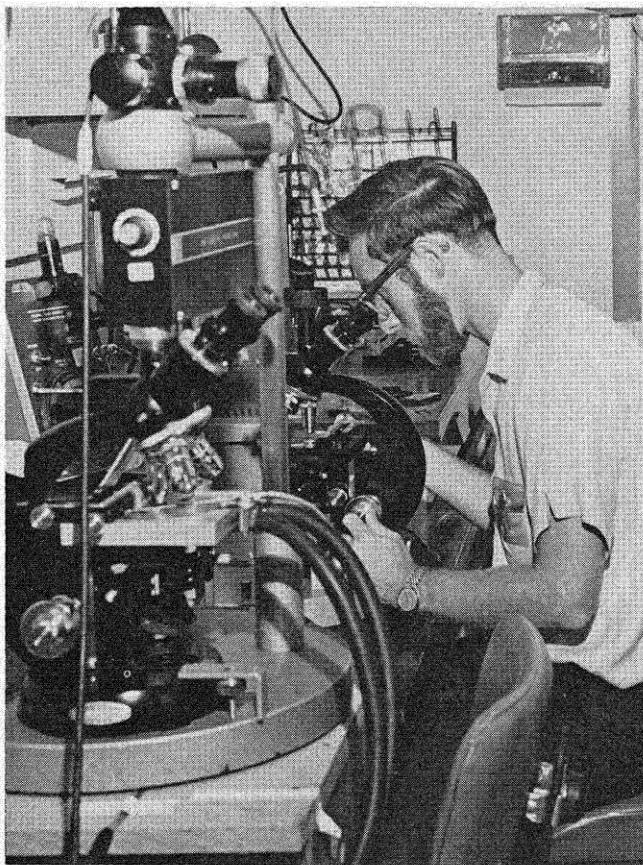
Other Caltech personnel will be moving their projects and teams into the lab within the next few months, and investigators from other institutions will be coming to Corona to do research.

*Caltech's Wheeler North and Charles Brokaw have major projects under way at the marine lab.*

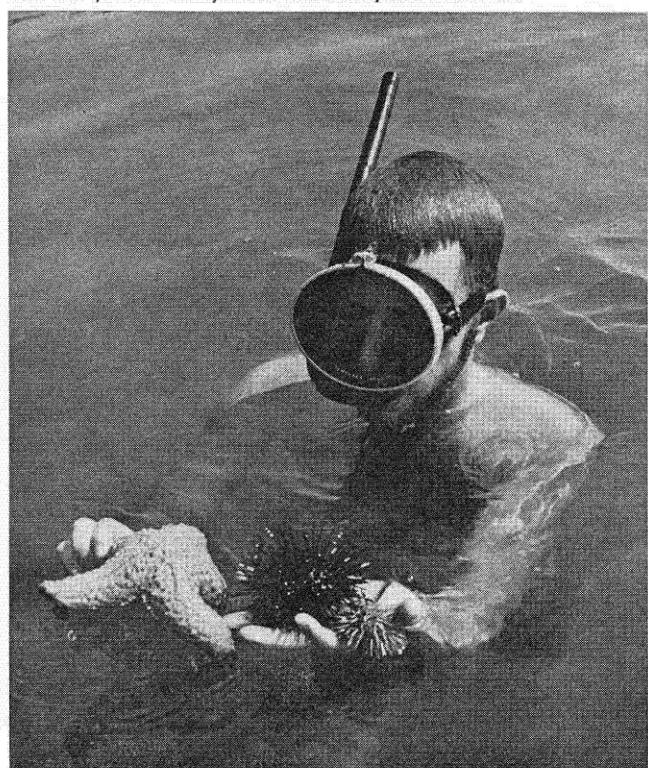




Dr. Brokaw's research requires abundant supplies of sea urchins available in Corona waters.

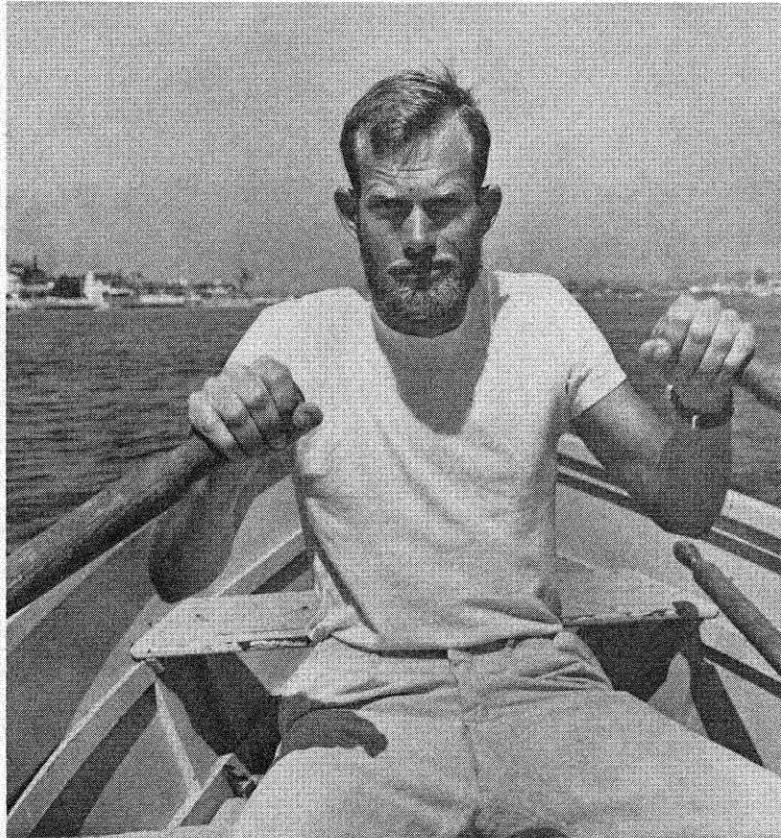


Graduate student Stuart Goldstein works with new laser microbeam equipment in the laboratory.



Bob Schor, Caltech senior in biology, scuba dives for marine flora and fauna in Newport Harbor.

The lab's skiff is taken by research assistant Einar Anderson to collect specimens in the harbor.



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# The Summer At Caltech

## *Chemical Physics Laboratory*

Construction has begun on the \$4 million Arthur Amos Noyes Laboratory of Chemical Physics, named for the distinguished chemist who helped pioneer the development of Caltech. The five-story laboratory, scheduled for completion by September 1967, will be the largest building on the campus and will provide space for more than 80 people as well as for the complex instruments required for research in the field embracing chemistry and physics.

Located on San Pasqual Street across from the Church Laboratory, the building will be of contemporary design with three floors above ground and two below.

## *Board of Trustees*

John E. Barber, who has served on the Caltech board of trustees continuously since 1954, has resigned as vice chairman of the board and has been elected an honorary trustee.

Three new members have recently been elected to the board: Reed O. Hunt, chairman of the board and chief executive officer of the Crown Zellerbach Corporation; James C. Self, textile company executive and president of Greenwood Mills in South Carolina; and Arthur M. Wood, vice president of Sears, Roebuck and Company for the Pacific Coast.

Shannon Crandall, Jr., a Caltech trustee since 1955, died on June 30. He had served as vice chairman of the board from 1957 until 1965, when he resigned and became an honorary trustee.

## *Honors and Awards*

Harrison S. Brown, professor of geochemistry, has been elected to a second four-year term as for-

eign secretary of the National Academy of Sciences, responsible for arranging U.S. participation in international scientific organizations and programs. Dr. Brown also was awarded an honorary doctor of sciences degree by Amherst College in June.

Frederick C. Lindvall, chairman of the division of engineering and applied science, recently received the Lamme Award of the American Society of Engineering Education, given annually to a distinguished engineer and educator who has contributed to the advancement of both professions. Dr. Lindvall also was awarded an honorary doctor of engineering degree by Purdue University in acknowledgment of his contributions to curriculum development in electrical engineering when he was a visiting professor there from 1963-65.

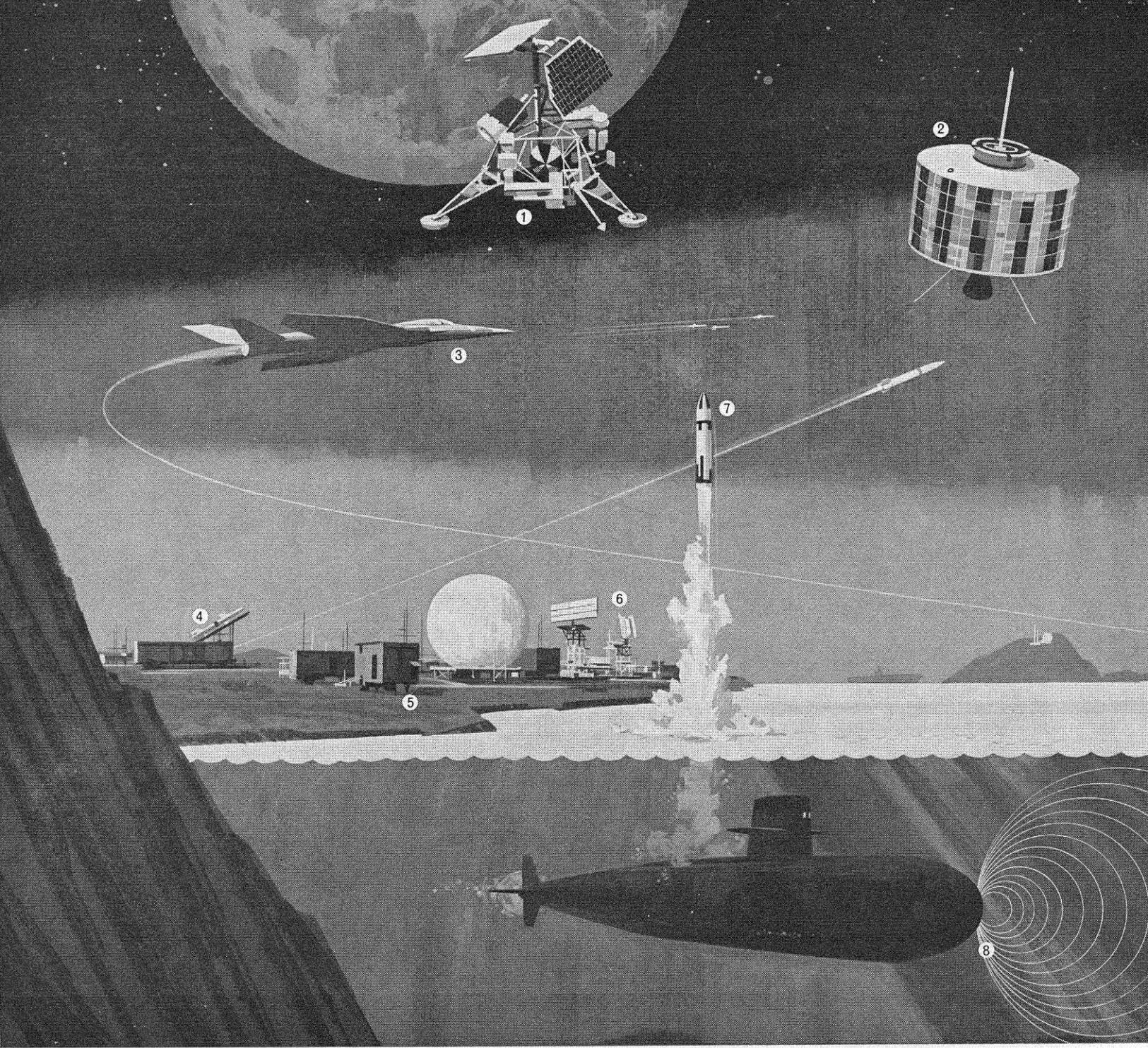
Frank E. Marble, professor of jet propulsion and mechanical engineering, has been elected a fellow of the American Institute of Aeronautics and Astronautics. The award, in recognition of significant achievements in aerospace technology, will be presented at the AIAA's December meeting in Boston.

William H. Pickering, director of Caltech's Jet Propulsion Laboratory, continues to receive honors for his space exploration contributions. He was awarded the Spirit of St. Louis Medal by the American Society of Mechanical Engineers and the city of St. Louis in May and, in June, he received an honorary doctor of science degree from Clark University in Worcester, Massachusetts.

John D. Roberts, chairman of the division of chemistry and chemical engineering, is winner of the American Chemical Society's 1967 Roger Adams Award in Organic Chemistry, given in recognition and encouragement of his outstanding contribu-

*continued on page 30*

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### Ph.D. Candidates CAMPUS INTERVIEWS

November 16, 1966

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## The Summer . . . *continued*

tions to research in organic chemistry—specifically his investigations on small ring carbon compounds.

Allan R. Sandage, staff member of the Mount Wilson and Palomar Observatories, is the first astronomer to receive the Pius XI Gold Medal for particular excellence in science, presented to him by Pope Paul VI at the Vatican Palace during a week-long meeting of the Pontifical Academy of Sciences in Rome recently.

### *Thomas Hunt Morgan Centennial*

Eight Caltech faculty members took part in a centennial symposium in memory of Thomas Hunt Morgan, first chairman of the Institute's division of biology, which was held last month in Lexington, Kentucky, where Morgan was born. James F. Bonner, Norman H. Horowitz, and Albert Tyler, professors of biology; Alfred H. Sturtevant, Thomas Hunt Morgan Professor of Biology, Emeritus; Henry

Borsook, professor of biochemistry; William B. Wood, assistant professor of biology; and Geoffrey Keighley, research associate in biology, participated in the program at the University of Kentucky.

### *First Leader*

Paul Goodman, author, playwright, literary and social critic, pacifist, teacher, and unofficial philosopher of the Berkeley Free Speech Movement, was on the Caltech campus for three days of discussions and meetings this month, as the YMCA's first Leader of America for the 1966-67 program.

### *New Coach*

Thomas Gutman, outstanding player for UCLA's 1959-61 football teams, is Caltech's new varsity football line coach and the Institute's first full-time wrestling coach. He has been on the coaching staff of Beverly Hills High School for the past three years.

## **Faculty Changes 1966-1967**

### PROMOTIONS

#### *To Professor:*

ALLAN J. ACOSTA — *Mechanical Engineering*  
ARDEN L. ALBEE — *Geology*  
ARTHUR J. BOUCOT — *Paleontology*  
EVERETT C. DADE — *Mathematics*  
ROGER F. DASHEN — *Theoretical Physics*  
RICHARD A. DEAN — *Mathematics*  
ROBERT S. EDGAR — *Biology*  
DEREK H. FENDER — *Biology and Applied Science*  
STEVEN C. FRAUTSCHI — *Theoretical Physics*  
F. BROCK FULLER — *Mathematics*  
ROBERT A. HUTTENBACK — *History*  
JON MATHEWS — *Theoretical Physics*  
AMNON YARIV — *Electrical Engineering*  
FREDERIK ZACHARIASEN — *Theoretical Physics*  
EDWARD ZUKOSKI — *Jet Propulsion*

#### *To Associate Professor:*

JOHN F. BENTON — *History*  
FRED E. C. CULICK — *Jet Propulsion*  
DONALD E. KNUTH — *Mathematics*  
THAYER SCUDDER — *Anthropology*  
DAVID R. SMITH — *English*  
BRADFORD STURTEVANT — *Aeronautics*  
GEORGE ZWEIG — *Physics*

#### *To Senior Research Fellow:*

WILLIAM R. GRAY — *Biology*  
EMERSON HIBBARD — *Biology*  
SUDARSHAN MALHOTRA — *Biology*  
RICHARD B. READ — *Radio Astronomy*  
R. H. STANFORD, JR. — *Chemistry*

### *To Assistant Professor:*

BARRY C. BARISH — *Physics*  
PAUL C. JENNINGS — *Applied Mechanics*  
BYRD L. JONES — *History*  
DANIEL G. KEEHN — *Applied Science*  
ALAN T. MOFFET — *Radio Astronomy*  
RUSSELL M. PITZER — *Theoretical Chemistry*  
BOB G. SANDERS — *Biology*  
BRUCE A. SHERWOOD — *Physics*

### NEW FACULTY MEMBERS

#### *Professors:*

NOEL CORNGOLD — *Applied Science* — from Brookhaven National Laboratory, where he was a member of the senior scientific staff.  
HARRY B. GRAY — *Chemistry* — from Columbia University, where he was professor of chemistry.

#### *Associate Professors:*

CHARLES B. ARCHAMBEAU — *Geophysics* — from United Electrodynamics in Virginia, where he was a research scientist.  
PETER GOLDREICH — *Planetary Science and Astronomy* — from UCLA, where he was associate professor of astronomy and geophysics.

#### *Senior Research Fellows:*

S. K. BHATTACHERJEE — *Physics* — from Tata Institute of Fundamental Research in Bombay, India, where he was associate professor.  
ISAIAH GALLILY — *Environmental Health Engineering* — from Tel Aviv, Israel.  
GORDON P. GARMIRE — *Physics* — from MIT where he was assistant professor of physics.

ROBERT F. ROY — *Geophysics* — from Harvard University, where he was a research fellow.

ANTHONY R. THOMPSON — *Radio Astronomy* — from Stanford University's Radio Astronomy Institute, where he was a radio astronomer.

*Assistant Professors:*

ALAN J. ARDELL — *Materials Science* — from Cambridge University, where he was a National Science Foundation research fellow.

EUGENE H. GREGORY — *Physics* — from UCLA, where he was assistant professor of physics.

ANDREW P. INGERSOLL — *Planetary Science* — from Harvard University, where he was a research associate.

W. L. W. SARGENT — *Astronomy* — from the University of California at San Diego, where he was assistant professor of astronomy.

J. MICHAEL SMITH — *Chemistry* — from UCLA, where he was a graduate student.

*Lecturers:*

DAVID P. MOZINGO — *Political Science* — from The RAND Corporation, where he is a specialist on China.

*Instructors:*

ROBERT C. ANDERSON — *Economics* — from Claremont College, where he is a graduate student in economics.

MICHAEL R. DOHAN — *Economics* — from MIT, where he was an instructor in economics.

JAMES W. GREENLEE — *French* — from the University of Illinois, where he was instructor in French.

EUGENE SPIEGEL — *Mathematics* — formerly a research fellow at Caltech.

**ON LEAVE OF ABSENCE**

ROGER F. DASHEN, professor of theoretical physics, to do theoretical research on elementary particles at the Institute for Advanced Studies, Princeton, and in Europe.

STERLING EMERSON, professor of genetics, to the Institute of Genetics in Copenhagen, as visiting professor.

BARCLAY KAMB, professor of geology and geophysics, to MIT as Crosby Visiting Professor.

DANIEL J. KEVLES, assistant professor of history, to Washington, D.C., to do research for a book at the Library of Congress and the National Archives.

CALEB W. MCCORMICK, JR., associate professor of civil engineering, to participate in industrial research.

JOHN B. OKE, professor of astronomy, staff member, Mount Wilson and Palomar Observatories, to do research at Mt. Stromlo Observatory in Canberra, Australia.

GERALD J. WASSERBURG, professor of geology and geophysics, to do research, on a National Science Foundation fellowship, in schools in Bern and Zurich, Switzerland.

**RESIGNATIONS**

PAUL J. BLATZ, associate professor of materials science, to North American Aviation Science Center at Thousand Oaks, Calif.

YUAN-CHENG FUNG, professor of aeronautics, to the University of California at San Diego.

ADRIANO M. GARSIA, professor of mathematics, to the University of California at San Diego.

WILLIAM P. SCHAEFER, assistant professor of chemistry, to the University of California at Davis.

RUSSELL A. WESTMANN, assistant professor of civil engineering, to UCLA.

RONALD H. WILLIAMS, associate professor of materials science, to the Bell Telephone Laboratories in Murray Hill, N.Y.

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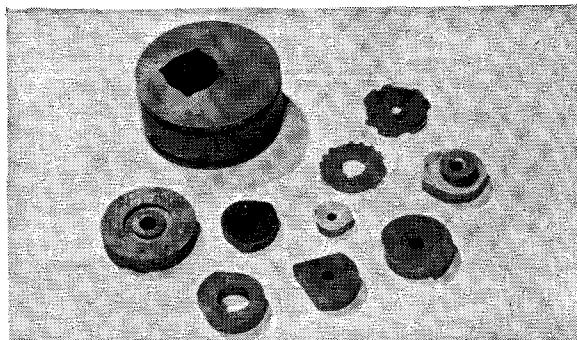
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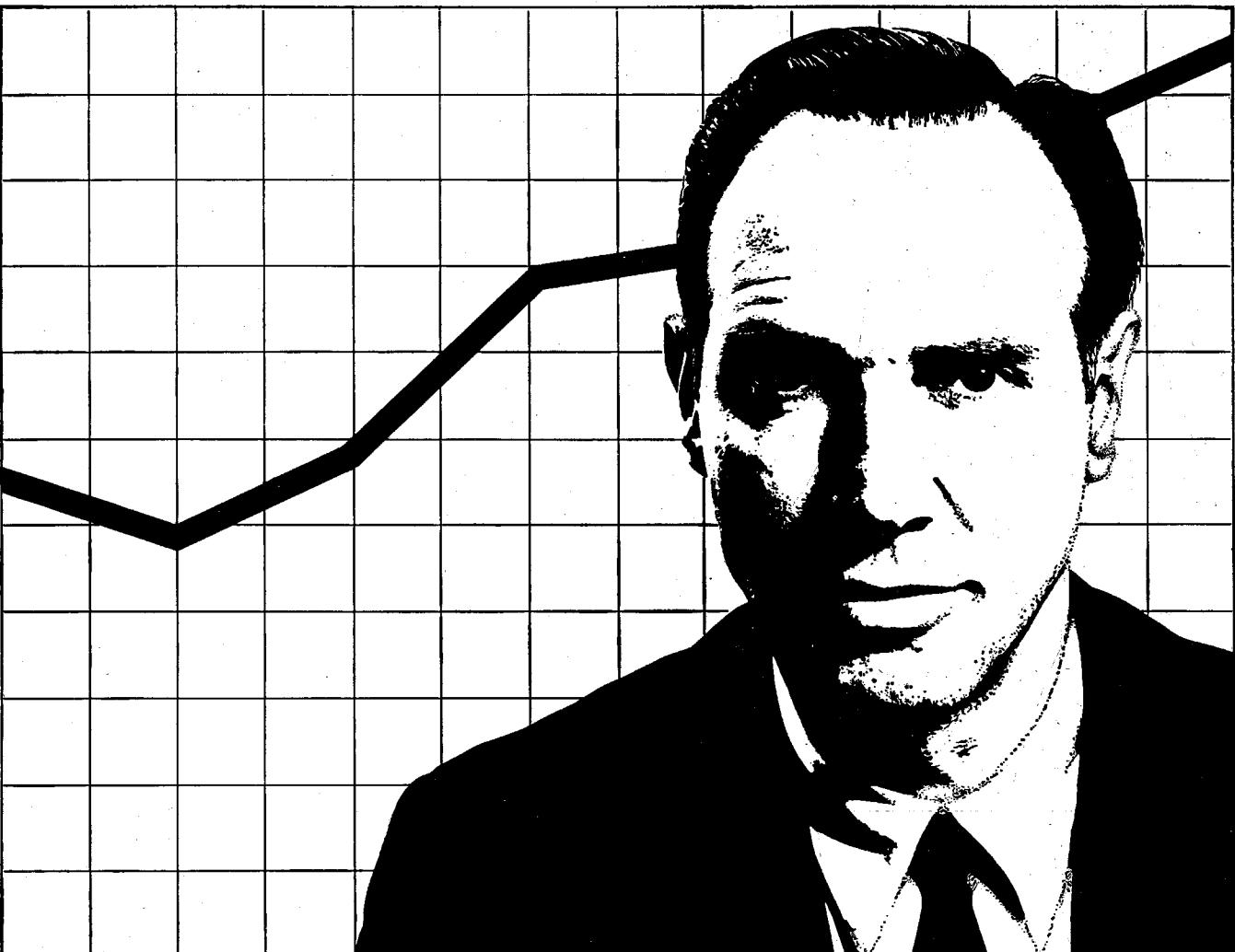


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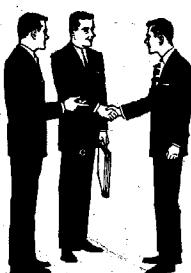
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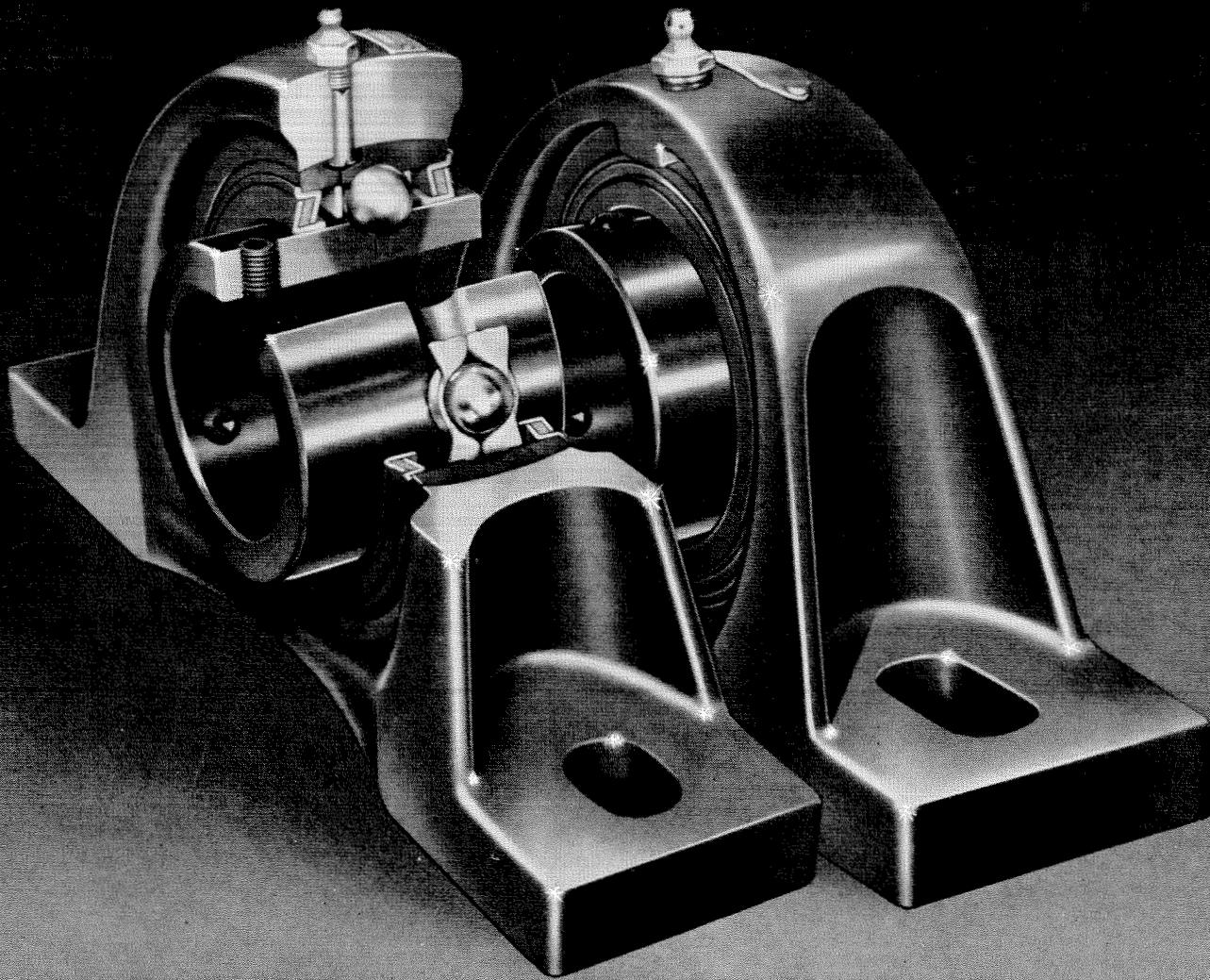
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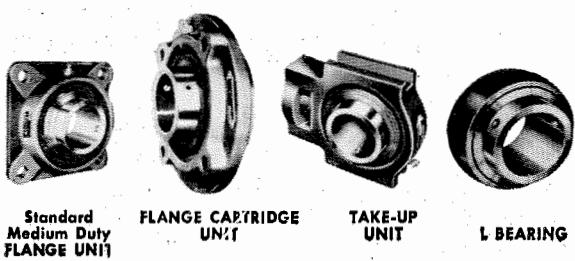
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# Personals

1920

VIRGIL BEST died in July at the age of 71, following a short illness. He was owner of the Best Machine Works in Pasadena and a retired science teacher. Best taught in Pasadena for 31 years, first at Lincoln and then at Garfield high schools, where he was head of the science department when he retired in 1953. He is survived by his wife, Marie, a son and daughter, and five grandchildren.

1926

C. Y. HSIAO works for the Chinese Government Mission in Washington, D.C., and lives with his family in Silver Spring, Md. He reports that of the four students from China who graduated in 1926, two, Y. H. HUANG and H. Y. CHANG, are "lost in the China mainland," and the third, J. C. HUANG, is a chemist in Formosa.

SEERLEY G. KNUPP writes that he has been practicing law in Whittier, Calif., since 1936. At the time of the reunion he was fishing in Baja California.

JOSEPH MATSON JR. is project coordinator for the B. P. Bishop Estate in Honolulu. He sends word that MIKE BRUNNER, '25, was in Hawaii for a month last spring.

AL SCHUELER writes that he is due to retire from his job as consulting engineer with the Westinghouse Electric Corp. in Beaver, Pa., early in 1967.

1927

GEORGE E. MOORE is professor of physics at the State University of New York at Binghamton this fall. He retired in August after 39 years with the Bell Telephone Laboratories in Murray Hill, N.Y. During his years with Bell he did research in electron tubes and oxide cathodes and, since 1950, specialized in chemical physics research. Moore and his wife have three children and two grandchildren.

1932

JAMES BRADBURN has been named division vice president and general manager of electronic data processing for the Radio Corporation of America in New York City. He is now responsible for the over-all direction of RCA's computer activities.

1935

DICKSON M. SHEPPARD has completed his assignment as director of the Good-year Technical Center in Colmar-Berg, Luxembourg, and has returned to Akron, Ohio, to await reassignment.

1936

PAUL S. JONES died in July in Pasadena. He had been a civil engineer with the California Division of Highways for the past 18 years. He is survived by his wife, three daughters, and a son.

JOHN L. WEBB, PhD '40, died last July, apparently of a heart attack, while driving to his mountain cabin at Idyllwild, Calif. Webb was chairman of the department of pharmacology in the USC School of Medicine. He had been on the faculty since 1940 and was widely known for his research in bioelectrical phenomena in relation to heart function. He was also an authority on experimental uses of drugs to block actions of enzymes in the heart. He is survived by his wife, Julia.

MICHAEL M. McMAHON has just completed 30 years with Pacific Lighting Service and Supply Company in Los Angeles, where he is manager of supply analysis. He and his wife live in Pasadena.

BRUCE L. HICKS, PhD '39, is research professor at the Coordinated Science Laboratory of the University of Illinois.

GLENN R. CARLEY is a group leader with the North Atlantic Treaty Organization at the Saclant ASW Research Centre in La Spezia, Italy.

CURTIS G. CORTELYOU is with the Mobil Oil Corporation in New York as worldwide coordinator of their air and water conservation program. The Cortelyous have four children and four grandchildren.

RICHARD W. DODSON is chairman of the department of chemistry of Brookhaven National Laboratory on Long Island, N.Y.

MINOR L. FAHRMANN, MS '37, has been with the Standard Oil Company of California since he left Caltech in 1937. He is currently chief engineer in charge of engineering, maintenance, and construction for the company's eastern subsidiary, Chevron, and lives in Westfield, N.J., with his wife and four children.

HENRY J. GOODWIN, MS '37, is a civil engineer and building contractor in Palos Verdes, Calif.

RAY A. JENSEN, MS '37, has been with Hughes Aircraft for 26 years. He and his wife have two sons; one is a freshman at Caltech.

ROBERT D. KENT has been with the engineering department of Texaco in Houston, Texas, for the past six years. He and

his wife have five children, ranging in age from 4 to 12.

HISAYUKI KURIHARA, MS '37, '38 is assistant cost and operations manager for Esso Standard Sekijo Kabushiki Kaisha in Tokyo. His son is attending MIT, and his daughter is in a university in Tokyo.

VERNE L. PEUGH is retired, but for one quarter each year teaches a graduate class at Stanford University on "heavy construction estimates." He is also writing a textbook on the subject.

APOLLO O. SMITH, MS '37, '38, recently received his 25-year pin from the Douglas Aircraft Company. He and his wife have a married daughter and two children at home in San Marino, Calif.

TYLER F. THOMPSON, professor of philosophy of religion, is in his 15th year at Garrett Theological Seminary in Evanston, Ill. He and his wife have five children: the oldest, married; the youngest, a sixth grader.

KARL UNHOLTZ, MS '39, is vice president of Unholtz-Dickie Corporation in Hamden, Conn. His only daughter graduated recently from Lake Erie College in Painesville, Ohio.

KENICHI WATANABE, PhD '40, is professor of physics and astronomy at the University of Hawaii in Honolulu.

1937

LAWRENCE T. FLEMING, research engineer at the Bell & Howell Research Center in Pasadena, has been named a fellow of the Acoustical Society of America and was cited for his contributions to the art of vibration measurement and design of accelerometers. He has been engaged in research involving physical measurements since the center was established in 1960.

1939

STEPHEN C. CLARK is an operations research analyst in the division of operations analysis in the U.S. Office of Education in Washington, D.C. He was formerly with the IBM Systems Research and Development Center at the Irvine campus of the University of California. Clark, whose wife, Anne, died in 1962, has a daughter attending the University of California at Riverside and two younger daughters living with his mother in St. Helena, Calif.

1940

FRED BRUNNER, MS '41, is manager of engineering in the Frankfurt, Germany, office of the Ralph M. Parsons Company. The Brunners have two sons in college in

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## Personals . . . *continued*

New York and a third son who graduated last June.

### 1941

ROBERT L. NOLAND has been elected executive vice president of AMETEK, Inc., in New York. He will direct and coordinate the company's manufacturing operations. Noland was previously executive vice president and vice chairman of the board of Haveg Industries, Inc.

### 1943

LEON KATZ, PhD, head of the physics department and director of the Linear Electron Accelerator Laboratory at the University of Saskatchewan in Saskatoon, Canada, is one of the nine university representatives appointed to the newly established Science Council of Canada. He has been with the university since 1946 and is well known for his part in establishing the laboratory—Canada's first. In 1957 he was Canada's only invited guest at the All Union Conference of the Academy of Sciences in the USSR.

### 1944

PAUL H. WINTER writes from Honolulu that his family and friends sailed their yacht, "Eolo," in June, on a 14-day passage from Long Beach to Hawaii, where they plan to stay and work for at least a year.

A. J. A. MORGAN, MS '47, PhD '51, professor of engineering at UCLA, was awarded a Fulbright travel grant to spend a sabbatical year, 1966-67, as visiting professor at the Royal Institute of Technology in Stockholm.

### 1945

WILLIAM H. EBERHARDT, PhD, professor of chemistry at the Georgia Institute of Technology in Atlanta, recently received an award from the Society of Sigma Xi for a research paper.

RAYMOND F. BERBOWER, assistant chief harbor engineer of the Port of Long Beach, Calif., recently received the C. A. Hogentogler Award of the American Society for Testing and Materials for his work on a paper on soils for engineering purposes. He has been with the engineering division of the port since 1946.

### 1946

JOHN EATON FLEMING is assistant professor of management at UCLA, where his eldest son is enrolled as a freshman. For the past two years Fleming has been on the faculty of California State College at Los Angeles. He and his wife and their five children live in San Marino.

HAROLD L. SARMENTO has been appointed supervisor of the Los Angeles division of Owens-Corning Fiberglas Corporation's commercial and contracting department. He was formerly sales branch manager for the company in Pittsburgh.

JOSEPH O. WEISENBERG, MS, AE '47, is assistant professor in the bureau of business management at the University of Illinois. He retired last year as a commander in the U.S. Navy, after 24 years of service.

ALI B. CAMBEL, MS, has been appointed director of the research and engineering support division of the Institute for Defense Analyses in Arlington, Va., a non-profit research organization sponsored by 12 of the leading universities of the nation. Before his appointment, Cambel held the Walter P. Murphy Distinguished Professorship at Northwestern University.

### 1947

FLOYD K. BECKER, MS, has been promoted to head of the exploratory development department in the customer telephone systems laboratory at Bell Telephone Laboratories in Holmdel, N.J. He has been with the Bell system since 1947, most recently serving as supervisor in the data communications development laboratory.

DAVID L. DOUGLAS, PhD '51, has been appointed vice president—research of Gould-National Batteries, Inc., in Minneapolis, Minn. He will continue as director of the research and development laboratory and will have further responsibilities for corporate technical planning.

JACK A. GIBBS, MS, retired this year after 28 years in the U.S. Air Force. He was brigadier general in command of the Sixth Air Force Reserve Region at the time of his retirement. Prior to that assignment he was deputy director of operational requirements at USAF headquarters in Washington. Gibbs received the Legion of Merit, one of the nation's highest peacetime decorations, while a member of the 1007th Air Intelligence Support Group on an earlier assignment in Washington.

COLONEL PAUL G. ATKINSON JR., MS, is the new commander of the Aerospace Research Laboratories at Wright-Patterson AFB in Dayton, Ohio, where basic research in the physical and engineering sciences is conducted. Atkinson has served more than 15 years in propulsion research and development and is a member of the propulsion and energetics panel of the NATO aerospace research and development advisory group. In his 23 years of military service, he has been decorated with two of the nation's highest

awards: the Distinguished Service Cross and the Legion of Merit.

JOE ROSENER JR. writes that he and his wife, Judy, plan to attend the Second Inter-American Partners of the Alliance Conference in Rio de Janeiro, Brazil, this fall. As chairman of the California Partners of the Alliance Committee (a non-government offshoot of the Alliance for Progress) Joe has already made trips to several Mexican states. The most recent was a 3,500 mile trip with his family by camper to Puerto Vallarta. He reports that he can well understand why few people drive to Puerto Vallarta. Joe ran into JIM THORP, '48, in Santa Fe, New Mexico, where Jim manages The Bishop's Lodge.

CHARLES B. SHAW JR. writes that he and Luchia Evelyn Powers were married in June in Las Vegas. Shaw is senior technical specialist in physical sciences at the autonetics division of North American Aviation in Anaheim, Calif.

A. H. J. MUELLER, MS '49, has been appointed assistant manager of the Tucson division of Hughes Aircraft. He has been with Hughes since September 1951, and prior to this appointment he was assistant program manager for operations of the Phoenix missile system, aeronautical systems division.

### 1948

THORNTON A. WILSON, MS, vice president—operations and planning of the Boeing Company, Seattle, has been elected a member of the company's board of directors. He was at one time manager of the Minuteman ICBM program for Boeing.

BYRON L. YOUTZ, professor of physics and executive assistant to the president of Reed College in Portland, conducted two seminars in Japan in August, arranged by the Japanese Science Education Society. The week-long courses were attended by science teachers, college professors, and officials of the ministry of education. Youtz has also taught in special institutes in Rhodesia and Chile.

### 1949

DAVID BARON writes that he has recently been appointed public service director in charge of the public works department of Westminster, Calif. Baron had been serving as assistant city engineer since 1965, and before that time was assistant county surveyor in Bakersfield. He and his wife have three sons and a daughter.

### 1950

CAPTAIN JOHN T. SHEPHERD, USN, is now assistant chief of staff for operations for the U.S. Naval Forces in Vietnam. From there he will go to Yokosuka, Japan,

to assume command of the Navy general stores ship, the USS Pollux.

WILSON BRADLEY JR., president of the electronics division of Becton, Dickinson & Co., Rutherford, N.J., and of its subsidiary, Endevco Corp. of Pasadena, has been named a director and a corporate vice president of the parent company.

1951

GRAYDON D. BELL, MS, PhD '57, has been promoted to professor of physics at Harvey Mudd College in Claremont.

BRUCE B. HEDRICK is serving as vice president of the Hugh Carter Engineering Corporation of Long Beach, a firm which has recently been incorporated and expanded.

1952

MICHAEL J. CALLAGHAN has accepted an assignment in the manufacturing technological department of the Shell Oil Company's head office in New York. He has been a research engineer at the company's Emeryville, Calif., research center since 1964.

1953

BERT E. BROWN, MS, has been promoted to associate professor of physics at the University of Puget Sound in Tacoma, Washington, where he has been a member of the faculty since 1960. He received his PhD from Oregon State University in Corvallis in 1963, for work on theoretical calculations of atomic structures.

1954

EDWARD J. GAUSS sends news of a recent achievement . . . a blue ribbon for the largest cabbage at the Alaska State Fair. The prize included \$1 for each of its 25 pounds. When not growing cabbages Ed heads the University of Alaska Computer Center.

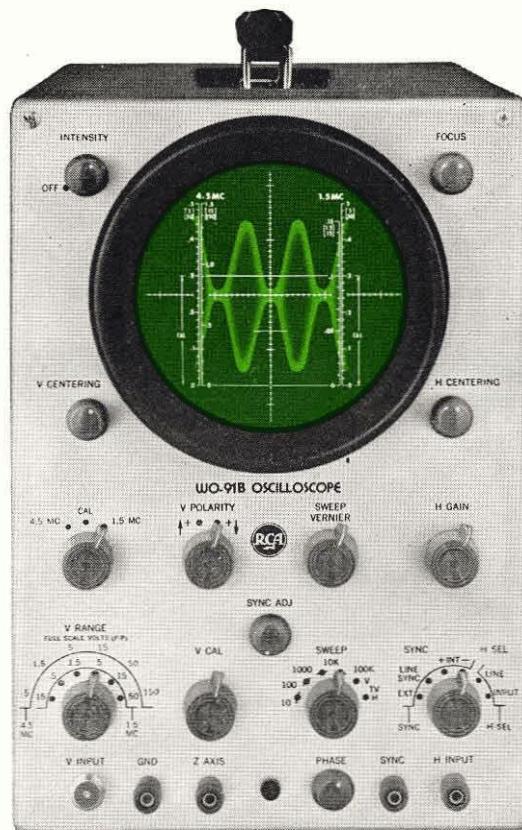
1955

WILLIAM G. SLY, PhD, has been promoted to professor of chemistry at Harvey Mudd College in Claremont.

1956

JOHN C. CARNEY, MS '57, is working as startup engineer for the Bechtel Corporation, with headquarters in San Francisco. He has recently returned from "the wilds of Colorado" on a new plant assignment for the company.

JAMES T. BRADBURY III, MS, has been named general manager of the Holland, Mich., facility of the Holland-Suco Color Company, a subsidiary of Chemetron Corporation. Bradbury, who has been with the organization since 1952, lives in Holland with his wife and three children.



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LEE A. DuBRIDGE

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## Personals . . . *continued*

DON J. HARNEY, MS, AE '57, has been appointed sales manager of CAL-POWER Corporation in El Segundo, California. He and his wife live in Garden Grove with their two children.

1957

J. HOWARD MARSHALL, PhD '65, one of the founders of the Analog Technology Corporation of Pasadena, is presently chairman of the board and vice president for projects. Analog, founded in May 1965, is involved mainly in the design and fabrication of scientific space instruments.

HARRY M. ROPER JR., MS, a major in the U.S. Army, is serving in Vietnam as commanding officer of the 48th Assault Helicopter Company. He graduated from the Armed Forces Staff College in Norfolk, Va., last January.

1958

NATHANIEL GROSSMAN has a new position as assistant professor of mathematics at UCLA. He was formerly with the Institute for Advanced Study at Princeton.

ABRAHAM ZUKERMAN, MS, PhD '62, has been promoted by the Aerospace Corporation in San Bernardino to staff engineer in the advanced concepts group of the weapon systems division. Before joining Aerospace in 1965, Zukerman was a director at Aerojet General Corporation and had earlier taught engineering mathematics at Caltech. He lives in Claremont with his wife, Rita, and their two children.

1959

JOHN D. STACK is assistant professor of physics at the University of Illinois. He received his PhD in 1965 from the University of California at Berkeley and was acting assistant professor there until this past summer.

JOHN WALDEN, MS, received his PhD in chemical engineering from the Polytechnic Institute of Brooklyn in June.

1960

PETER D. NOERDLINGER, PhD, has joined the department of physics and astronomy at the University of Iowa in Iowa City as associate professor. He was formerly assistant professor of physics at the University of Chicago.

W. CARL GOTTSCHALL JR. is assistant professor of chemistry at the University of Denver this fall. For the past two years he has been engaged in postdoctoral study at the Argonne National Laboratory near Chicago, where he was working on radiation chemistry of solutions.

JAMES L. FARMER received his PhD in biology from Brown University in Providence, R.I., in June.

1961

DOUGLAS K. STEWART, MD, and his wife will be living in Bogota, Colombia, for the next two years, where he will be working with the public health service as a staff physician to the Peace Corps Volunteers. When he returns, Stewart plans to begin a residency in internal medicine in Seattle.

1962

STOTTLER STARR, MS, has recently been appointed project associate of the Ohio University Center for Economic Opportunity located in Athens, Ohio. He will be responsible for planning and executing seminars and institutes to assist business leaders in taking a more active part in the war on poverty. Starr received his MBA from Harvard in June.

CARL W. HAMILTON is studying at the Alfred P. Sloan School of Management at MIT on a national defense fellowship, which supports his doctoral work in mathematical economics and operations research.

1963

DAVID STOUTEMYER is an instructor in the engineering department of the University of Hawaii this fall. He has been a stress analyst at the United Shoe Machinery Corporation in Beverly, Mass., since receiving his MS at MIT in 1965.

ALFRED C. PINCHAK, PhD, started for Alaska this past summer with two Caltech friends, HARRY TOWNES, MS '60, and WILL HARRISON. They reported from Whitehorse, Yukon, that they intended to make the ascent of Mt. McKinley. Pinchak has been on a short assignment for Ohio State University at the Aerospace Research Laboratories in Dayton, Ohio, following his tour of duty with the U.S. Air Force.

HENRY D. I. ABARBANEL received his PhD in physics from Princeton in May.

1964

CHARLES K. CRIMES, PhD, a major in the U.S. Air Force, is back flying again—overseas—after four years at the Air Force Institute of Technology in Ohio as a professor of aeronautics.

USHA SHAH, MS, is now the wife of SURYANARAYANA VARNASI, MS '61. They live in Seattle.

HAROLD T. THOMAS received an MA degree in chemistry at Wesleyan University in Middletown, Conn., in June.

WILLIAM R. RICKS, first lieutenant in the U.S. Air Force and an F-105 Thunderchief pilot, is on duty with U.S. combat air forces in Southeast Asia.

**ALUMNI ASSOCIATION  
CALIFORNIA INSTITUTE OF TECHNOLOGY  
Pasadena, California**

**BALANCE SHEET**

June 30, 1966

ASSETS	\$	4,322.48
Cash in Bank		
Investments:		
Share in C.I.T. Consolidated Portfolio	\$106,215.00	
Deposits in Savings Accounts	17,023.01	123,238.01
Investment Income Receivable		5,927.36
Postage Deposit		235.10
Furniture and Fixtures, at nominal value		1.00
Total Assets		<u>\$133,723.95</u>
 <b>LIABILITIES, RESERVES AND SURPLUS</b>		
Accounts Payable		\$ 4,923.35
Deferred Income:		
Membership Dues for 1966-67 paid in advance	\$ 11,495.10	
Investment Income for 1966-67 from C.I.T.		
Consolidated Portfolio (earned during 1965-66)	<u>5,709.36</u>	17,204.46
Life Membership Reserve		69,100.00
Reserve for Directory:		
Balance, July 1, 1965	\$ 5,044.14	
1965-66 Appropriation	2,500.00	
1965-66 Directory Expense	<u>(7,005.54)</u>	538.60
Surplus:		
Balance, July 1, 1965	\$ 41,211.00	
Share of Gain on Disposal of Investments		
of C.I.T. Consolidated Portfolio for 1965-66	2,768.82	
Excess of Expenses over Income for 1965-66	<u>(2,022.28)</u>	41,957.54
Total Liabilities, Reserves and Surplus		<u>\$133,723.95</u>

**STATEMENT OF INCOME AND EXPENSES**

For the Year Ended June 30, 1966

INCOME	\$	20,843.75
Dues of Annual Members		
Investment Income:		
Share from C.I.T. Consolidated Portfolio	\$ 5,300.06	
Interest on Deposits in Savings Accounts	<u>1,204.87</u>	6,504.93
Annual Seminar		6,000.05
Program and Social Functions		2,099.80
Total Income		<u>\$ 35,448.53</u>
 <b>EXPENSES</b>		
Subscriptions to Engineering and Science Magazine:		
Annual Members	\$ 14,579.25	
Life Members	<u>3,304.00</u>	\$ 17,883.25
Annual Seminar		5,830.64
Administration (Directors' Expenses, Postage, Supplies, etc.)		3,328.50
Directory Appropriation		2,500.00
Program and Social Functions		2,498.02
Fund Solicitation		2,457.37
Membership Committee		1,568.18
ASCIIT Assistance		1,404.85
Total Expenses		<u>\$ 37,470.81</u>
Excess of Expenses over Income		<u>\$ 2,022.28</u>

**AUDITOR'S REPORT**

Board of Directors, Alumni Association, California Institute of Technology  
Pasadena, California

I have examined the Balance Sheet of the Alumni Association, California Institute of Technology, as of June 30, 1966, and the related Statement of Income and Expenses for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the accompanying Balance Sheet and Statement of Income and Expenses present fairly the financial position of the Alumni Association, California Institute of Technology, at June 30, 1966, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

CALVIN A. AMES  
Certified Public Accountant

September 27, 1966

# Caltech Calendar

## October

- 17 Caltech Lecture Series: Edwin H. Land—“New Experiments in Color Vision.” Beckman, 8:15 p.m.
- 19 YMCA-ASCIT public meeting. Governor Brown, Athenaeum lawn, 11 a.m.
- 22 Parents’ Day
- 24 - 27 Seventy-Fifth Anniversary Convocation
- 26 Concert: Chad & Jeremy, British popular singers. Beckman, 8:30 p.m.
- 30 Concert: Los Angeles Artists Ensemble. Dabney, 8:15 p.m.
- 31 Lecture: Aron Kuppermann—“The Intimate Story of a Chemical Reaction.” Beckman, 8:15 p.m.

### ABOUT SCIENCE

Caltech’s radio series, “About Science,” is now being heard across the country on 80 affiliated stations of the National Education Network. Check your local newspaper radio logs.

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The 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.
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Pasadena, California 91109

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- A form indicating a desire to keep watch of opportunities although I am not contemplating a change.

Name ..... Degree (s) .....

Address ..... Year (s) .....

## November

- 7 Concert: Igor Stravinsky, Robert Craft, conductors, Caltech 75th Anniversary Symphony Orchestra. Beckman, 8:30 p.m.
- 8 Freshman-Sophomore Mudeo
- 14 Lecture: Arnold O. Beckman—“A Trustee Looks at Caltech.” Beckman, 8:15 p.m.
- 19 Norman Luboff Choir. Beckman, 8:30 p.m.
- 19 Interhouse Dance
- 20 Concert: Goldman Duo. Dabney, 8:15 p.m.
- 21 Lecture: Arthur E. Raymond—“Over the Horizon in Air Transportation.” Beckman, 8:15 p.m.
- 28 Lecture: Maarten Schmidt—“Quasars and the Universe.” Beckman, 8:15 p.m.

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Informal luncheons every Thursday at 11:45 A.M.

Contact Mr. Farrar, EX 9-5277, on Thursday morning

for reservations.

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Visiting alumni cordially invited—no reservation.

# How dull if everybody who joined us had the same aims, color, and interests!

The guy who wrote what you are reading joined the company as an optical physicist. Now he's an advertising man. His assistant, an English and French major from Catawba College in Salisbury, N.C., who first joined our French affiliate, Kodak-Pathé, in Paris, has just written a manual in English that introduces beginners to a system of separations chemistry for which we market equipment and supplies. Her husband works in our Photographic Technology Division engineering color motion-picture processing systems. (Four other departments tried to lure him away, but he decided he preferred the exciting new development work in his area.) The chairman of our board also came originally as a physicist, the president as a mathematician, one of our two executive vice presidents as a chemical engineer, the other as a Ph.D. chemist. On the other hand, our vice president of marketing majored in economics at the local university.

The point: out of self-interest, pure and frank, we have to help every college graduate who joins us find where he is happiest and can therefore earn raises fastest. What makes this a little easier here for both parties is our tremendous scope.

Having long been part of many, many more industries than the one with which the general public identifies us, we operate in technologies that range from optics to cattle nutrition, from knitting to laser-cavity design. Per-

haps more significant to the person choosing an affiliation for the long haul, we have room and need for every shade of personal bent. In most people personal bent is still to be discovered at the time of college graduation.

One makeup is tuned for avid pursuit of better understanding of the physical world, whatever the purpose. He can enjoy himself here. Another will enjoy himself here far more in tough competition to create demand for the ultimate fruits of the first fellow's studies. One technical talent finishes what the other technical talent starts. To man the long line between them, we have urgent need for just about every other honest technical talent, male or female, all creeds, all colors. That's how broad we are.

Chat with our representative on campus or drop a note about yourself to Director,\* Business and Technical Personnel Department, EASTMAN KODAK COMPANY, Rochester, N.Y. 14650.

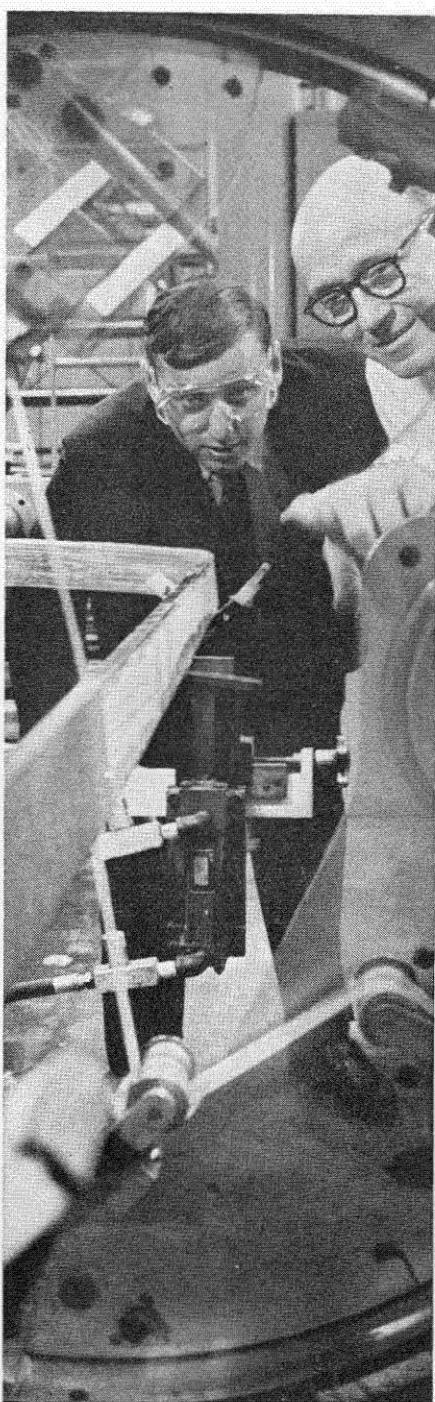
\*The engineer who previously occupied that position has been promoted to associate director of the Photo Technology Division. One of his former assistants then moved up to the job.



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