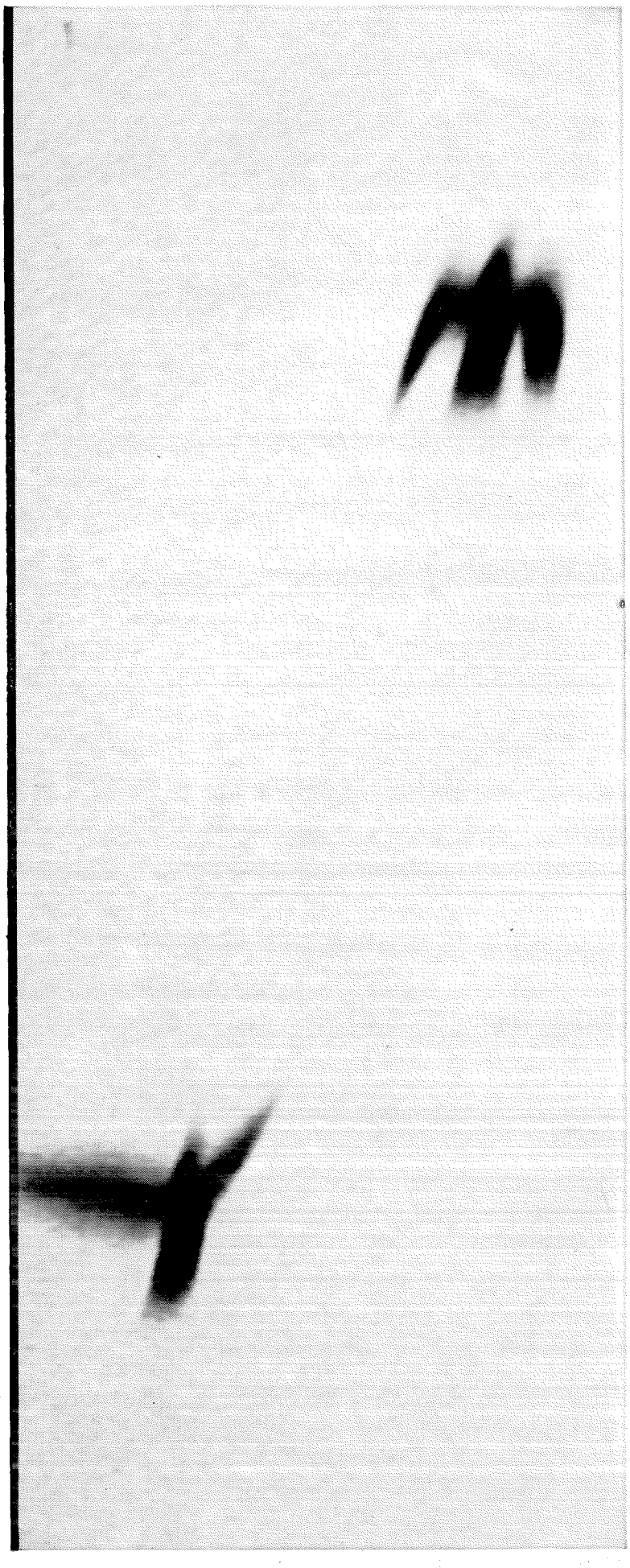
ENGINEERING | AND | SCIENCE

October 1959

The Changing Campus . . . page 3

Published at the California Institute of Technology



The shape of flight

The shapes of things that fly have always been determined by the materials they are made of. Feathers form wings that are basically alike for all birds—and membrane forms an entirely different wing for insects. It takes thousands of years, but nature improves its materials and shapes, just as technology improves the materials and shapes of aircraft. But here, the improvements in materials are so rapid that designs become obsolete almost as soon as they are functional.

Today, our aeronautical designers and missile experts work with types of materials that didn't exist just a few short years ago. Steels are probably the most important examples: United States Steel has just developed *five* new types of steel for the missile program. They are called "exotic" steels because they have the almost unbelievable qualities necessary for unearthly flights.

The shape and the success of our space birds depend on steel. If you would like to get facts about the wide range of career possibilities in the steel industry, write to United States Steel, Personnel Division, Room 2316, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

SPACE TECHNOLOGY LABORATORIES, INC.

FELLOWSHIPS

FOR

Doctoral & Postdoctoral Study

AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

OR THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

1960
1961

EMPHASIS IN
THE STUDY PROGRAM
WILL BE ON
Systems Engineering

SPACE TECHNOLOGY Fellowships have been established in recognition of the great scarcity of scientists and engineers who have the very special qualifications required for work in Systems Engineering, and of the rapidly increasing national need for such individuals. Recipients of these Fellowships will have an opportunity to pursue a broad course of graduate study in the fundamental mathematics, physics, and engineering required for careers in these fields, and will also have an opportunity to associate and work with experienced engineers and scientists.

Systems Engineering encompasses difficult advanced design problems of the type which involve interactions, compromises, and a high degree of optimization between portions of complex complete systems. This includes taking into account the characteristics of human beings who must operate and otherwise interact with the systems.

The program for each Fellow covers approximately a twelve-month period, part of which is spent at Space Technology Laboratories, and the remainder at the California Institute of Technology or the Massachusetts Institute of Technology working toward the Doctor's degree, or in post-doctoral study. Fellows in good standing may apply for renewal of the Fellowship for a second year.

ELIGIBILITY The general requirements for eligibility are that the candidate be an American citizen who has completed one or more years of graduate study in mathematics, engineering or science before July, 1960. The Fellowships will also be open to persons who have already received a Doctor's degree and who wish to undertake an additional year of study focused specifically on Systems Engineering.

AWARDS The awards for each Fellowship granted will consist of three portions. The first will be an educational grant disbursed through the Institute attended of not less than $2,000, with possible upward adjustment for candidates with family responsibilities. The second portion will be the salary paid to the Fellow for summer and part-time work at Space Technology Laboratories. The salary will depend upon his age and experience and the amount of time worked, but will normally be approximately $2,000. The third portion will be a grant of $2,100 to the school to cover tuition and research expenses.

APPLICATION PROCEDURE *For a descriptive booklet and application forms, write to Space Technology Laboratories Fellowship Committee. Completed applications together with reference forms and a transcript of undergraduate and graduate courses and grades must be transmitted to the Committee not later than Jan. 20, 1960.*

SPACE
TECHNOLOGY
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wherever there's electronics...

there's Transitron

How does blood pressure react to various levels of anaesthesia? The Statham manometer and associated data acquisition systems, incorporating Transitron semiconductors, provides this vital information. It is one of many life-or-death applications in which the electronics industry is serving medicine. At Transitron, more than 3,500 employees work exclusively to develop and produce silicon and germanium semiconductors of unfailing reliability, to which one could indeed trust a man's life. In medicine — as in missiles, radar, atomic subs, communications, jets, and thousands of other military and commercial applications — wherever there's electronics — there's Transitron, leading the field in advanced semiconductor reliability.

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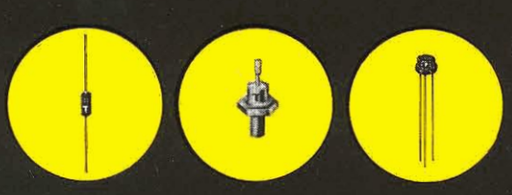

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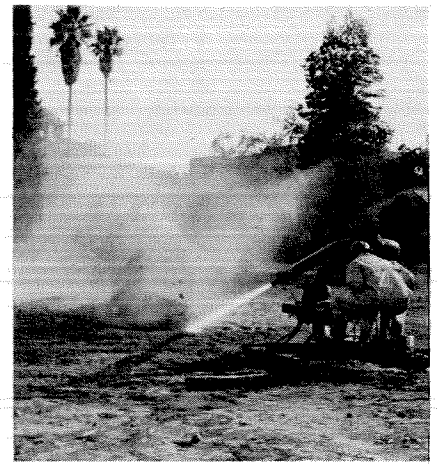
ENGINEERING | AND | SCIENCE



On Our Cover

Alfred Ingersoll, associate professor of civil engineering, mans a hydraulic mining gun and shoots a 100-mile-an hour jet of water to break ground for the new W. M. Keck Engineering Laboratories on September 2.

The gun was triggered by the breaking of a frozen piece of steel held by William Keck, Jr., under a hammer wielded by Howard B. Keck. When the steel bar broke, it interrupted an electric circuit and started the gun. This spectacular groundbreaking technique was designed (by Caltech engineers) to represent the various kinds of engineering that will be studied in the new building.

The Keck laboratory is the ninth of the eighteen new buildings that will be constructed under the Caltech Development Program. For a pictorial progress report on current construction on the campus, see page 13.

C. A. G. Wiersma

professor of biology, who wrote "Coding and Decoding in the Nervous System" on page 21 has been at Caltech since 1933, when he received his PhD from the University of Utrecht in his native Holland.

Picture Credits:

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6, 19 – Harvey
20 – Bob Smith-Black Star
21 – Naomi Johnson
32, 33 – Stan Sajdera '61

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Important news about the first books to come out of the Physical Science Study Committee

THE SCIENCE STUDY SERIES

During the past three years the Physical Science Study Committee, a group formed at M.I.T., has been working on a program of fundamental importance: to reshape the teaching of physics in secondary schools in the United States.

One vital part of this work has been the commissioning of distinguished scientists to write books which will explain the essence and satisfactions of their work to searching minds of all ages. The first five Science Study Series books, in soft covers and designed for wide distribution and sale at popular prices, are now being published by Doubleday Anchor Books.

During the coming year, at least fifteen of these cogent, readable, illustrated books will be made available. Ultimately, the Science Study Series will comprise more than seventy paper-back volumes. They will range over the key topics of modern physics and geophysics. They will highlight the relationships between the physical sciences and the life sciences. They will revive the most stirring eras in scientific history and the lives of the great scientists. Although an occasional classic will be included in the Series, most of the titles are being especially written to meet the vast and ever-growing needs of an American public whose future may well depend on its scientific awareness.

In addition to the books listed elsewhere in this advertisement, future volumes are now being prepared by such eminent scientists and authors as I. Bernard Cohen, Rene Dubos, Freeman J. Dyson, Laura Fermi, Donald G. Fink, William A. Fowler, Alan Holden, Bernard Jaffe, Alexander Kolin, Philip Morrison, Robert M. Page, Bruno Rossi, Victor F. Weisskopf, Jerome B. Wiesner, and Robert R. Wilson.

"There just weren't any such books when I was a high school student. How lucky those who want to learn about science will be to have them. These books are written by men who know first-hand what is important and what isn't, what is known and what still is not understood, what can be validly explained in simple terms and what can't. And, through the facts and explanations glows a true and real background of science and scientists which no non-participant could provide . . ."—JOHN R. PIERCE, Director of Research, Communications Principles, Bell Telephone Laboratories.

"The Series is superb . . . The discussions are clear and to the point, and certainly should prove thrilling and exciting reading, not only to youngsters but to intelligent oldsters as well."—CHAUNCEY D. LEAKE, President-Elect, American Association for the Advancement of Science.

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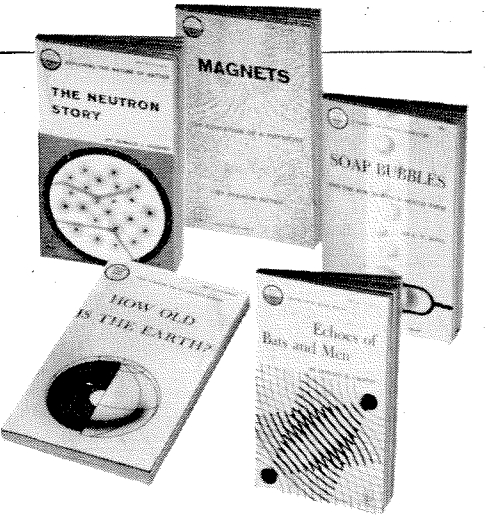


The first five titles in the Series to be published September 10:

THE NEUTRON STORY

By Donald J. Hughes, Brookhaven National Laboratory. An absorbing survey of the nature and the uses of the neutron in the atomic age. "Most concise and clear introduction to neutron physics."—HAROLD T. PETERSEN, JR., *Westinghouse Science Talent Search Winner, Valley Stream, New York* 39 drawings, index, 95¢

MAGNETS: The Education of a Physicist

By Francis Bitter, M.I.T. "MAGNETS is a little gem. It is a masterpiece. This combination of autobiography and popular scientific exposition is very rare and extraordinarily effective in humanizing the whole subject."—B. ALDEN THRESHER, *Chairman, College Entrance Examination Board* 27 drawings, index, 95¢

SOAP BUBBLES AND THE FORCES WHICH MOULD THEM

By Sir Charles Vernon Boys. "SOAP BUBBLES is a superb classic that I am delighted to have available once more. It is as fresh as ever, and remains just the sort of book by a distinguished scientist . . . that can capture the imagination of the young (and the old)."—DEREK J. DE SOLLA PRICE, *The Institute for Advanced Study* 69 drawings, 95¢

ECHOES OF BATS AND MEN

By Donald R. Griffin, Harvard University. How bats, porpoises, beetles, electrical engineers, and blind men use echoes to navigate. "An almost ideal popularization of science: lucid without being condescending, authoritative and thoroughly scientific, but more fascinating than most novels."—GEORGE GAYLORD SIMPSON, American Museum of Natural History 15 drawings, index, 95¢

HOW OLD IS THE EARTH?

By Patrick M. Hurley, M.I.T. Provocative new theories on the origin and nature of the earth, with emphasis on recent findings on the earth's interior radioactivity. 27 drawings, 8 halftones, index, 95¢

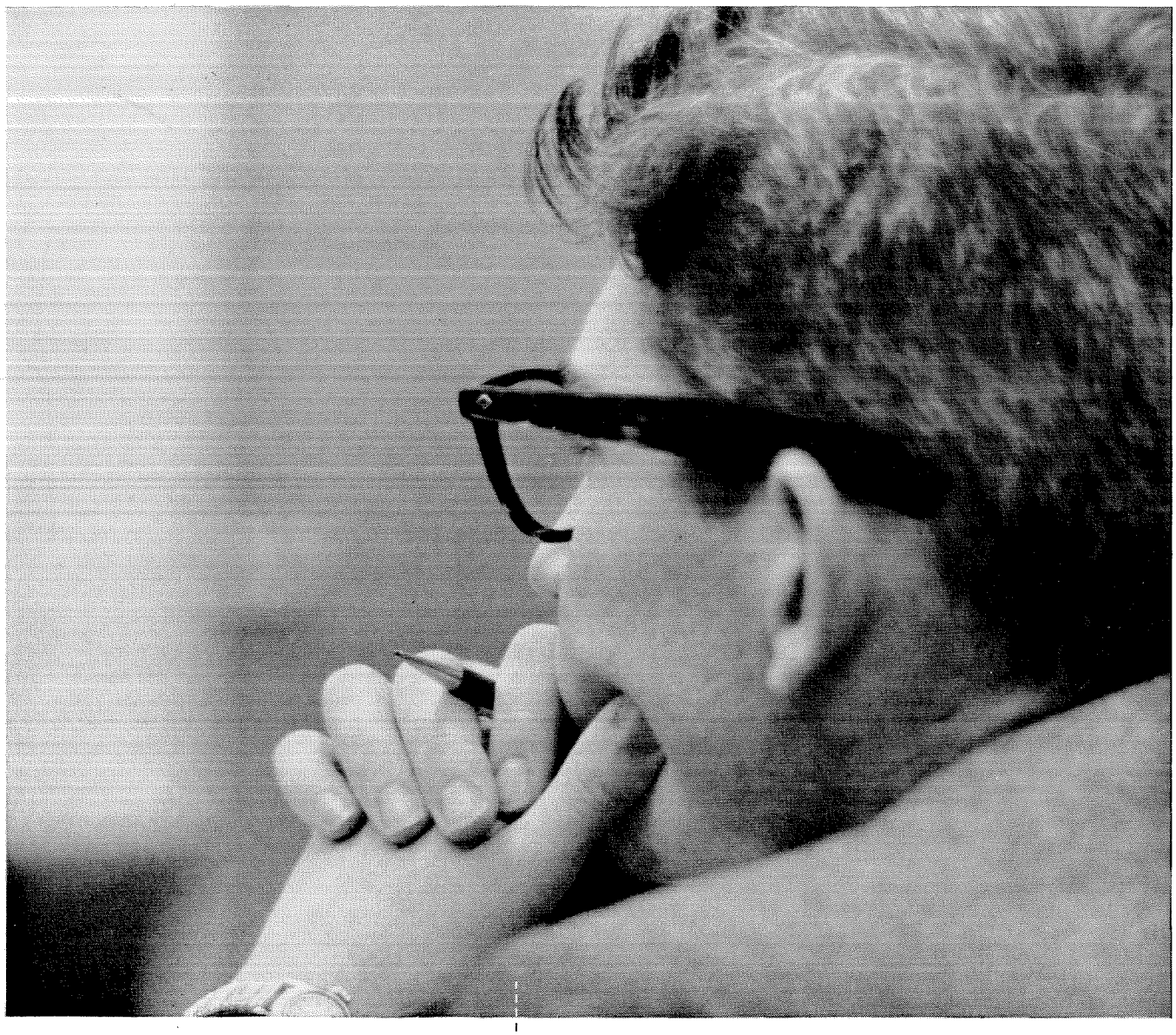
Forthcoming titles available early in 1960 include:

The Physics of Television • Galileo • Crystals and Crystal Growing • Radio Astronomy • The Birth of a New Physics • Waves and the Ear

The Science Study Series is available wherever Anchor Books are sold, and is distributed to high school students and teachers by Wesleyan University Press, Columbus, Ohio.

For further information, please write to

DOUBLEDAY & COMPANY, INC., 575 MADISON AVENUE, NEW YORK 22, N. Y.



THE HUMAN FACTOR in today's technology

Scientists have long been preoccupied with the technological problems of Man and the Machine. The increasingly complex nature of advanced systems has created an urgent need to enhance man's contribution to effective systems performance. The complicated nature of this relationship requires the skills of psychologists, social scientists, mathematicians, and engineers.

At Ramo-Wooldridge, human engineering, personnel selection, individual and system training, display design, and communications are successfully integrated into systems design and development by the technique of large-scale simulation.

Simulated inputs enable scientists to observe a system as it operates in a controlled environment and make possible the collection of data on performance, training, human engineering, maintenance, and logistics and support. Scientists and engineers use this data to assure the design, production, and delivery of a unified system capable of high performance and reliability.

Expanding programs at Ramo-Wooldridge in the broad areas of electronic systems technology, computers, and data processing have created outstanding opportunities for scientists and engineers. *For further information concerning these opportunities write to* **Mr. D. L. Pyke.**

RAMO-WOOLDRIDGE

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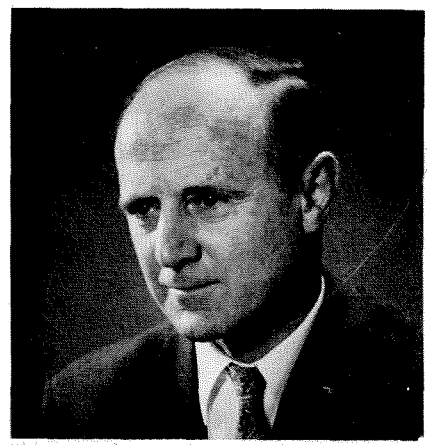
a division of ***Thompson Ramo Wooldridge Inc.***

Letters

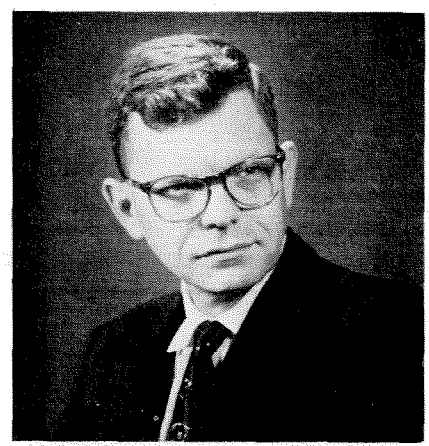
SIRS:

After looking over that portfolio of faculty portraits in the May issue of *Engineering and Science*, I couldn't resist a whirl at composing some gag captions for them. — *Harold Huston* '29



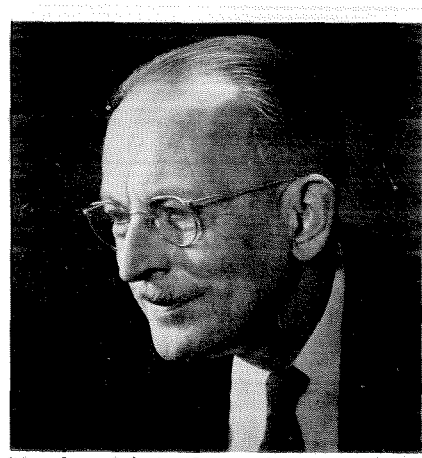
"Now where the devil you s'pose that rocket went?"

"Charley," I said to myself, "that's about all the ash you can handle."



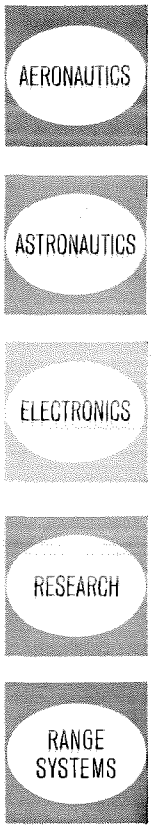
"Now let's see, where are my glasses?"

"Let me think now — butter, eggs, cheese — what else did she say?"



"I shouldn't have burned those lousy exam books, but they make a bright fire."

"Bisodol! Geritol! I never touch the stuff!"



Five Vought Divisions Provide Engineers Greater Opportunity for Space-Age Advancement

Young engineers, particularly, will be interested in the new opportunities created by Chance Vought's recent realignment into five divisions.

Today, for every Vought engineer, there is a division to make fullest use of his talents and to speed his personal advancement. And, of course, he is backed by the four other divisions whose balanced activities add security to his company and his future.

Vought's realignment was the result of considerable study of both company capabilities and new business opportunities. The move intensifies a diversification program which began early in 1959. It specifically gears this progressive, 42-year-old aircraft firm for the challenges and opportunities of the age of space.

ASTRONAUTICS DIVISION

Vought is taking fullest advantage of its existing capabilities and is drawing on 12 years' experience in the missile field to obtain broader responsibilities in the race for space. Concentration will be on advanced vehicles for space exploration, and on ballistic and anti-ballistic missile systems.

Under a current contract, Vought is readying the four-stage *Scout* research rocket and its launcher for the National Aeronautics and Space Administration. Also, Vought and other members of the Boeing team are participating in the development of the *Dyna-Soar* boost-glide vehicle in competition for an Air Force contract. In the human factors of flight, Vought is taking the lead with its orbital flight simulator and space-oriented Cockpit Laboratory.

AERONAUTICS DIVISION

Weapons of many types will take shape here. For example: new generations of manned aircraft and atmospheric missiles, and devices for antisubmarine warfare. Systems to support these weapons, and subcontracting assignments are other Aeronautics activities.

Among this division's current contracts: a Navy order for development of an environmental protection and escape capsule for aircraft pilots. Other work includes production contracts for three versions of F8U *Crusader* aircraft, study contracts in submarine detection and classification, and subcontracts for military and commercial aircraft assemblies.

ELECTRONICS DIVISION

Vought electronics will be developed, manufactured and marketed in increasing volume. Military systems under development include antennas and related electronics, ground support electronics and antisubmarine warfare apparatus.

RESEARCH DIVISION

In a new Research Center, scientists of this division will mine new knowledge from many fields. Basic research is planned into astronautics, undersea warfare, the life sciences (relating to human factors of flight), electrogravities and other areas. As it evolves into applied research, this advanced work will materially support other Vought divisions.

RANGE SYSTEMS DIVISION

Twelve years' experience in remote base operation qualifies Vought for additional business in this new field. The Range Systems team will establish and operate test ranges and test equipment for missiles and space vehicles.

Genesys Corporation, a wholly owned subsidiary company, intensifies Vought's diversification into commercial electronics. Company emphasis is on automation, and its key personnel are engineers experienced in the fields of electronics, computers, magnetic memory, and associated electro-mechanical devices.

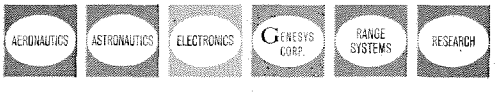
You live at a discount in Dallas

In Texas there is no state income tax and no local or state sales taxes. Low school and property levies add to your savings. Home construction costs – as well as house and apartment rentals – are below the national average. Fuel costs are negligible, and most groceries cost less.

Dallas has grown faster since 1950 than any other U. S. city. One reason is the city's wealth of entertainment and cultural centers. Another reason is the attractive cost of living.

Student engineers are invited to write for further information about new Vought activities, and how you can start your career with one of Vought's five divisions. Please address inquiries to:

Professional Placement Office
Dept. CM-25



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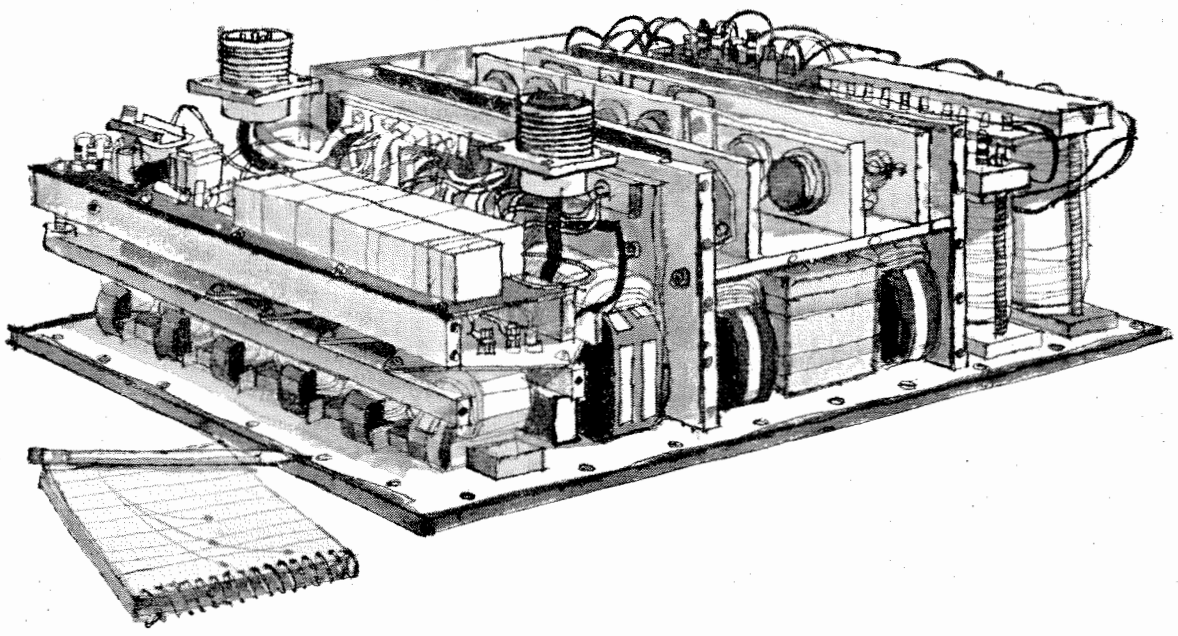
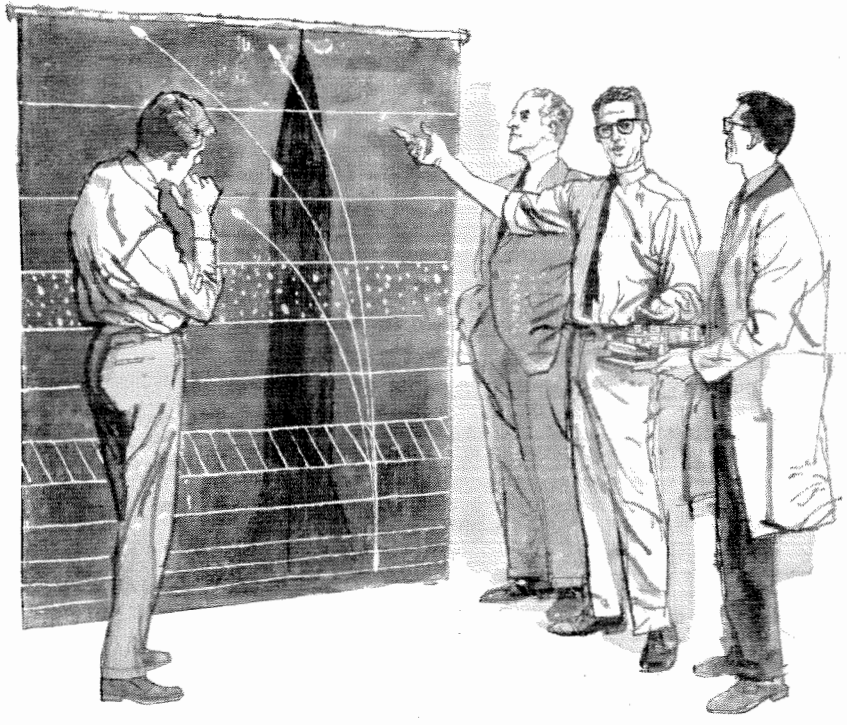


Shooting for the moon ...and beyond

The High Capacity Static Inverter, latest electronic achievement from General Motors, provides exceptionally stable and precise frequency control for power and guidance requirements of missiles and rockets.

General Motors positions are now available in these fields for men holding Bachelor's, Master's and Doctor's degrees: Mechanical Engineering • Electrical Engineering • Industrial Engineering • Metallurgical Engineering • Chemical Engineering • Aeronautical Engineering • Ceramic Engineering • Mathematics • Industrial Design • Physics • Chemistry • Engineering Mechanics



The minds of inquiring scientists and engineers are the spark that brings the wonders of tomorrow to the threshold of today. At General Motors the sky is the limit for men who work in these and other highly specialized fields.

If you're looking for a place to develop your talent . . . and let your imagination soar, consider the opportunities in science and engineering at General Motors, working on products such as electronic components, automobiles, astronautics, diesels, inertial guidance systems, aircraft engines and equipment.

You can grow vertically and laterally in your career at GM . . . vertically through the Division where you work, and laterally through the other Divisions of the Corporation. In addition, GM offers financial assistance to employees who wish to enter or progress in post-graduate studies.

Step into a job with a *real* future. See your Placement Officer or write to General Motors, Salaried Personnel Placement, Personnel Staff, Detroit 2, Michigan.

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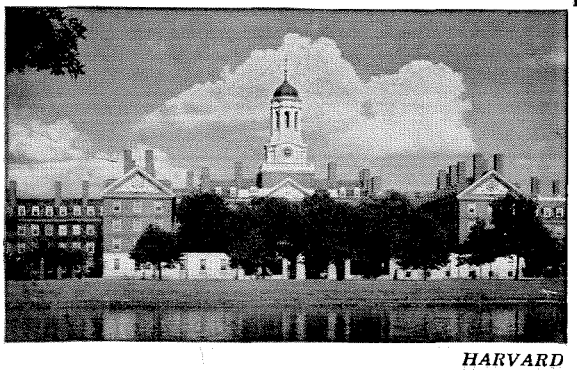
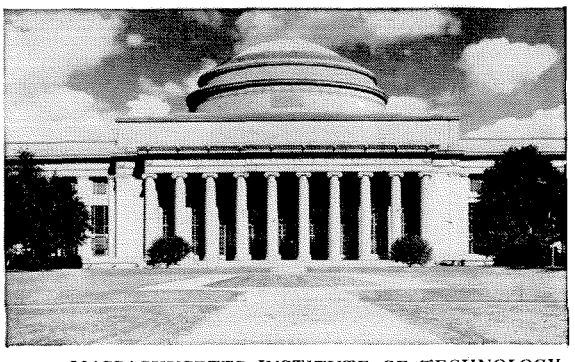
Raytheon Graduate Program

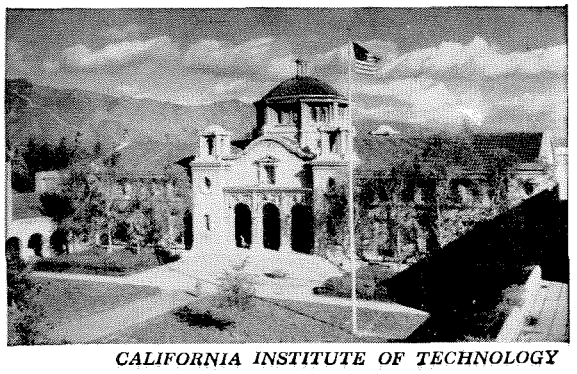
FOR STUDY AT HARVARD MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND CALIFORNIA INSTITUTE OF TECHNOLOGY IN 1960-61



HARVARD



MASSACHUSETTS INSTITUTE OF TECHNOLOGY



CALIFORNIA INSTITUTE OF TECHNOLOGY

The Raytheon Graduate Program has been established to contribute to the technical development of scientists and engineers at Raytheon. It provides the opportunity to selected persons employed by Raytheon, who are accepted as graduate students by Harvard University, Massachusetts Institute of Technology and California Institute of Technology, to pursue at Raytheon's expense, regular courses of study leading to a master's or doctor's degree in science or engineering in the institution of their choice.

The Program requires, in general, two or three semesters of study, depending on circumstances, with the summer months spent in the Company's research, engineering, or manufacturing divisions. It includes full tuition, fees, book allowances and a salary while at school. Students are eligible for health, accident, retirement and life insurance benefits, annual vacation and other privileges of full-time Raytheon employees.

To be considered for the Program, applicants must have a bachelor's degree in science or engineering, and should have outstanding student records, show technical promise, and possess mature personal characteristics. They may apply for admission to the Program in anticipation of becoming employees of Raytheon.

YOU ARE INVITED TO ADDRESS YOUR INQUIRY to Dr. Ivan A. Getting, Vice President, Engineering and Research, outlining your technical background, academic record, school preference, and field of interest, prior to December 1, 1959.

RAYTHEON COMPANY, Waltham 54, Mass.

Excellence in Electronics RAYTHEON

Books

Ossian's Ride

by Fred Hoyle

Harper & Brothers $3.00

As a visiting professor of astronomy at Caltech, Fred Hoyle spends the first term of each academic year at the Institute. As a fellow of St. Johns College at the University of Cambridge (where he is now Plumian Professor of Astronomy and Experimental Philosophy) he spends the remainder of the academic year in England.

Along with this peripatetic academic schedule, Mr. Hoyle has an active career as a popular writer. Starting in 1952, after two lively and controversial books on astronomy *(The Nature of the Universe* and *Frontiers of Astronomy)* he turned to philosophy *(Men and Materialism)*, tried his hand at current affairs *(A Decade of Decision)*, then plunged boldly – and very successfully – into science fiction with *The Black Cloud*.

Ossian's Ride represents still another departure for Mr. Hoyle, because this is a chase story, a real spies-and-counterspies thriller, in the Graham Greene and Eric Ambler tradition. Of course, Hoyle doesn't do it anything like as well as the old masters on his first try, but he's in there firing with both barrels all the way.

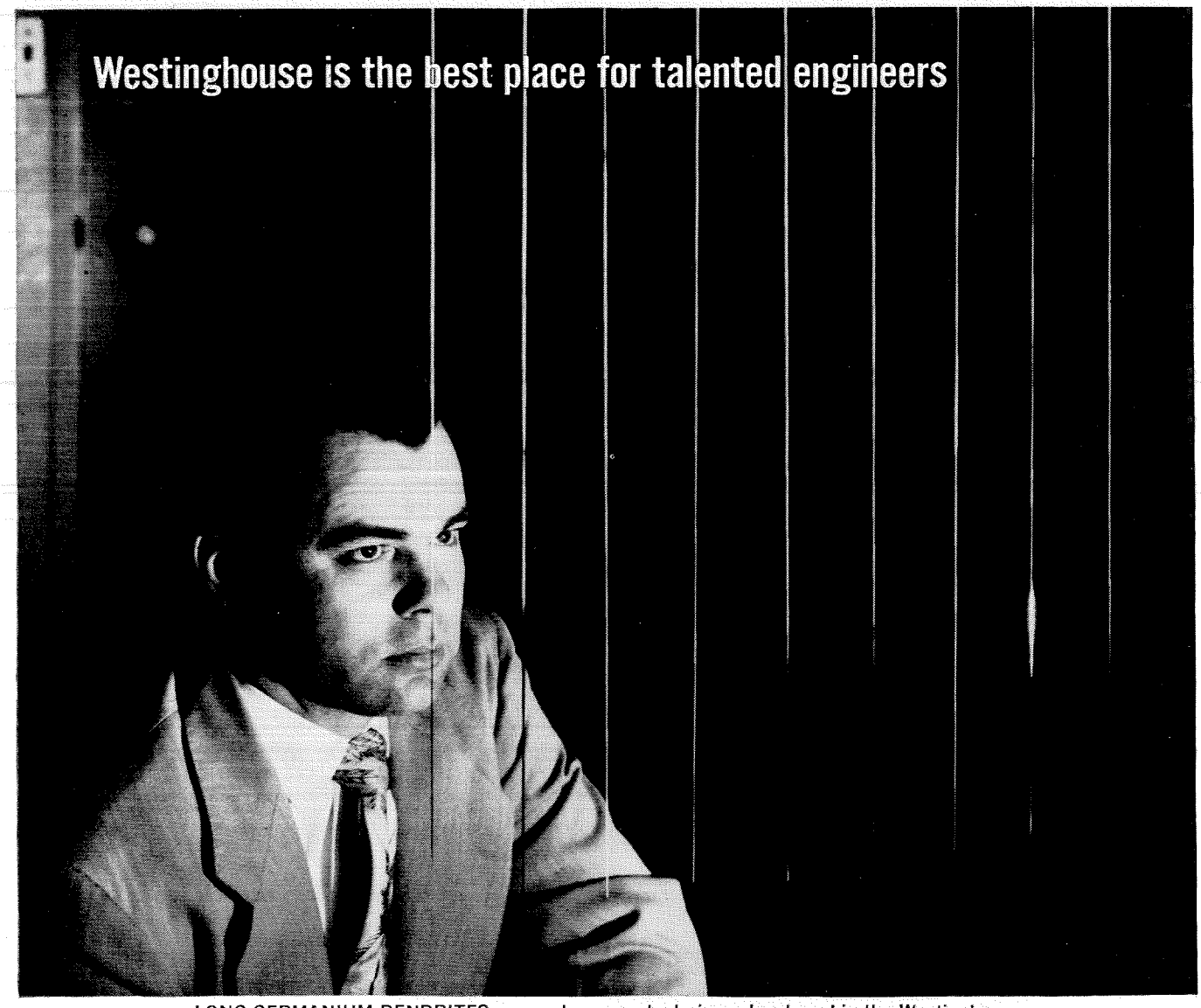
Ossian's Ride, naturally enough, has plenty of scientific overtones. In 1958, as Hoyle tells it, a small group of scientists established an industry in Western Ireland for extraction of a range of chemicals from the organic material in peat. In a short time, they were producing an amazing range of valuable chemicals. Profits were enormous.

In 1962, when the organization (known as I.C.E. for Industrial Corporation Eire) developed a contraceptive pill, profits were even greater. Soon the capital resources of the corporation were over a thousand million pounds.

In 1964, I.C.E. began to change its emphasis from chemistry to physics. It began importing metals. It drew a steady volume of outstanding scientists into its employ. By 1969 it had a chain of commercially working thermonuclear reactors.

It is 1970 when *Ossian's Ride* begins, and Western Ireland is sealed off from the rest of the world. No one can break through the iron curtain that protects I.C.E. It is up to Mr. Hoyle's hero, a durable young mathematician, to make his way into the forbidden territory and discover the secret of what I.C.E. is doing, and how it does it.

Hoyle keeps his story going at such a clip that he hasn't much time for characterization, or for tying up a lot of loose ends of plot—which results in a kind of rough and ready performance. It may be confusing, but it's undeniably lively.



LONG GERMANIUM DENDRITES, grown by a new technique developed in the Westinghouse Solid State Physics Laboratory, are here inspected by Dr. A. I. Bennett, research physicist.

The Solid State Lab helps you when your idea needs a new semiconductor

The Solid State Physics Laboratory helps Westinghouse engineers exploit the rich phenomena of the solid state. Problems are solved in low temperature and semiconductor physics, and magnetic and ferroelectric materials. If an engineer's idea requires a new kind of semiconductor, this group may be able to develop it for him.

This laboratory is staffed by 27 Ph.D.'s, 4 M.S.'s, and 7 B.S. junior engineers. Here's one way it ties in with work at operating divisions:

The Air Arm Division is now developing superminiaturized electronic systems

Our Youngwood plant is designing the new devices needed for these systems

The Solid State Physics Lab is perfecting a method for growing the dendritic material needed to make these devices

The young engineer at Westinghouse isn't expected to know all of the answers. Our work is often too advanced for that. Each man's work is backed up by specialists—like the men in this Solid State Physics Lab. Even tough problems are easier to solve with this kind of help.

If you've ambition and real ability, you can have a rewarding career with Westinghouse. Our broad product line, decentralized operations, and diversified technical assistance provide hundreds of challenging opportunities for talented engineers.

Want more information? Write to Mr. L. H. Noggle, Westinghouse Educational Dept., Ardmore & Brinton Roads, Pittsburgh 21, Pa.

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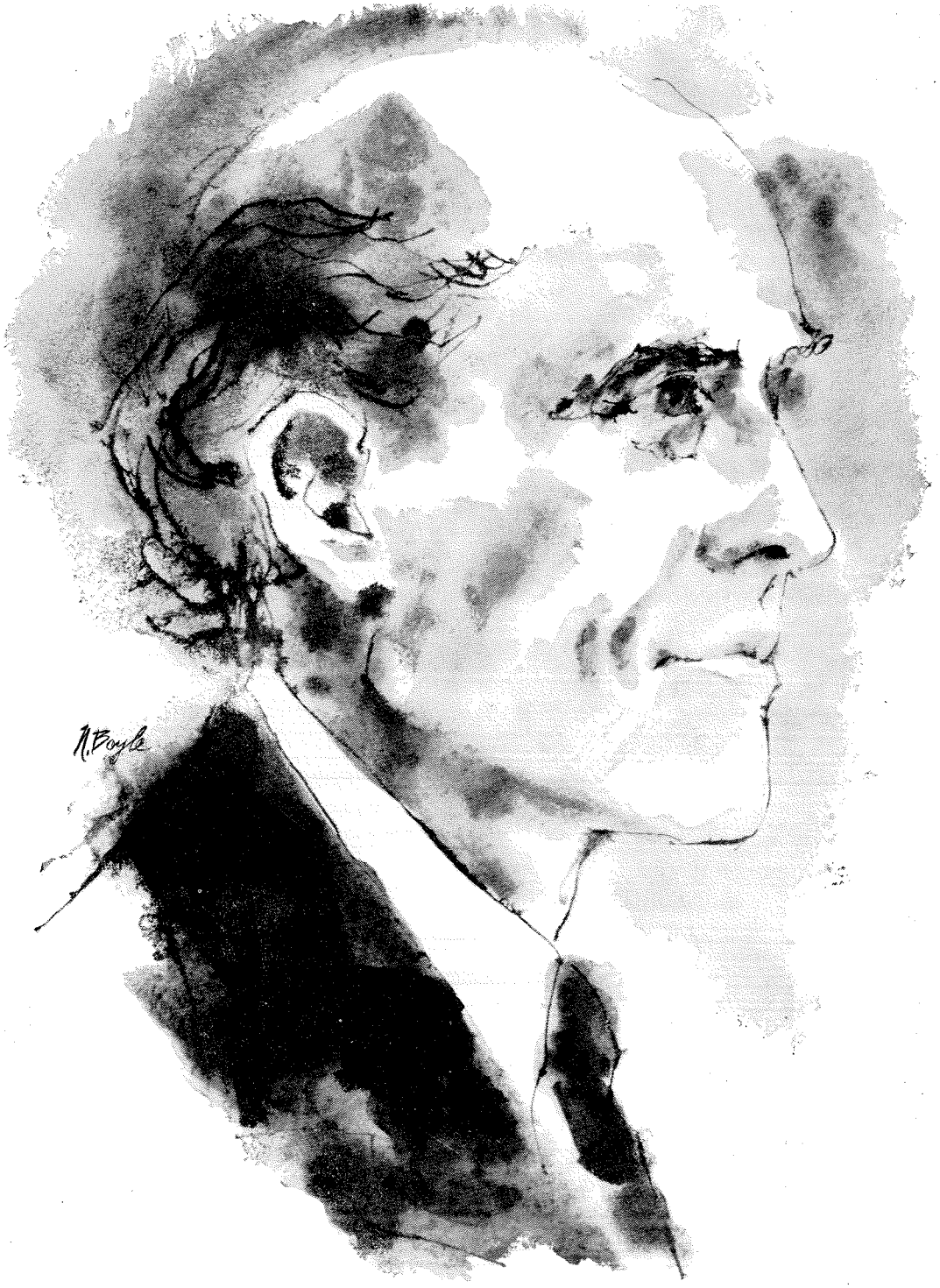


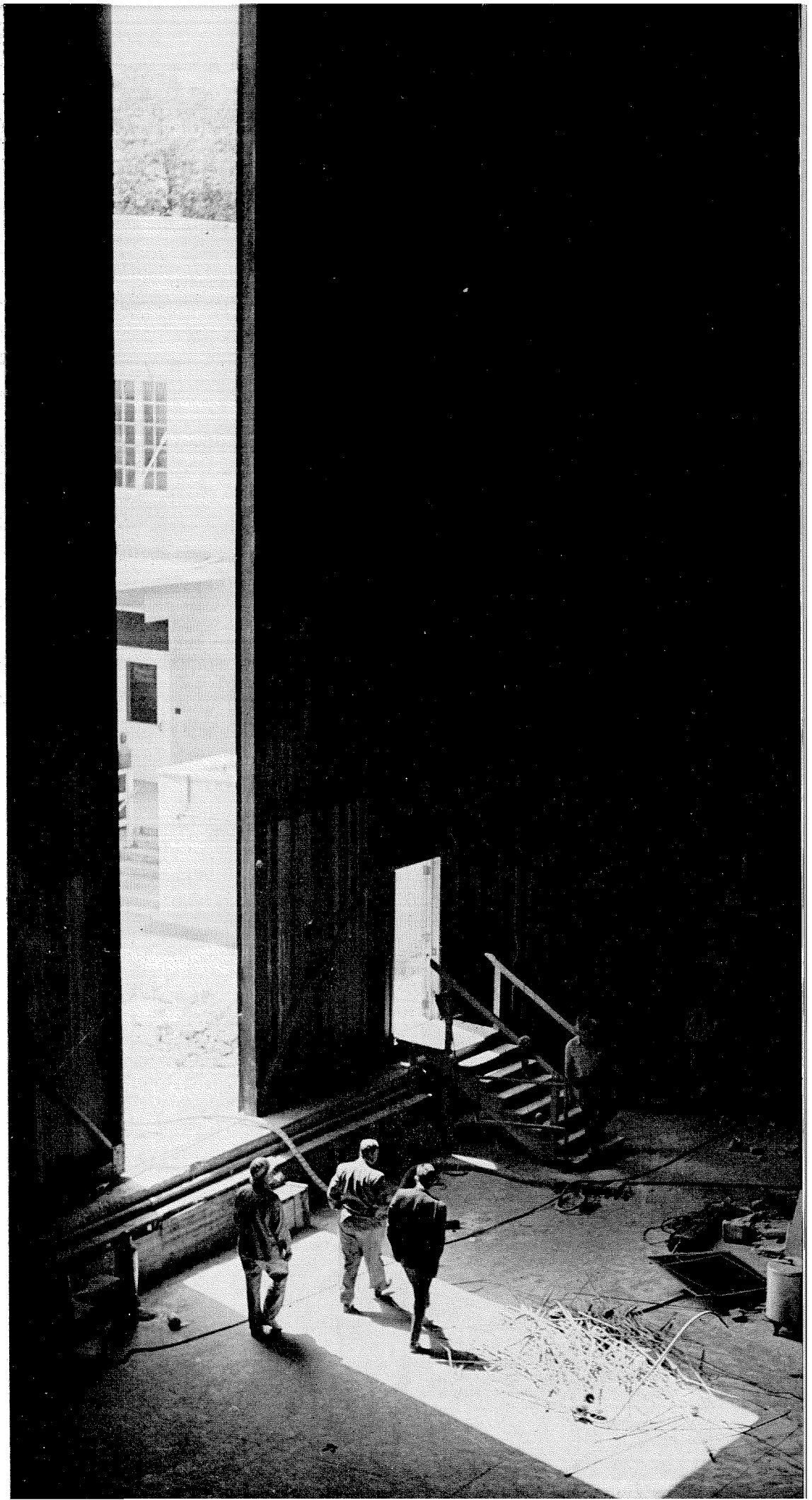
Karl Pearson...on mystery versus ignorance

"Does science leave no mystery? On the contrary, it proclaims mystery where others profess knowledge. There is mystery enough in the universe of sensation and in its capacity for containing those little corners of consciousness which project their own products, of order and law and reason, into an unknown and unknowable world. There is mystery enough here, only let us clearly distinguish it from ignorance within the field of possible knowledge. The one is impenetrable, the other we are daily subduing."

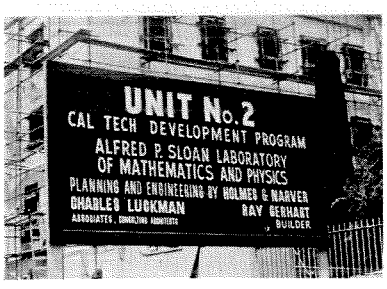
—*Grammar of Science, 1892*

ENGINEERING AND SCIENCE
October 1959, Volume XXIII, No. 1

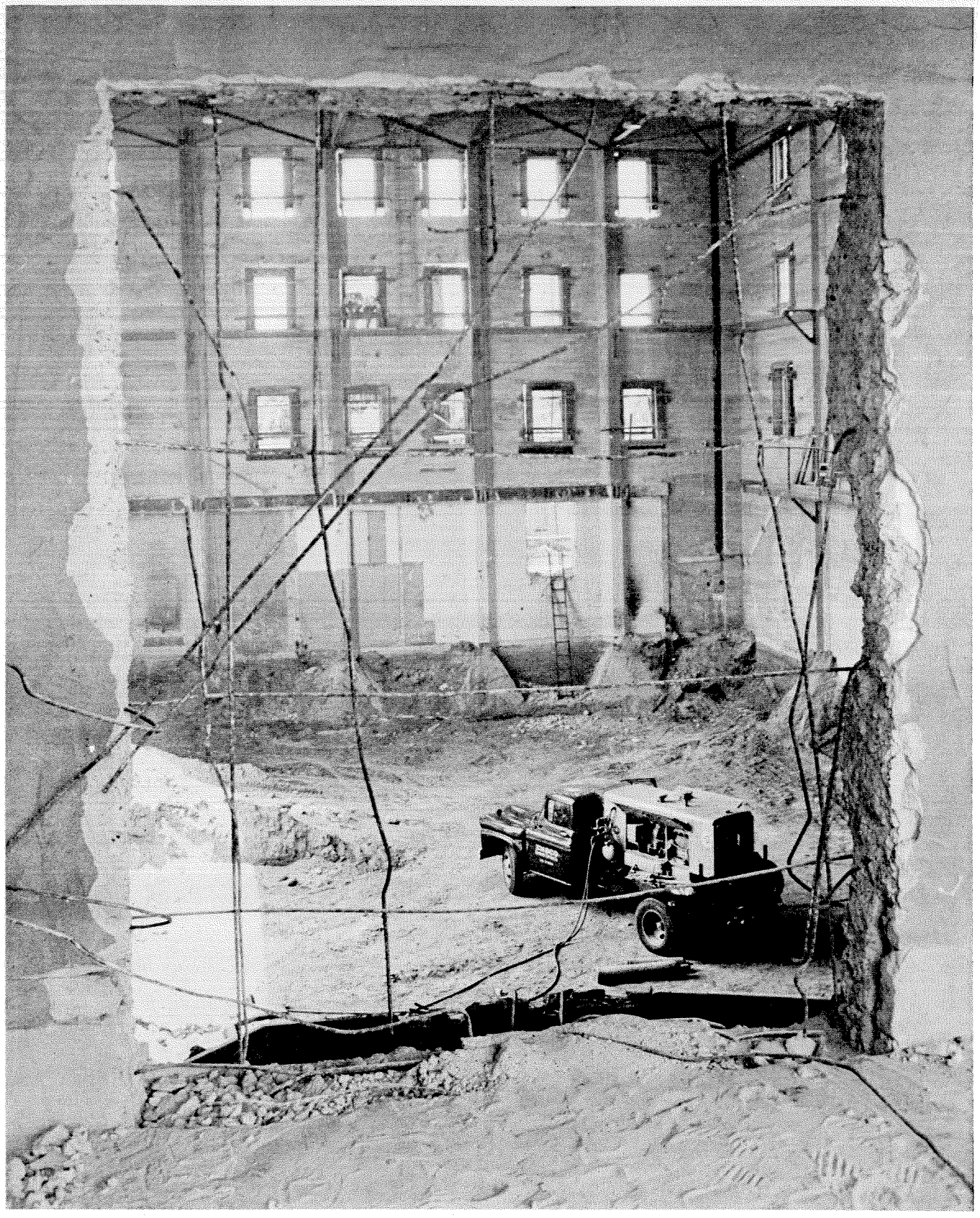
THE CHANGING CAMPUS



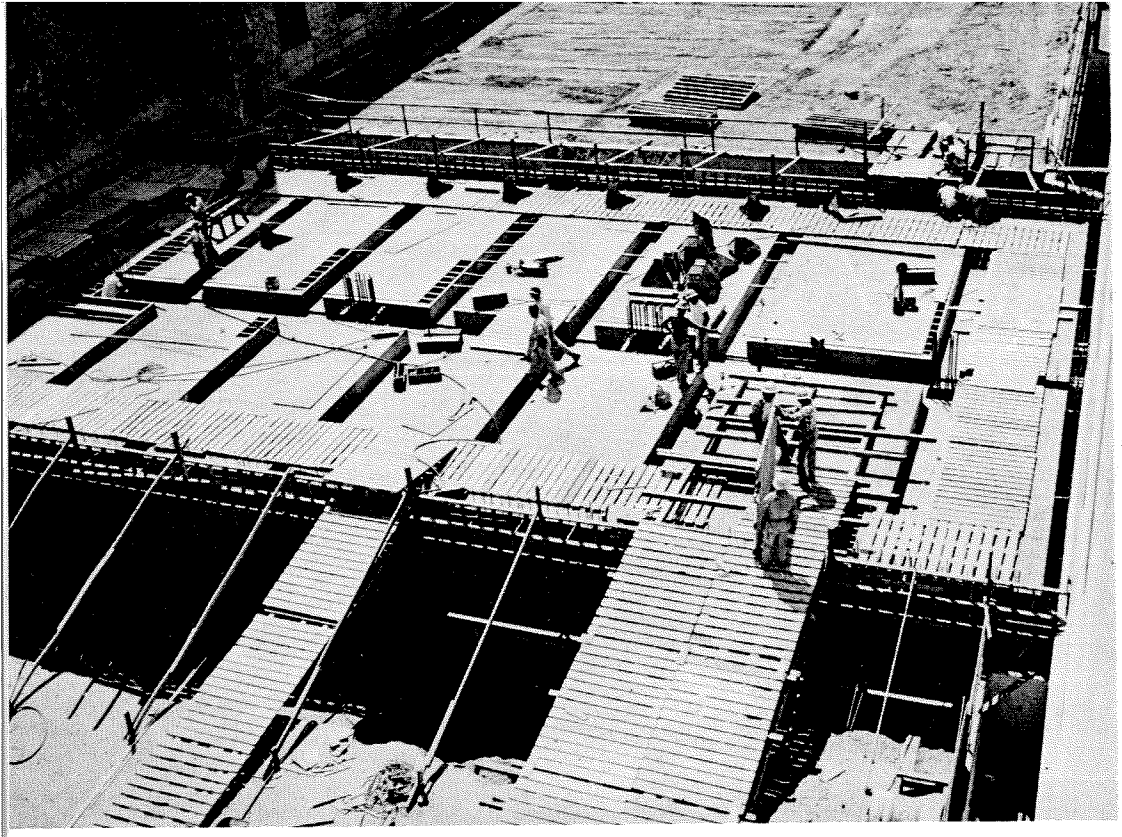
The old High Voltage Laboratory makes way for a new mathematics and physics building.

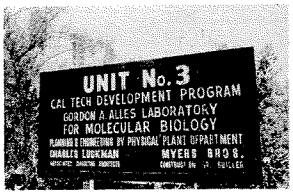


Caltech's Development Program calls for construction of 18 new buildings on the campus. Unit No. 1, the Physical Plant Building, on the north side of San Pasqual Street between Holliston and Chester Avenues, was dedicated in June. By then, the bulldozers, power shovels and cranes had moved onto the central campus to break ground for Unit No. 2.



Unit No. 2, the Alfred P. Sloan Laboratory of Mathematics and Physics, retains the shell of the old High Voltage Laboratory, but will become a five story (two floors below ground) structure with offices for faculty members and graduate students in mathematics, facilities for research in low temperature physics, and a new 10-million-volt Van de Graff accelerator to be used in research on the nuclear reactions of light elements.

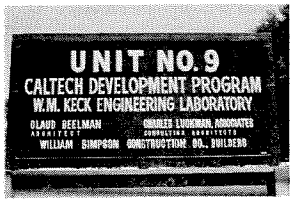




Unit No. 3, the Gordon A. Alles Laboratory for Molecular Biology, unites the present Kerckhoff and Church Laboratories, providing space for research in virology, biochemistry, biophysics, immunology and psychobiology.

Unit No. 4, the Campbell Plant Research Laboratory, is an addition to the Dolk and Earhart Laboratories. It will provide 3,000 square feet of de-smogged, air-conditioned plant-growing space for studies of plant viruses and plant development problems.

Ground was broken in September for three new Student Houses and a Campus Coffee Shop, on the site of the "temporary" barrack buildings of World Wars I and II. The new Houses will be ready by the fall of 1960.



Unit No. 9, the W. M. Keck Engineering Laboratories, is located at Chester Avenue and San Pasqual Street, across from the present Spalding Engineering Laboratory. The new engineering building will provide facilities for teaching and research in sanitary engineering, hydraulics and water resources.

The Summer at Caltech

Faculty Changes

New members of the Institute's staff of instruction and research for 1959-60 include:

A. L. Albie, visiting professor of geology, from Washington, D.C., where he has been working with the U. S. Geological Survey since 1950. Dr. Albie received his PhD from Harvard University in 1957.

Robert J. Allen, visiting professor of English, from Williams College, Massachusetts, where he has been chairman of the English department since 1949. Dr. Allen received his PhD from Harvard University in 1929.

Jerome A. Berson, visiting professor of chemistry, from the University of Southern California where he is professor of chemistry. Dr. Berson received his PhD from Columbia University in 1949.

Paul J. Blatz, senior research fellow in aeronautics, from the Aerojet-General Corporation where he has been a technical specialist. Dr. Blatz received his PhD from Princeton University in 1948.

A. G. W. Cameron, senior research fellow in astronomy, from the Chalk River Atomic Energy Center of Canada, Ltd. Dr. Cameron received his PhD from the University of Saskatchewan in 1952.

R. F. Chisnell, visiting lecturer in aeronautics, from the University of Manchester in England where he is a lecturer in mathematics and English. Dr. Chisnell will spend the first term at MIT before coming to Caltech in January.

Alan Green, assistant secretary of the YMCA, who is a graduate of Claremont Men's College and the Pacific School of Religion in Berkeley, Calif.

Marshall Hall, Jr., professor of mathematics, from Ohio State University where he has been professor of mathematics since 1949. Dr. Hall received his PhD from Yale University in 1936.

Fred Hoyle, visiting professor of astronomy, from the University of Cambridge where he is Plumian Professor of Astronomy and Experimental Philosophy.

Hans D. Krumhaar, senior research fellow in aeronautics, from the University of Goettingen in Germany where he is scientific assistant in aeroelasticity. Dr. Krumhaar received his PhD from the University of Goettingen in 1955.

Henry Kuivila, visiting associate in chemistry, on a National Science Foundation grant. Dr. Kuivila is professor of chemistry at the University of New Hampshire.

Anton Lang, professor of biology, from UCLA where he has been associate professor of biology. Dr. Lang received his PhD from the University of Berlin in 1939, and was a research fellow at Caltech from 1950 to 1952.

Henry W. Menard, visiting professor of submarine geology, from the Scripps Institute of Oceanography where he has been associate professor of submarine geology since 1951.

James E. Mercereau, assistant professor of physics, who received his PhD from Caltech in June.

John F. Nye, visiting professor in glaciology, from the University of Bristol in England where he is a lecturer in physics.

Robert W. Oliver, visiting professor of economics, from the Stanford Research Institute where he was an economist. Dr. Oliver received his PhD from Princeton University in 1957.

Arnold M. Paul, instructor in history, from UCLA where he has been physics instructor in the extension division since 1956. Dr. Paul got his PhD from UCLA in 1958.

Cornelius J. Pings, Jr., associate professor of chemical engineering, from Stanford University where he has been associate professor of chemical engineering. Dr. Pings received his BS in 1951, his MS in 1952 and his PhD in 1955 from Caltech. He will also serve as resident associate of Fleming House during the 1959-60 academic year.

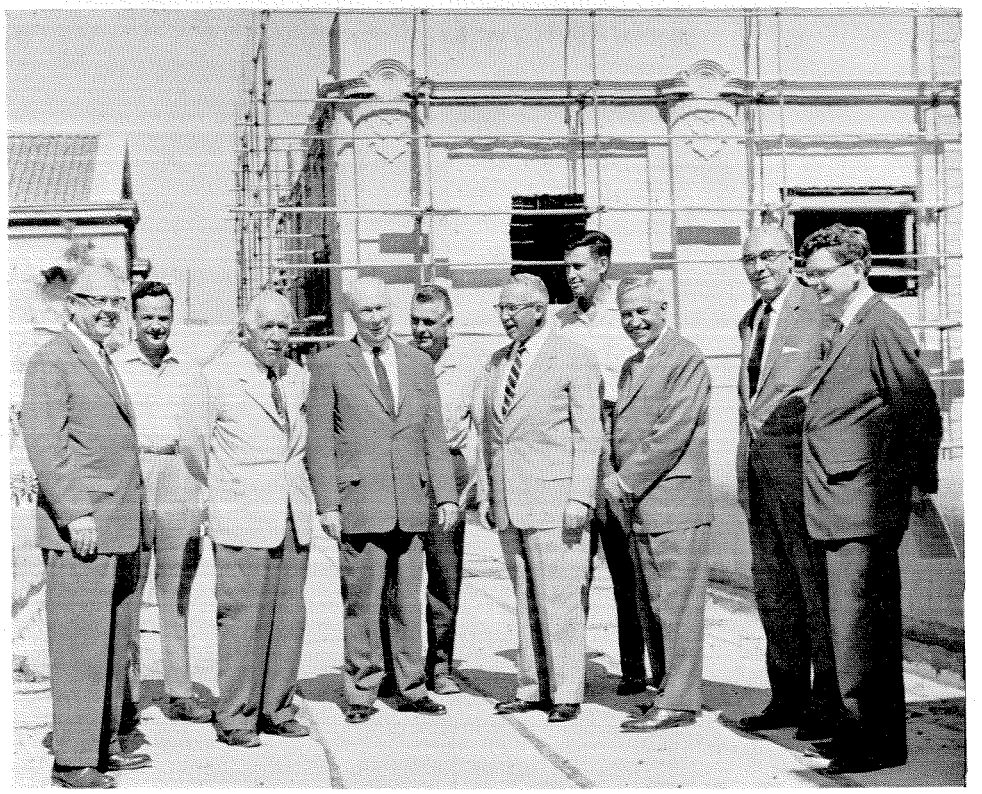
G. Bailey Price, visiting professor of mathematics, from the University of Kansas where he is professor of mathematics and chairman of the department.

Octavio G. Ricardo, research associate in aeronautics, from the Technological Institute of Aeronautics in Sao Paulo, Brazil, where he is associate professor of structures.

G. Wilse Robinson, associate professor of chemistry, from John Hopkins where he has been assistant professor of chemistry since 1954. Dr. Robinson received

SUMMER VISITOR

Niels Bohr, director of the Institute for Theoretical Physics in Copenhagen, Denmark (third from left) and W. V. Houston, president of the Rice Institute in Houston, Texas, (fourth from left) tour the campus with Caltech physicists Fowler, Feynman, Pellam, Bacher, Christy, DuBridge, Anderson and Lauritsen.



his PhD from the University of Iowa in 1952.

August T. Rossano, Jr., visiting professor of environmental health engineering, from the Robert A. Taft Sanitary Engineering Center in Cincinnati where he is technical liaison officer of the air pollution program for the Public Health Service.

Maarten Schmidt, associate professor of astronomy and staff member of the Mt. Wilson and Palomar Observatories, from the University of Leiden Observatory in Holland where he was a staff member.

Cushing Strout, associate professor of history, from Yale University where he has been assistant professor of history since 1956. Dr. Strout received his PhD from Harvard University in 1952.

Hugh P. Taylor, Jr., assistant professor of geology, who received his PhD from Caltech in June.

Otis L. Updike, Jr., visiting associate in chemistry, from the University of Virginia where he has been associate professor of chemical engineering since 1955.

George W. Wetherill, visiting professor of geochemistry, from the Carnegie Institution in Washington, D.C., where he is a staff member of the department of terrestrial magnetism.

Harold E. Wilcox, visiting associate professor of chemistry, from Southern College in Birmingham, Alabama, where he has been professor of chemistry and head of the department since 1946. Dr. Wilcox received his PhD from Ohio State University in 1939.

ON LEAVE OF ABSENCE:

James C. Davies, associate professor of political science, to the University of California at Berkeley as visiting associate professor of political science.

Albert E. Engel, professor of geology, to the Scripps Institute of Oceanography at La Jolla as professor of geology.

Murray Gell-Mann, professor of theoretical physics, to the University of Paris as visiting professor of theoretical physics on a senior postdoctoral National Science Foundation Fellowship.

Beach Langston, associate professor of English, to lecture on American literature at the Universities of Lille and Rennes in France on a Fulbright grant.

Hardy C. Martel, associate professor of electrical engineering, to the Bell Telephone Laboratories in Murray Hill, N. J., as a member of the technical staff for one year.

Herschel K. Mitchell, professor of biology, to the University of Zurich in Switzerland where he will do a year's research on *Drosophila* flies in Professor Ernst Hadorn's laboratory.

Vincent Z. Peterson, assistant professor of physics, to the National Institute of Nuclear Physics in Frascati, Italy, on a Fulbright grant. He will conduct research on high energy nuclear physics.

Charles F. Richter, professor of seismology, to the Geophysical Institute of Tokyo University in Japan as a Fulbright Research Scholar to conduct research in seismology.

Walter A. Schroeder, research associate in Chemistry, to the Carlsberg Laboratory in Copenhagen, Denmark, as a Guggenheim Scholar.

J. Harold Wayland, professor of applied mechanics, to the Microhydrodynamics Center in Strasbourg, France; Cambridge University, England; and University College, Cork, Ireland.

DEPARTURES:

James A. Noble, professor of geology, resigned to work as a private consultant to industrial firms in Pasadena.

Frits Went, who was in charge of Caltech's Earhart Laboratory, to the Missouri Botanical Gardens in St. Louis, as director.

PROMOTIONS:

To Professor:

Julian Cole—Aeronautics and Applied Mechanics
Samuel Epstein—Geochemistry
Yuan-Cheng Fung—Aeronautics
Robert Leighton—Physics
Harden McConnell—Chemistry
Guido Munch—Astronomy
Charles Papas—Electrical Engineering
Matthew Sands—Physics
Robert Walker—Physics

To Associate Professor:

Clarence Allen—Geology
Felix Boehm—Physics
Donald Coles—Aeronautics
Richard Dean—Mathematics
F. Brock Fuller—Mathematics
Dino Morelli—Mechanical Engineering
Gerald Wasserburg—Geology

Caltech's Cosmopolitan undergraduates.

To Senior Research Fellow:

Marjorie Caserio—Chemistry
Ricardo Gomez—Physics
Thomas Matthews—Astronomy

To Assistant Professor:

Toshi Kubota—Aeronautics
Jon Mathews—Physics

Second Jazz Festival

The Caltech Student Body will present its second Pasadena Jazz Festival at the Civic Auditorium on October 31. The show will feature the Dave Brubeck Quartet, the Arthur Lyman Quartet, the Andre Previn Trio with Shelly Manne on the drums, and singer Mavis Rivers. Tickets are available at Mutual ticket agencies, the Caltech News Bureau, or by writing to Box 76, California Institute of Technology.

Caltech in Print

Caltech features turned up in two national magazines last month—*Fortune* and *Cosmopolitan.*

Under the title "Magnetic Caltech," *Fortune* writer George A. W. Boehm covered the past history and future growth of the Institute—and dug up a lively assortment of Caltech anecdotes.

The liveliest:

"No other school screens its students so carefully; faculty members tour the country to give personal interviews to 700 of the highest-ranking candidates for the freshman class. The ones accepted scored in the upper 1 or 2 percent in the nationwide College Entrance Board examinations. And they will undoubtedly have lively imaginations as well as textbook learning.

"A general-biology examination last year posed the following question: 'You have been sent by the National Aeronautics and Space Administration to outer space and charged to report for each celestial body as to whether or not it is inhabited by living objects. How will you recognize objects as living?'

"The answers were, to say the least, ingenious. Most of the students suggested exposing unfamiliar objects to strong radiation or cutting them in half on the theory that such treatment would cause drastic changes in living things. One student, however, advised a more direct approach: 'Ask if it is alive. Even a negative reply should make you suspicious.'"

In *Cosmopolitan,* in a picture story on college campuses and college dress, a group of Caltech undergraduates appeared—in glorious color—attired in their House coats. As far as the *Cosmopolitan* coverage went, the Caltech students seemed to be among the best-dressed in the country. This may come as something of a surprise to regular inhabitants of this campus.

Coding and Decoding in the Nervous System

Discovery of a "sixth sense" in the humble crayfish opens up new avenues in neurophysiological research

by C. A. G. Wiersma

One of the many ways in which man is distinguished from other organisms is in the extraordinary development of his nervous system. How is the nervous system constructed? How does it function? These are questions of tremendous importance for an understanding of the relation of mind and body. Answers are being sought at levels of research ranging all the way from individual molecules to the whole organism.

For over 25 years, the Institute's department of neurophysiology has been studying how messages are transmitted through the nerves, from the sense organs to the brain, and back to the muscles. In the vertebrates, and more especially in mammals, the number of nerve fibers present is staggeringly large, making it difficult to trace the fate of a signal in any one channel. However, the crayfish, whose nerve cells are relatively large in size and relatively small in number, was found to be an ideal subject for such basic studies.

In recent months, a new type of sensation has been discovered in the crayfish which is tentatively labeled a "sixth sense." This sense is unique because information is transmitted in a different way than in other sense organs. The nerve cell fibers involved, which are called the unidirectional movement fibers, collaborate in the control of the leg joints of the crayfish.

A nerve is a bundle of separate nerve fibers, each capable of transmitting a signal either to or from the nervous system (the brain and spinal cord). All sensations, all voluntary muscle contractions, and many

other activities depend on this conduction of nerve impulses. There are strong reasons to believe that in any one nerve fiber each nerve impulse is like any other, so the only variable for transmitting different messages is the time sequence in which the impulses follow each other.

Like other arthropods, the crayfish carries out the "business of living" with a relatively small number of nerve cells (below 100,000). Even so, this animal seems to react and adjust to the environment as adequately as the frog, whose nerve cells may be numbered in the millions. In both arthropods and vertebrates, the more highly developed forms (insects and mammals) show considerable refinement in their reactions without proportional increases in the total number of nerve cells. The advantage of studying the less-complexly-reacting crayfish lies, as in the case of the frog, in the greater predictability of the reflex responses. In the study of the crayfish, one may, of course, encounter processes which are absent as such in the vertebrates. An understanding of these processes may lead to the finding of related ones in vertebrate nervous systems.

Unique decoding

The first discovery to call attention to the crayfish as a useful experimental animal was the peculiarity in transmission between its motor nerve impulses and the contraction of its muscle fibers. An outstanding feature of the arthropod nervous system is the small number of motor fibers innervating its muscles. Even such a large muscle as the one that closes the claw of the lobster, which consists of many thousands of muscle fibers, receives only two motor fibers. A comparably large vertebrate muscle, on the other hand, is innervated by hundreds of nerve fibers. In these muscles, speed and strength of contraction are to a large extent regulated by a variation in the number of motor fibers activitated at a given moment. Obviously, such a mechanism is quite ineffective when there are only two motor fibers; in fact, since each motor fiber in many crustacean muscles innervates *all* of the muscle fibers, it would not operate at all. But it turns out that when the same sequence of motor impulses is induced by electrical stimulation of the two fibers in turn, the resulting contractions are quite different. This means that at the neuromuscular junction the similar signals are decoded in quite different ways. It has been possible to show that each individual muscle fiber possesses this decoding property; but how this comes about is not completely understood yet.

The most likely hypothesis at present is that a chemical transmitter substance is released at the junctions, and that there is a slight, but significant, difference in the composition of the chemicals released by the two motor nerve fibers. It will, of course, be necessary to study such transmitters in isolation before further light can be thrown on these intriguing differences. The importance of such investigations is the insight they offer into the elusive coupling process between the activation and the contraction of muscle fibers.

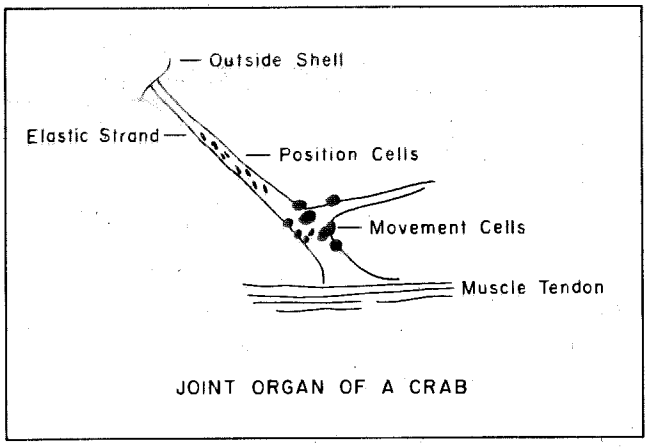
In addition to motor nerve fibers, crayfish muscles receive nerve fibers from the central nervous system which *inhibit* contraction. So far, decapod crustaceans such as crayfishes, lobsters and crabs are the only animals in which this inhibitory mechanism has been found to be present. With these animals it is possible to isolate and stimulate single inhibitory fibers along with the motor fibers for given muscles. Such nerve-muscle preparations allow precise study of the mechanism of inhibition far more easily than similar complex inhibitory mechanisms in the vertebrate central nervous system.

Chemical transmitters

According to present views, inhibition also comes about by the release at the nerve endings of a chemical transmitter whose action interferes in a complex manner with that of the excitatory transmitter substance. Thus, by liberating two different types of substances, the decoding of identical impulse series in the two kinds of fibers leads to opposite effects in the muscle fiber.

The investigation of peripheral neural mechanisms in the crayfish has also contributed significantly to the problem of coding environmental changes into nerve impulse sequences. In the abdomen of the crayfish there are seven flexible joints, each provided with two pairs of sense organs called the muscular stretch receptor organs. Each indicates, by the firing of a single sensory fiber, how far a small specialized muscle is stretched, and, in general, the relative position of two segments of shell. Though the two organs on one side are similarly built, they differ quite noticeably in their reactions to flexion. If a shell segment is bent quickly to a certain degree with respect to the one in front, one sense organ (the slow receptor) will keep firing at an almost undiminished rate for more than an hour, or as long as the position is maintained. The other organ (the fast receptor) will adapt and become quiet after a burst of impulses, lasting not more than a minute. The stretch receptors, when properly isolated, consist of a smaller amount of living substance than any other isolated piece of tissue with the capacity of generating action potentials. For this reason they are particularly useful for investigating such problems as the action of drugs on generation of impulses.

Crayfish stretch receptors have still another useful feature. They are the only receptors so far known which receive an inhibitory innervation. By stimulation of an inhibitory fiber, it is possible to diminish the sensitivity of these receptors at will, and thus to adjust their sensitivity. Similar suppression of incoming sensory impulses must also occur regularly in the human central nervous system, such as when we exclude certain noises from our consciousness. However,



JOINT ORGAN OF A CRAB

Like the crayfish, the crab is another of the decapod crustaceans which has a relatively small number of nerve cells, some large in size. This simple type of system is useful in studying how messages are transmitted through the nerves.

these complex phenomena are completely central in the vertebrate nervous system, and thus harder to study. It is interesting to note that as yet it is not known what use the crayfish makes of its peripheral inhibitory mechanism.

The "sixth sense"

The coding of stimuli into nerve impulses in these crayfish stretch receptors is similar to most known sensory fibers. That is, the frequency is proportional to the logarithm of the stimulus strength. The new organ or "sixth sense" which has been found in the crayfish and other decapod crustacea can be considered as a new type of sensation because of the remarkable method by which the stimulus is transformed into an impulse sequence.

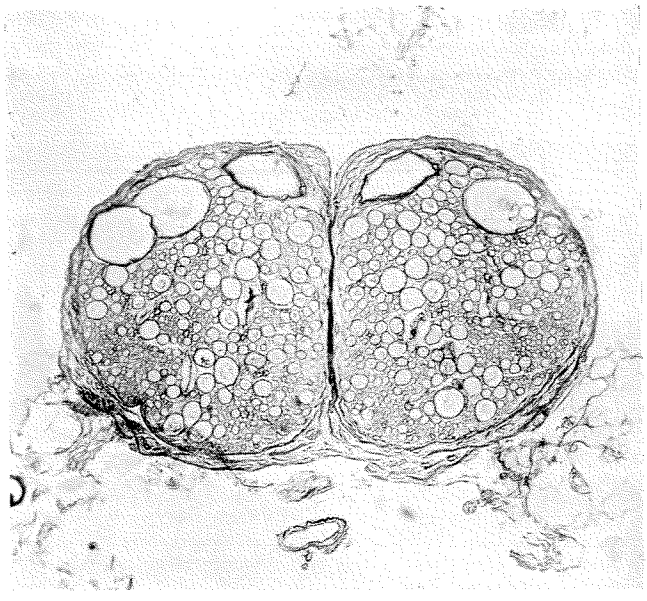
The drawing above illustrates how the nerve cell bodies of this organ are attached to an elastic strand which spans the joints. Each of the sense organs is able to fire at least four quite different types of discharges into corresponding nerve fibers. By isolation of the fibers it was found that these are: a) sensory fibers which signal position to one side of the midpoint of the arc through which the joint can move; b) fibers which signal the position only to the other side; c) fibers which discharge during movement anywhere over the whole arc in one direction; d) fibers which signal movement in the opposite direction.

The position fibers respond with outputs similar to those described for the stretch receptors – that is, their frequency gradually increases as more extreme positions are reached. Instead of two there are many of these fibers for each organ, and all of these appear to be appreciably different with regard to the positions at which they start to fire. They also differ in adaption rates; some fire for very long times at constant frequencies, while others adapt very quickly.

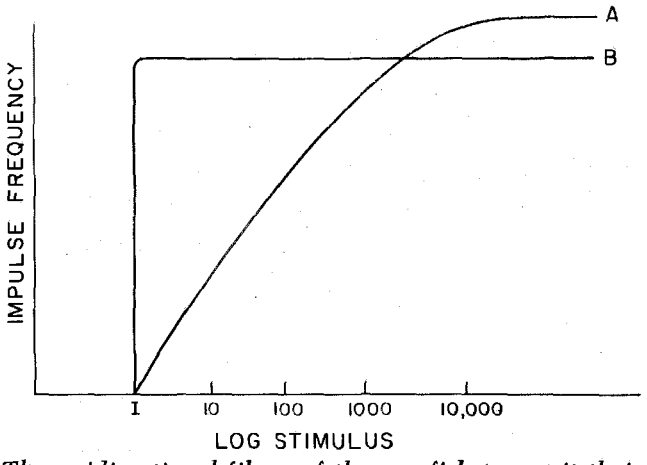
The "movement" fibers, on the other hand, have a completely different type of response which is especially evident in the most sensitive ones. They fire at constant rates once the movement is slightly faster than threshold and stop firing as soon as movement ceases. For instance, such a fiber will fire 40 impulses per second when the joint is moved at an angular speed of 1° per second, and at exactly the same rate when the motion is more than a thousand times faster. For the total possible movement of the joint from one extreme to the other (an angle of about 120°) 4800 impulses will result for the first speed, whereas only 4 impulses will be fired at the second speed. These 4 impulses cannot convey any other information than the first 4 of the 4800, and therefore the only information that can be extracted from these signals is how *long* movement takes place – not how *far* or at what *speed*. It is true that, for speeds between 0.6 and 1° per second, the fiber under discussion does not fire at its maximum speed, and that impulses are separated by longer time intervals. However, the basic frequency still remains 40 per second, and the difference is that random impulses drop out as speed decreases. As a result, the oscilloscope record obtained looks very much like a comb in which teeth are randomly missing.

Movement fibers

From one such sense organ some six fibers sensitive to movement in one direction can be obtained, each of which has a different threshold and fires at a different maximum frequency. Though their maximum frequency is higher, the most insensitive fibers produce only 12 impulses for a single maximal motion at



Cross-section microphotograph through the abdominal cord of a crayfish. Giant fibers are at the top and smaller interneurons occur in greater numbers throughout.



The unidirectional fibers of the crayfish transmit their information in a different way from fibers in other sense organs. A *shows the relation found in most sense organs;* B *the relation found in the new type of sensation.*

the optimal speed. Because of these differences in threshold between the movement fibers, the organ as a whole can provide information which denotes movements at different speeds to the central nervous system. But it should be noted that it will depend on the central connections whether this information is really used, and if so, in what way. In the diagram above, the difference between the relation of impulse frequency and stimulus strength of these fibers and the "normal" type is given.

The central nervous system

The central nervous system of the crayfish has also been found to be of considerable interest and usefulness. One of the main reasons for this is the small number of interneurons, those fibers which connect the nerve fibers with each other. In addition, these interneurons are large in size, which makes it possible to detect their signals, or even to isolate them completely. It is thus possible to study the effect of stimulating them individually.

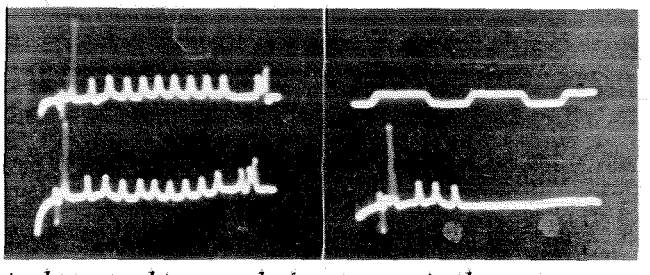
Especially easy to isolate are the four giant fibers, which serve the animal in the escape reaction of backward swimming. By stimulating these and recording from motor fibers, it has been shown that transmission and decoding of their impulses to the motor fibers at the synapses offers a number of interesting features. In general, transmission is much more effective at these synapses than is usual. For the motor nerve fibers causing the strong tail flexion, a one-to-one transmission relation is present. A remarkable feature of these synapses is that they may be wholly electrical, without a chemical transmitter substance. The membrane separating the two fibers has the property of a rectifier, permitting current flow in only one direction. This serves as an assurance against stimulation in the wrong direction.

The synapses of the giant fibers with certain motor fibers show that a single impulse in the one can lead to a repetitive discharge in the other. This multiplication of the signal can result in as many as 10 to 15 motor impulses from a single action potential in the giant fiber (below). But most crayfish interneurons, like those of other animals, transmit only after a number of impulses have reached them. In both of these latter types of transmissions, the liberation of chemical transmitter substance must be involved.

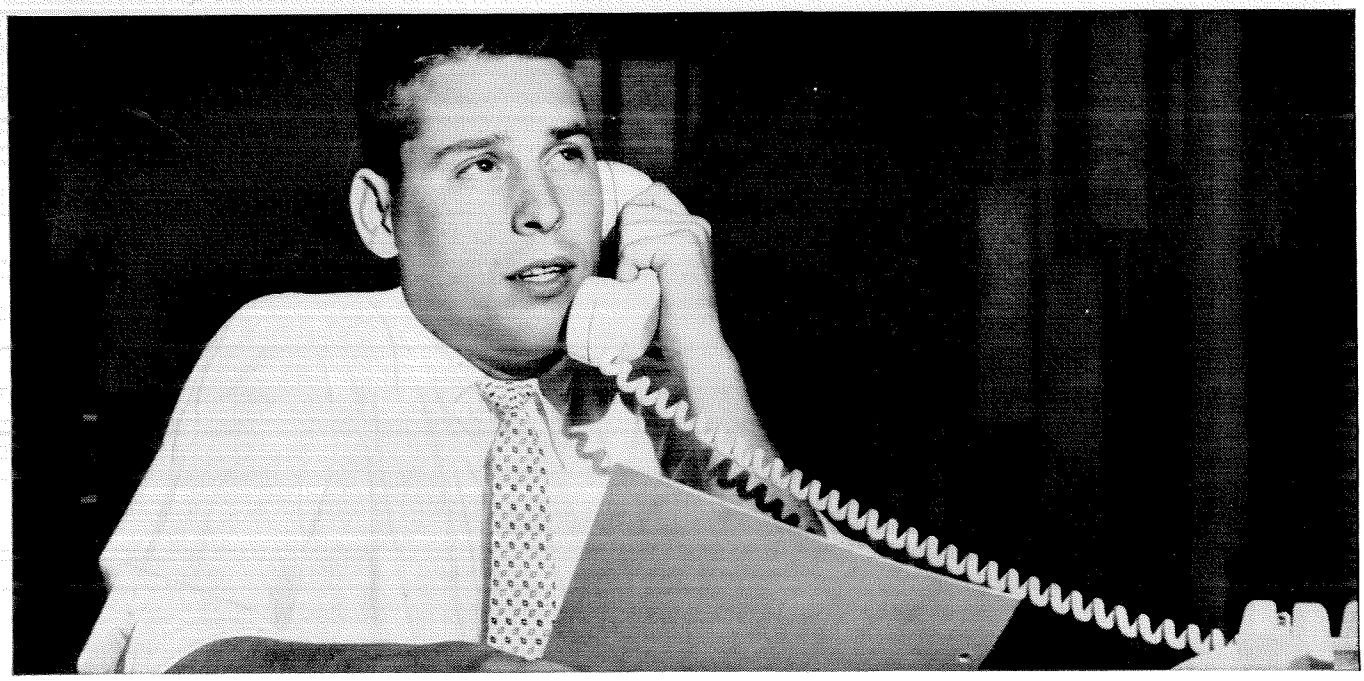
In the crayfish central nervous system a single interneuron is able to spread its impulses over wide areas because it has many endings, widely separated, where synapses exist with other fibers. Even more remarkable is the fact that there are also many interneurons which can receive impulses at very different levels. This leads to collision of impulses in the main axon of such fibers, when they are stimulated at two places at the same time. As a result, the output of such fibers – that is, the impulses reaching the place where they synapse with following fibers – becomes difficult to predict.

An unexpected finding

Interneurons can receive inputs from many sources, differing in the type of sensation or in the localization of the sensation. Remarkably enough there are many interneurons in the crayfish which do the latter, so that there appears to be a plethora of this type of combination – whereas the "integration" of different types of sensation, though present, is much more poorly represented. This unexpected finding may be important for views concerning the structure of such systems. However, before the mechanisms present can be understood, it will be necessary to do more than investigate the reactions of specific interneurons. It will be necessary to know the subsequent consequences of these impulses in the higher parts of the nervous system before their function can become evident. This is a difficult task in any animal, but if the coding and decoding processes taking place in central nervous systems can ever be completely analyzed, those of the crayfish could be the first.



A photographic record of responses in the motor nerve of a crayfish. Left, repetitive discharges in two symmetrical nerves – right, discharge in a single nerve after fatigue at the synapse. Time, 60 cycles per second.



He's been on his way up from the day he started work

James C. Bishop got his B.S. in Electrical Engineering from the University of Illinois on June 23, 1953. On July 1, he went to work as a lineman in the Illinois Bell Telephone Company management training program. On July 2, he was "shinnying" up telephone poles.

And he's been "climbing" ever since. A planned rotational training program, interrupted by a stint in the Army, took Jim through virtually every phase of plant operations.

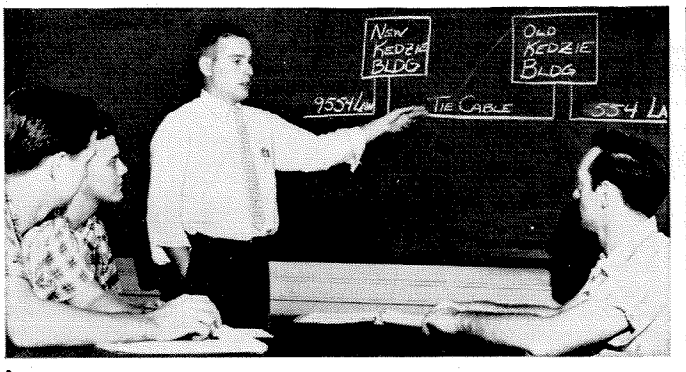
He was promoted to Station Installation Foreman in July, 1957. Then came more training at company expense—in human relations and other supervisory subjects—at Knox College.

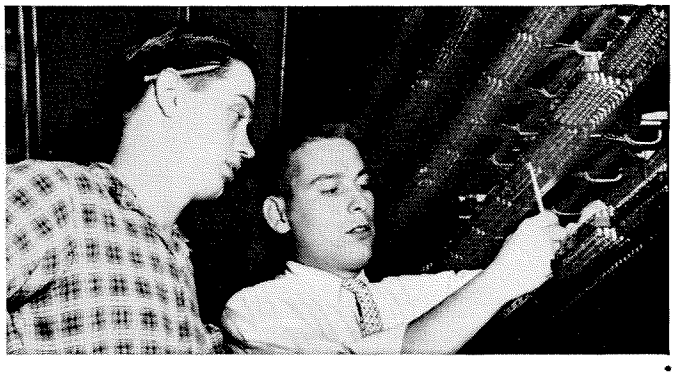
Since early 1958, Jim has been Central Office Foreman in the Kedzie District of Chicago, which embraces about 51,000 telephone stations. He has 19 men reporting to him.

"I was hired as 'a candidate for management,'" he says. "I know I'll get the training and opportunity to keep moving ahead. How far I go is up to me. I can't ask for more than that."

* * *

Find out about career opportunities for *you* in the Bell Telephone Companies. Talk with the Bell interviewer when he visits your campus. And, meanwhile, read the Bell Telephone booklet on file in your Placement Office.

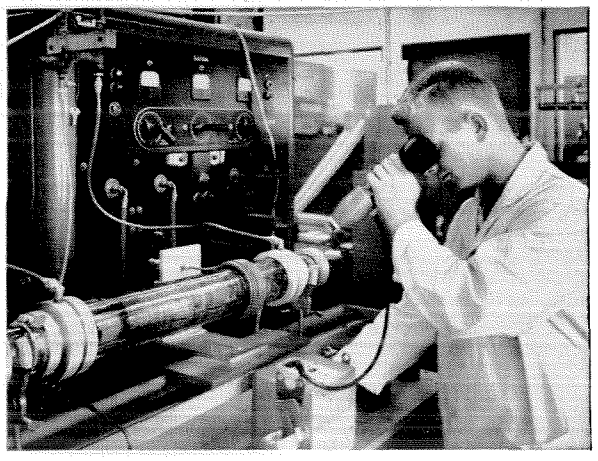




Jim Bishop holds training sessions regularly with his men. At left, he discusses cable routes in connection with the "cutover" of his office to dial service. At right, he and a frameman check a block connection on the main frame.

BELL TELEPHONE COMPANIES

Checking Einstein with



Purity Plus—*Hughes Products Division engineer checks semiconductor materials to insure purity.*

Exit cones *capable of withstanding temperatures of 6000° F. represent one example of advanced engineering being performed by the Hughes Plastics Laboratory.*

an atomic clock in orbit

To test Einstein's general theory of relativity, scientists at the Hughes research laboratories are developing a thirty pound atomic maser clock *(see photo at left)* under contract to the National Aeronautics and Space Administration. Orbiting in a satellite, a maser clock would be compared with another on the ground to check Einstein's proposition that time flows faster as gravitational pull decreases.

Working from the new research center in Malibu, California, Hughes engineers will develop a MASER (Microwave Amplification through Stimulated Emission of Radiation) clock so accurate that it will neither gain nor lose a single second in 1000 years. This clock, one of three types contracted for by NASA, will measure time directly from the vibrations of the atoms in ammonia molecules.

Before launching, an atomic clock will be synchronized with another on the ground. Each clock would generate a highly stable current with a frequency of billions of cycles per second. Electronic circuitry would reduce the rapid oscillations to a slower rate in order to make precise laboratory measurements. The time "ticks" from the orbiting clock would then be transmitted by radio to compare with the time of the clock on earth. By measuring the difference, scientists will be able to check Einstein's theories.

In other engineering activities at Hughes, research and development work is being performed on such projects as advanced airborne systems, advanced data handling and display systems, global and spatial communications systems, nuclear electronics, advanced radar systems, infrared devices, ballistic missile systems... just to name a few.

The rapid growth of Hughes reflects the continuous advance in Hughes capabilities—providing an ideal environment for the engineer or physicist, whatever his field of interest.

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NOVEMBER 23 and 24

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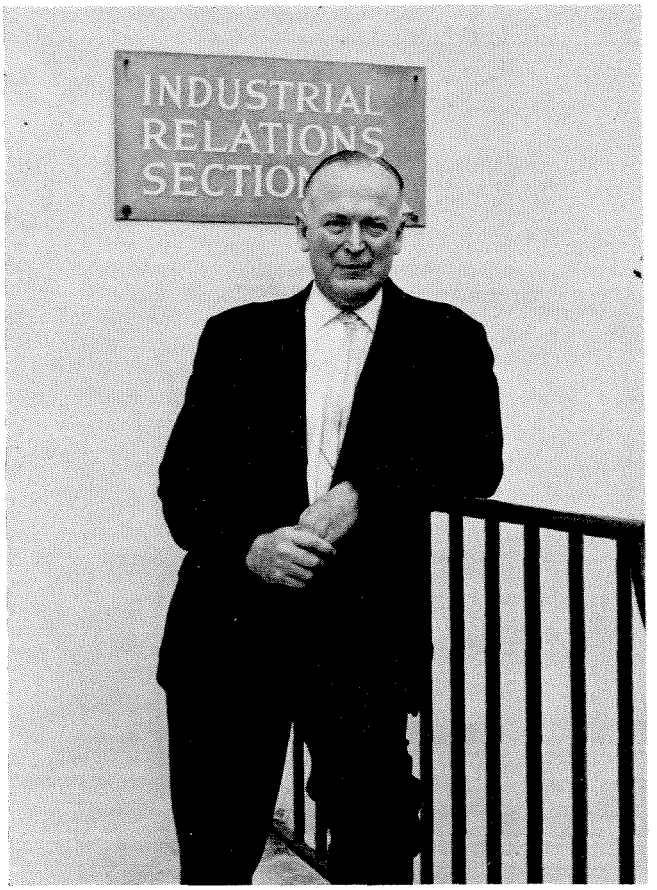


Robert D. Gray,
professor of economics
and industrial relations, and
director of Caltech's Industrial
Relations Section.

An Anniversary

Caltech's Industrial Relations Section celebrated its twentieth anniversary on September 29 with a banquet at the Biltmore Hotel in Los Angeles.

On hand to review the work of the Section were Norman Chandler, president of the Times-Mirror Company; Donald W. Douglas, Jr., president of the Douglas Aircraft Company; Lloyd L. Austin, president of the Security-First National Bank; and Bonar Dyer, personnel director for Walt Disney Productions.

Harry J. Volk, president of the Union Bank, and chairman of Caltech's Committee on the Industrial Relations Section, presided at the banquet, and Lawrence A. Appley, president of the American Management Association, was the main speaker.

The Industrial Relations Section was established at Caltech in 1939 "to increase and disseminate a knowledge and understanding of the philosophies, principles, policies and procedures affecting the functions of management and labor." To achieve this objective, the Section initiated five basic activities and, with varying emphasis, it has continued these activities up to the present time.

1. It has made available to Caltech undergraduates and graduate students an introduction to the problems of management and supervision – stressing the problems of supervising technical teams in industry, government, and education.

2. It has operated a reference library covering the field of management in general, with emphasis on personnel administration. This is one of the most comprehensive collections of materials on industrial relations and management to be found anywhere.

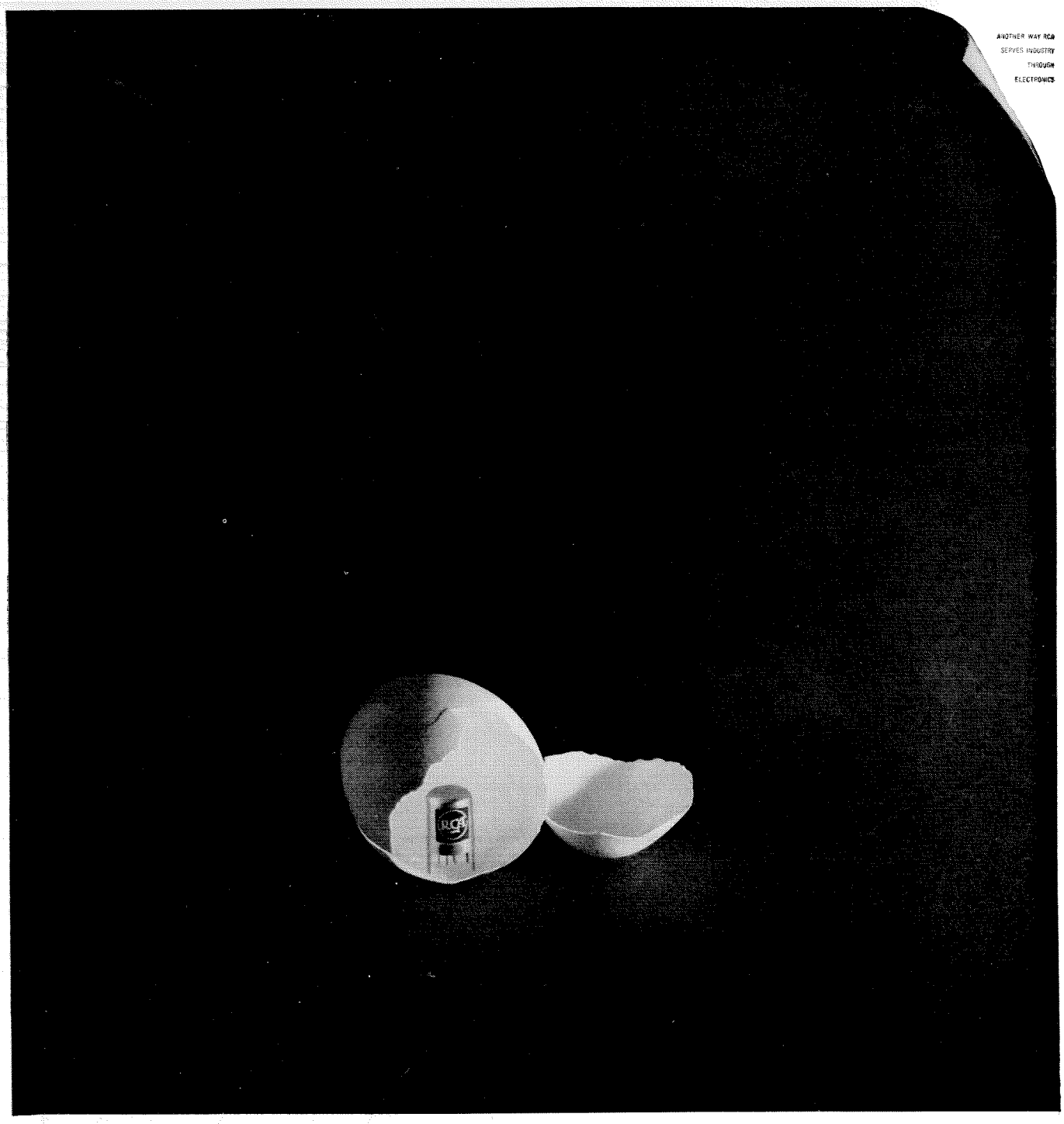
3. It has held meetings and conferences which have been attended by more than 17,500 representatives of industrial firms and organizations.

4. It has conducted surveys and research in a number of fields, with emphasis on problems of supervision, opinions of employees, and employee benefit plans.

5. It has published more than 135 items covering the varied aspects of management and personnel administration, and many of these publications have been used in supervisory training programs conducted by other schools and by individual companies. In observance of its twentieth anniversary, the Section is publishing its first book, *Frontiers of Industrial Relations.*

In recent years the work of the Section has been facilitated by the establishment of two other units within it – the Benefits and Insurance Research Center and the Management Development Center. And since its inception the Section has benefited from the advice of the Committee on the Industrial Relations Section made up of Caltech trustees and faculty members.

As measured by the number of its full-time staff members, the Industrial Relations Section is one of the smallest teaching and research units at Caltech. Much of its work, however, has been made possible by the use of several hundred part-time conference leaders from business organizations, unions, government, and other colleges.



RCA Electronics introduces the tube of tomorrow

Called the Nuvistor, this thimble-size electron tube is likely to start a revolution in electronics. RCA engineers scrapped old ideas—took a fresh look at tube design. The result will be tubes that are far smaller, perform more efficiently, use less power, can take more punishment, are more reliable. Developmental models now being tried out by designers will have a profound effect on the size, appearance, and performance of electronic equipment for entertainment, communications, defense, and industry in the future. It is another example of the way RCA is constantly advancing in electronics.

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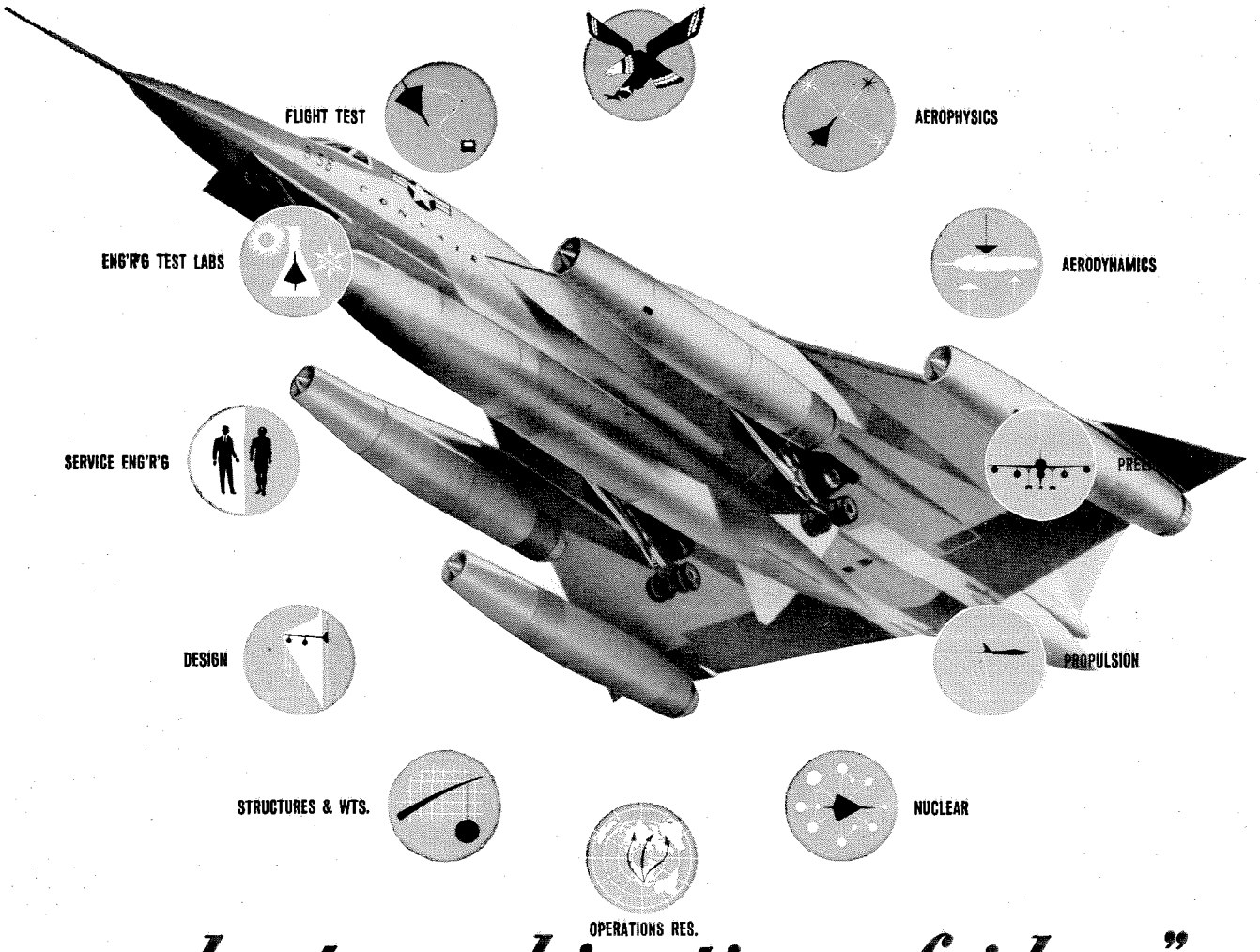

...best combination of ideas"

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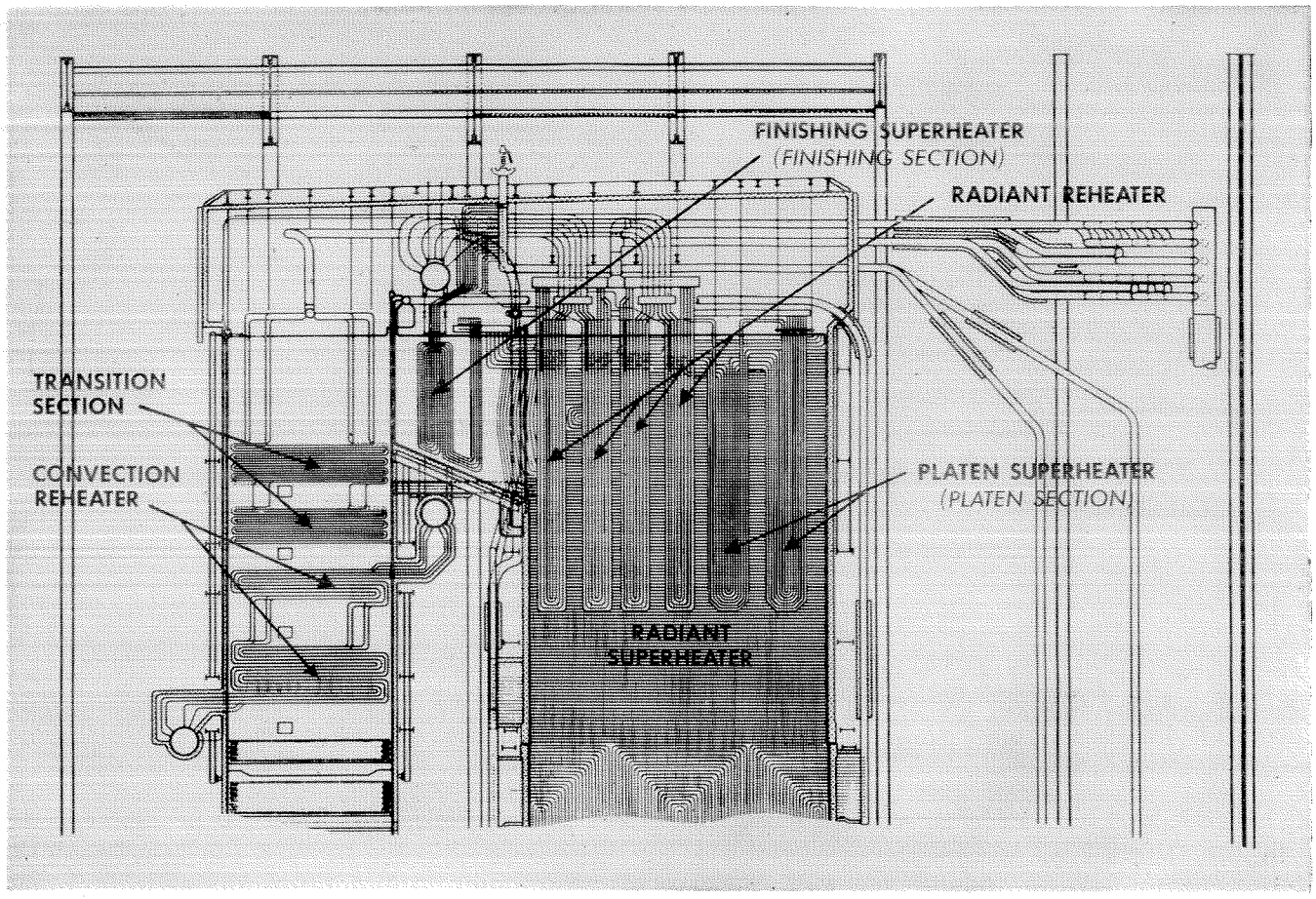


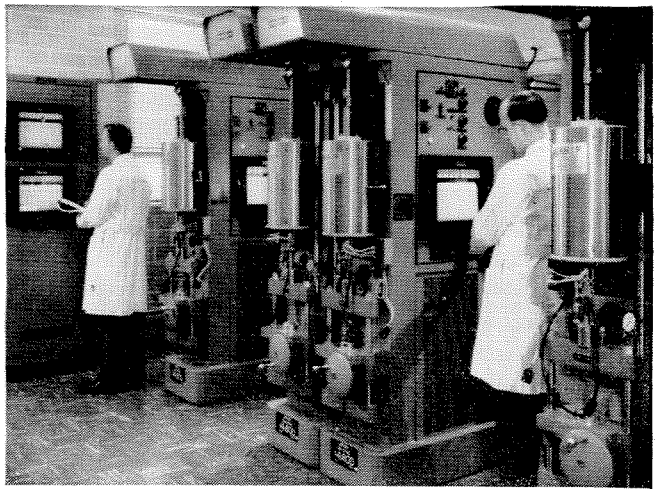
How to get steel tubes to harness highest steam pressures and temperatures

IN constructing Philadelphia Electric Company's revolutionary new Eddystone power plant, engineers had to harness the highest combination of pressure and steam ever achieved in a central station with 5,000 psi at 1,200° F. This called for superheater tubes (see diagram above) of a special stronger steel never before used in steam power plants. No one had ever succeeded in piercing this tougher steel to make seamless steel tubing.

The problem was given to Timken Company metallurgists, experts at piercing steels for 40 years. And they turned the trick. They made the steel for the platen and finishing super-heaters with the alloying elements in just the right balance for perfect piercing quality. They pierced *20 miles* of tubes free from both surface and internal flaws.

Timken Company metallurgists and Timken steels have solved all kinds of tough steel problems. They can help you on problems you may face in industry.

And if you're interested in a career with the leader in specialty steels . . . with the world's largest maker of tapered roller bearings and removable rock bits . . . send for free booklet, "Better-ness and Your Career at the Timken Company". Write Manager of College Relations, The Timken Roller Bearing Company, Canton 6, Ohio.



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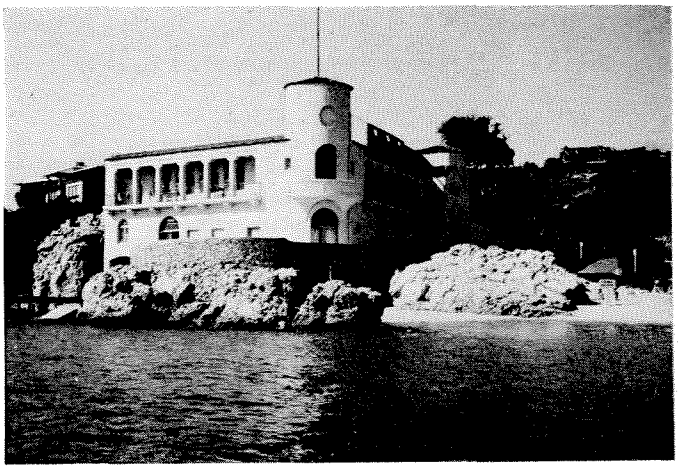


The Kerckhoff Marine Laboratory, near the entrance to the harbor in Corona del Mar, about 50 miles from Pasadena.

Caltech's Marine Laboratory

In 1928 Thomas Hunt Morgan, the founder of Caltech's Division of Biology, rented a pier and shack in Corona del Mar, for collecting purposes. After collecting at low tide Morgan and Albert Tyler planned to spend the night sleeping on the floor of the shack. Unfortunately they forgot that on days of very low tides there are also very high tides. They woke up soaked. This experience may have well marked the moment when a firm decision was made to acquire a marine station for the Institute.

The present Kerckhoff Marine Laboratory is located near the entrance to the harbor in Corona del Mar, on the east side of Newport Bay, about 50 miles from Pasadena. It was bought in 1929 for $50,000 from the very respectable but impoverished Palisades Club, which had used the building as a boat and bath house. Alfred A. Noyes and Ernest H. Swift, who were members of the club, were instrumental in arranging the sale. As its name indicates, the laboratory was acquired with funds given the Institute by William G. Kerckhoff, who also gave the money for the laboratories on the campus that bear his name.

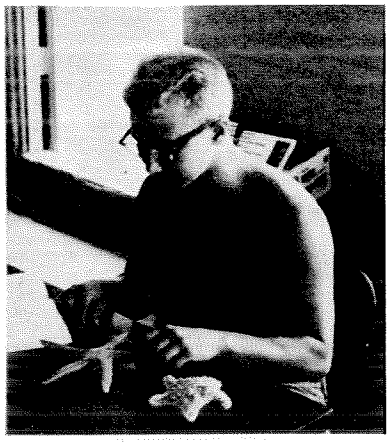
Several laboratories for teaching and research in marine zoology, embryology and physiology were set up in the new marine station. A salt water system was installed, and boats and tackle for collecting marine animals and sea-water aquaria for keeping them were acquired. The proximity of the marine station to Pasadena makes it possible to supply the biological laboratories with living material for research and teaching. The fauna at Corona del Mar and at Laguna Beach, which is nearby, is exceptionally rich and varied, and is easily accessible.

Morgan studied the problem of self-sterility in the hermaphroditic ascidian, Ciona, at the Marine Laboratory. In 1932 George E. MacGinitie came to the Institute from Pacific Grove to run the new marine station. Among others who have used the Laboratory's facilities for investigations are Harold Plough, now at Amherst College, for work on cell sterility; John Spikes, of Utah; N. H. Horowitz, as a graduate student of Dr. Tyler's; Bradley Scheer, now at the University of Oregon; and A. E. Mirsky, now at the Rockefeller Institute, who did early work on the development of methods for extraction of nucleic acids from sperm.

Among present-day Institute personnel making use of the Station are Heinz Lowenstam, in geology; Dr. Tyler, C. A. G. Wiersma, and Roger Sperry, in biology; and Dan Campbell, in chemistry. In recent years the use of the Marine Laboratory has been restricted to staff research workers, guest investigators, and qualified graduate students and undergraduate students.

Every summer a course in marine biology is given for students majoring in biology at the Institute. This is a popular course, as much for the course content as for the opportunities for water sports. A coeducational class for Pomona College students has also been given at the station in recent summers, and for the last several years the Caltech and Pomona classes have been held jointly.

On the page opposite—a student report on the Lab's 1959 summer session.



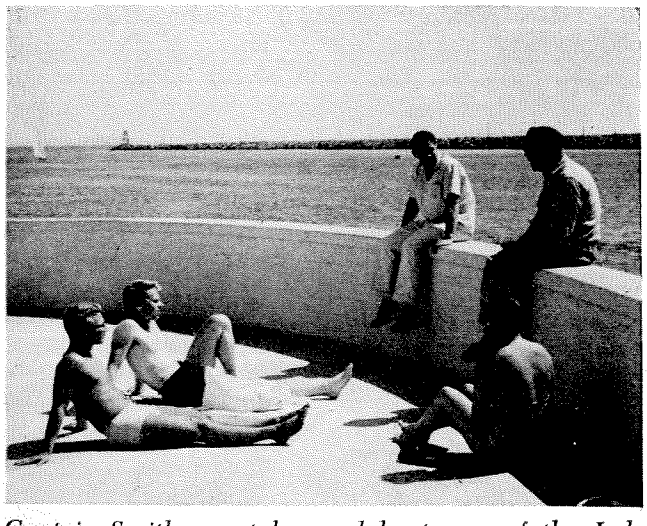
Academics at the Beach

The Sophomore-who-was-now-a-Junior came back to his room after his last final, stacked a spare Blue Book at the top of the pile of miscellany on his desk, and lay down to daydream awhile before he began the complicated business of moving out for the summer.

It just wasn't the same this year, he thought. Finals weren't the Days of Reckoning they had been last year, but just a sort of anticlimax to the work of the term. Last year, too, he had dreaded the summer, because it meant spending three months in the suburban tepidity of Pasadena, at a job he didn't like. But this year he was going to the Institute's Marine Laboratory at Corona del Mar. For the next five weeks he would be within diving distance of the ocean, studying biology – without integral signs, slide rules, and Gauss's Law to bother him. Of course, he would have plenty of time to swim and bask in the sun and still study hard enough to get an A in the course.

His daydream was disturbed by the entrance of his roommate, singing "Finals are over!" off-key, in his usual near-tenor voice.

"I hadn't noticed," the Junior said, grinning and getting up to leave. Moving could wait; right now he was going to look at some skin-diving equipment.



Captain Smith, caretaker and boatsman of the Lab, conducts an extracurricular session.

It had been a long, hot drive through the thick air of Los Angeles and the congested traffic of the beach cities, and the ocean had never looked quite so inviting, surrounding the Marine Lab at the bottom of the bluff.

Captain Smith, caretaker and boatsman of the Lab, welcomed him. "If you would like a place to sleep tonight, you might find it valuable to give a hand with pitching the sleeping tent on the roof. Doing so would also keep the students who are *already* at work from pounding *large* lumps on you when they get around to it. You see, you are quite late." There was a twinkle of sorts in his eyes.

Well, that swim will have to wait, thought the Junior. On his way up to the roof he passed a girl and remembered that there were to be some students from Pomona taking the course, too. He paused to think for a second but continued up to the roof after deciding that they couldn't possibly let the girls use the sleeping tent too.

Now the tent was up, but it was dark and he would have to wait until the next day to break in that skin-diving equipment. Besides, he was content to sit on the balcony facing the Newport channel, wishing that he owned one sailboat or another and listening to Captain Smith tell how those fishing boats had long

bowsprits because they were used in the spearing of broadbills and how 30 years ago – no, it was nearly 40 years now – he had run an ocean-going tug that had helped haul the rocks that formed the west jetty, across the channel there.

And the Junior thought of the girl he had passed. What was she like and who was she? Well, there would be five weeks to find out; it was time to sack out now.

"Yo-ho HOOOOO! The wind blows free . . ." A near-baritone this time. What a hell of a way to get up in the morning, thought the Junior. He made his way down to the kitchen, where he found an assembly of the other ten students taking the course, along with Dr. Pequegnat, the professor in charge.

"I have called you together to discuss something dear to the hearts of us all – food," the professor began, looking slightly bored. "We are going to talk about the preparations of our meals for the next five weeks. Lynne, here – your teaching assistant – will give you the details. And I hope you can figure out something quickly for breakfast, because I'm famished."

The Junior recognized the girl as the one he had passed on the stairs.

"We are going to divide you into three committees," she began in a businesslike manner, seemingly ignoring him – not at all an easy feat, considering that his mouth was hanging quite agape.

Breakfast was palatable but brief, as people began to leave the table to make their way up to the classroom. The first lecture; he had best not be late.

"Your assignment for the first week is Chapters one through fifteen," began the professor. "You will also be held responsible for the scientific names of 30 or so of the more common animals in this area. In addition, you will spend your lab periods this week learning to identify the components of the plankton of the water in this vicinity."

"The animal kingdom is divided into several groups called *phyla*. Singular, *phylum* . . . . ."

Phylum, plur. *phyla* went into the Junior's notebook, and academics at the beach had begun.

Diving lesson

Now it was time to break in that skin-diving equipment. But it didn't take him long to realize that it would be some time before he would be able to dive more than five feet. The annoying thing was that Lynne was consistently going down three times that far. "Keep your mouth open. It keeps the pressure off your ears," she said, hardly noticing him.

He tried it, but only managed to come up coughing and choking. "Your mouth – not your lungs, silly," she said. The water in his lungs was almost worth it. She had smiled at him.

Cooking lesson

By some draft system he did not understand, the Junior had been chosen to make spice cake for dinner that evening. And when the time came to make it, it was Lynne who showed him how to grease the pans, light the oven, and even how to hold the mixing spoon. Then, over an after-dinner cup of coffee on the balcony facing the channel, it was Lynne who told him that no one could really expect that his first spice cake would be perfect and he shouldn't worry about it and maybe he'd better study a little now.

And so he studied a little and went to sleep and dreamed of being able to dive 50 feet and make good spice cakes.

"Today," began the professor, "we will consider the phylum Protozoa." And so went five weeks. Skin diving, cooking, washing dishes, studying, taking tests every Saturday morning.

The final was over. The Junior was "swabbing down the deck" under the careful supervision of Captain Smith.

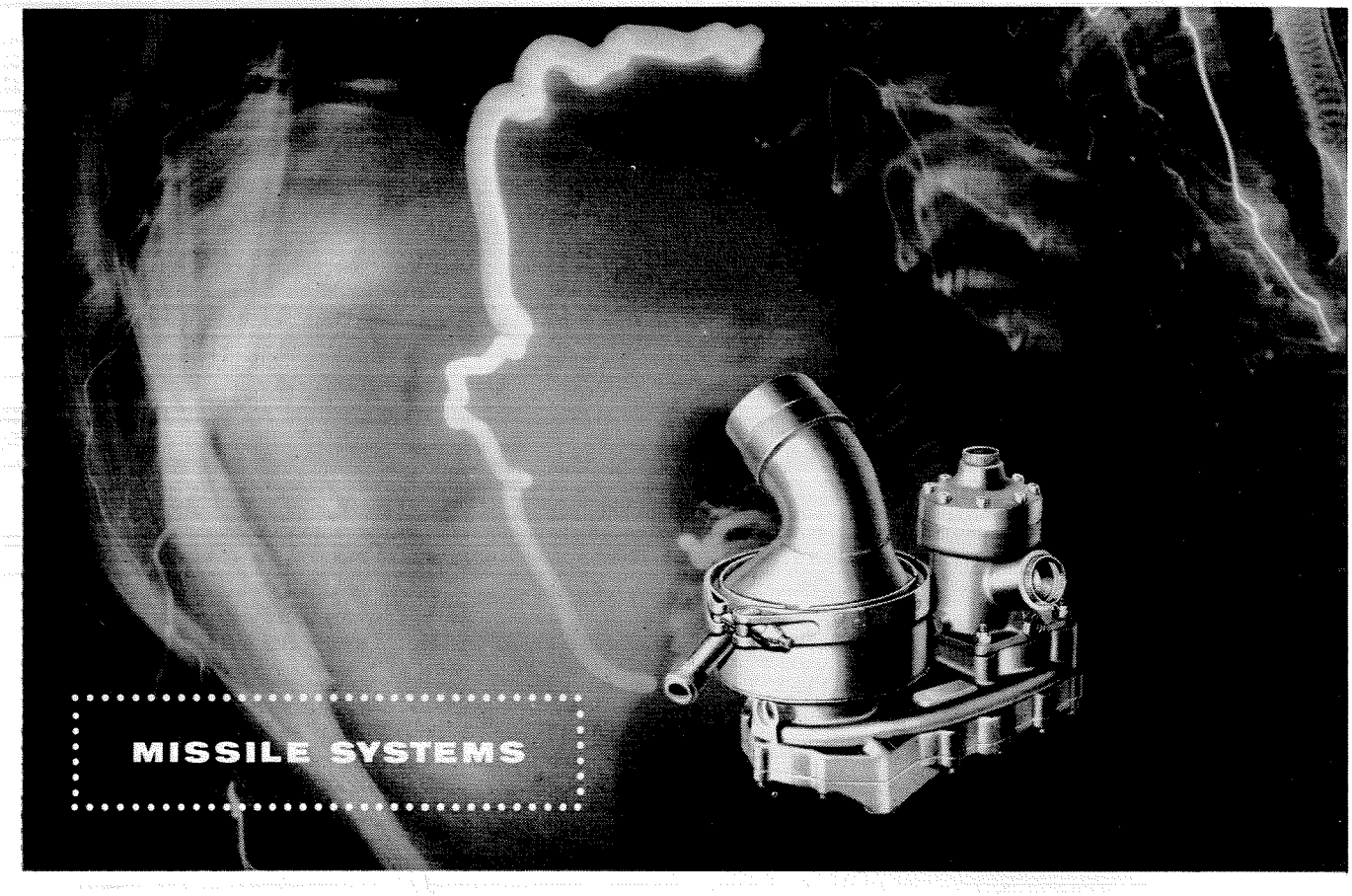
"This reminds me of the time I sailed from Acapulco in an old one-lunger –" the Captain was saying, but the Junior had heard this one before. He began to think about what he had gained in his short time as a beach boy. All the zoology I know, he thought – the names of a gross or so of the beasties of the Pacific Ocean. I didn't get that A, but there are other things. A suntan. Stronger ear drums. New friends . . .

Lynne? Well, the course was over now. He would be going his way and she hers. They would write occasionally, but she was of course pinned to this fellow at Pomona, and he of course would be seeing this girl in Pasadena.

The Marine Lab had received its final cleaning, to the satisfaction of Captain Smith. He finished his story about the one-lunger and the Junior made his way back to Pasadena. Academics at the beach were over.

As he first caught sight of the smog in the Los Angeles basin, he mused one final time about Lynne and couldn't help thinking about how beautiful the moon was at Corona del Mar in the summer and about how he never did make a spice cake that didn't taste as if it had been marketed by Goodyear.

– Stan Sajdera '61



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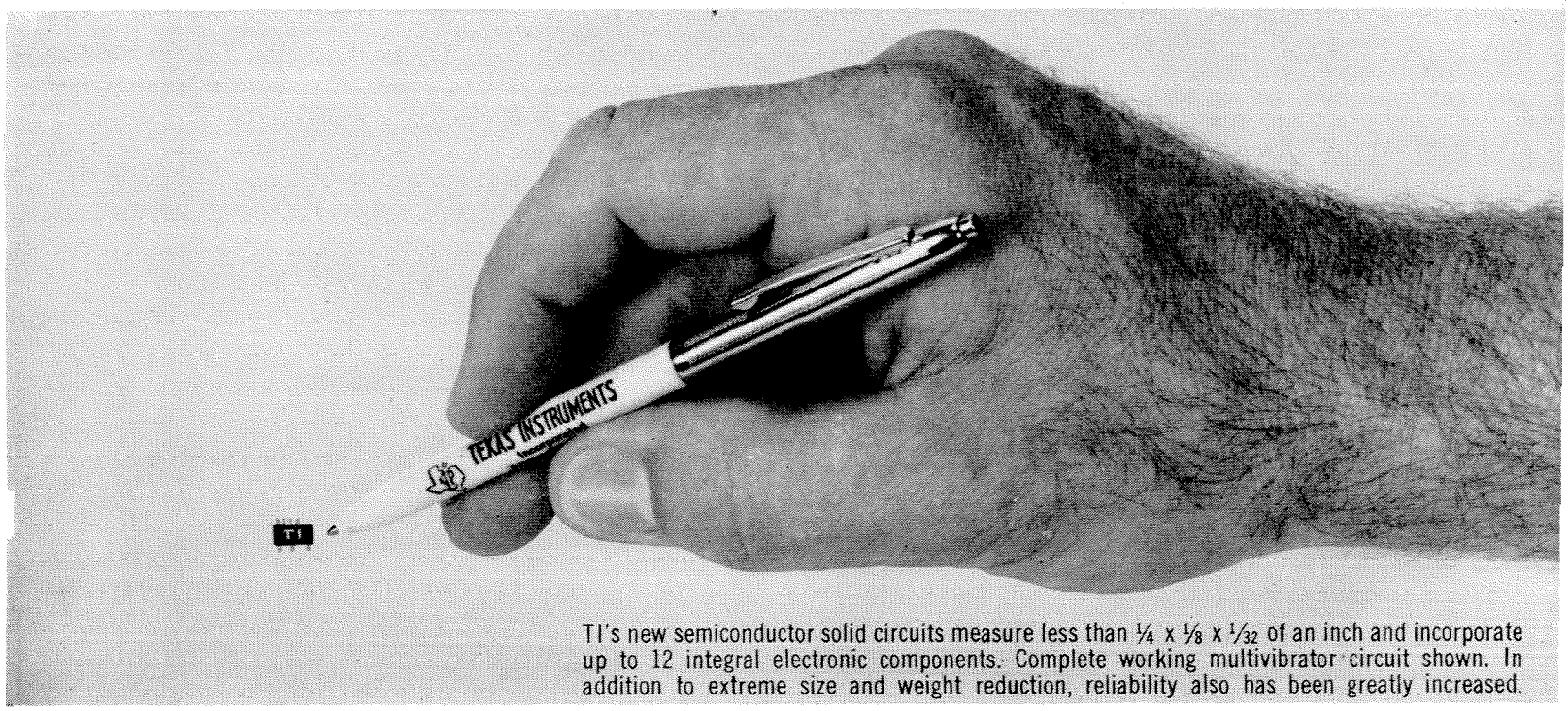

TI's new semiconductor solid circuits measure less than ¼ x ⅛ x 1/32 of an inch and incorporate up to 12 integral electronic components. Complete working multivibrator circuit shown. In addition to extreme size and weight reduction, reliability also has been greatly increased.

join TI engineers in such challenging programs as micro-miniaturization

TI develops new semiconductor solid circuit with component densities up to 34 million per cubic foot!

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Such significant developments naturally result from TI's great emphasis on creative ability and freedom of professional expression. *You'll find many challenging opportunities at Texas Instruments where such technological advances are a frequent occurrence.* At the Apparatus division, weight and size are critical factors in its missile and aircraft electronic and electromechanical systems. You may explore new possibilities for making these systems even smaller and more reliable using the new semiconductor solid circuits. Or, with the GeoSciences and Instrumentation division, you may exercise this new concept in circuitry to create new and more compact commercial and industrial instrumentation.

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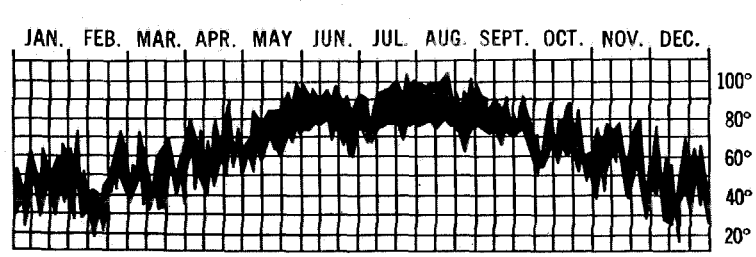
To join this fast-moving company at the forefront of scientific technologies, please send resume to W. T. Hudson, Dept. 1306, Texas Instruments Incorporated, 6000 Lemmon Avenue, Dallas 9, Texas.



(Graph courtesy of Dallas Times Herald, January 7, 1959)

Dallas' 12-month weather chart shows that temperature averaged 65.9° in 1958, with humidity at a comfortable low level. Dallas skies are predominantly clear and sunny, devoid of industrial haze or smog.

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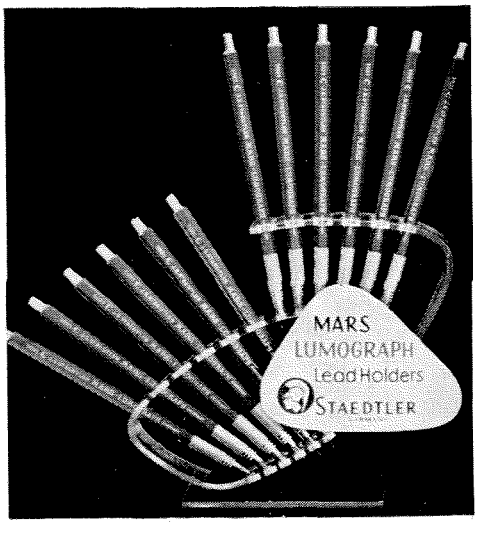

MARS

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Personals

1918

Robert C. Sticht, chemical engineer at Commonwealth Fertilizer & Chemicals, Ltd., in Victoria, Australia, died last December 29, as the result of an accident. He received a fractured skull in a fall from some scaffolding while he was examining new loading equipment that he had designed for his company. Bob was largely responsible for the design and supervision of construction of Western Australia's unique bulk wheat handling system in 1932.

During the Second World War, he was engaged in supervising the design and installation of various projects associated with munitions production. After the war he was responsible for the installation of a new superphosphate factory at Albany in Western Australia. He was a Fellow of the Royal Australian Chemical Institute, a member of the Australasian Institute of Mining and Metallurgy, and a past president of the Society of Chemical Industry of Victoria.

1932

Robert W. Webb, MS, PhD '37, professor of geology at the University of California in Santa Barbara, has been re-elected vice chairman of the faculty for 1959-60. Bob joined the Santa Barbara faculty in 1948 after several years on the geology staff at UCLA.

1933

Sterling Beckwith, PhD, consulting engineer with offices in Lake Forest, Ill., has received a Lamme Gold Medal for 1958 from the American Institute of Electrical Engineers for "meritorious achievement in the development of electrical apparatus or machinery." The medal is one of the most coveted honors in the electrical engineering field.

1934

A. E. Thompson, manager of General Petroleum's Torrance refinery since 1949, celebrated his 25th year with the company in June.

Raymond W. Traynor, instructor of physics at Burbank Senior High School in Burbank, attended a Shell Merit Fellowship Seminar at Stanford University during the summer. The seminars, which were held at Stanford and Cornell Universities, are sponsored annually by Shell Companies Foundation, Inc., to strengthen the teaching of high school chemistry, physics and mathematics.

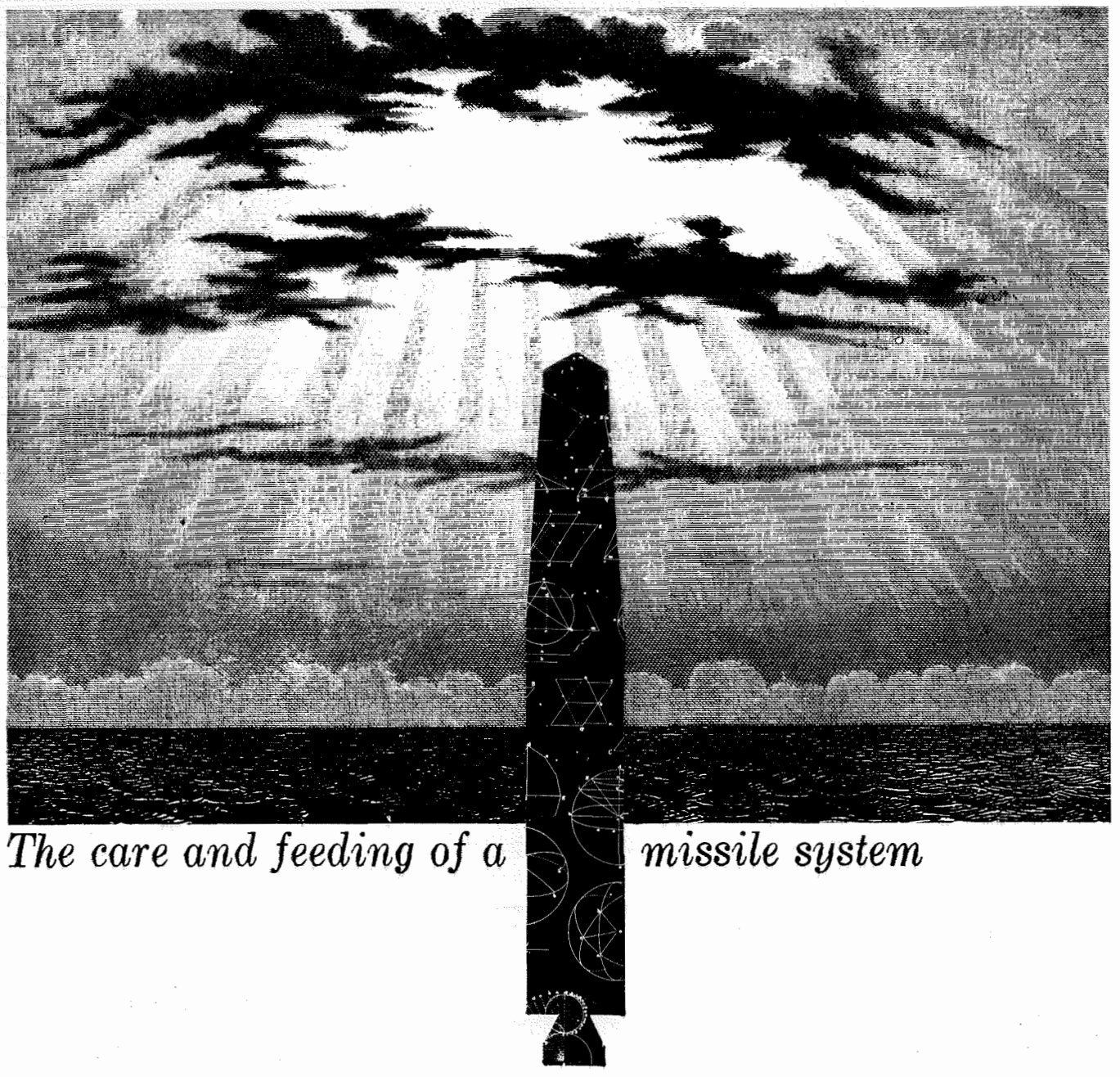
William V. Medlin, PhD, supervisor in the oil process engineering department of Shell Development Company's Emeryville Research Center, is now technical assistant to Dr. Harold Gershinowitz, president of the Shell Development Company in New York. Bill has been with Shell since 1935.

1938

Gardner P. Wilson is now head of the newly created Western Engineering Division of Brush Instruments in Los Angeles. He was formerly head of the Western Engineering Branch of the ElectroData Division of the Burroughs Corporation.

Frederic H. Moore writes that he "was recently transferred by my company, Texaco Inc., to New York and promoted to the job of assistant chief design engineer in our engineering department. I find the work stimulating and enjoy my return back to the department I started in some 21 years ago.

continued on page 40



The care and feeding of a missile system

It takes more than pressing a button to send a giant rocket on its way. Actually, almost as many man-hours go into the design and construction of the support equipment as into the missile itself. A leading factor in the reliability of Douglas missile systems is the company's practice of including all the necessary ground handling units, plus detailed procedures for system utilization and crew training. This complete job allows Douglas missiles like THOR, Nike HERCULES, Nike AJAX and others to move quickly from test to operational status and perform with outstanding dependability. Douglas is seeking qualified engineers and scientists for the design of missiles, space systems and their supporting equipment. Write to C. C. LaVene, Box 600-E, Douglas Aircraft Company, Santa Monica, California.

Alfred J. Carah, Chief Design Engineer, discusses the ground installation requirements for a series of THOR-boosted space probes with Donald W. Douglas, Jr., President of

DOUGLAS

MISSILE SYSTEMS ■ SPACE SYSTEMS ■ MILITARY AIRCRAFT ■ JETLINERS ■ CARGO TRANSPORTS ■ AIRCOMB ■ GROUND-HANDLING EQUIPMENT

"My daughter had her first child, a daughter, Kathleen Deibert, on May 1, so we are anxious to return to California to see the new grandchild.

"I am now finishing my term as District Governor of District 51 in Toastmasters International."

John G. McLean, vice president in charge of coordinating and planning for Continental Oil Company in Houston, has been promoted to vice president in charge of financial and transportation activities.

1939

Charles H. Townes, PhD, professor of physics at Columbia University in New York City, will receive a Stuart Ballantine Medal from the Franklin Institute in Philadelphia at a ceremony to be held on October 21. The award will be given for his development of the "maser," a sensitive and precise measuring device used to gather new information on planets and galaxies and to test cosmological theories. The National Aeronautics and Space Administration hopes to place an atomic clock based on the maser into orbit within two years. Experiments with the clock are expected to give Einstein's general theory of relativity one of its most searching checks.

1942

Capt. Nova B. Kiergan, Jr., AE, has retired from the U.S. Navy and will make his home in Indianapolis. He has served as commanding officer of the U.S. Naval Avionics Facility in Indianapolis since 1957. The Kiergans have three children – Nova B. III, 23; Jacqueline, 21; and John, 12.

John Miles, MS '43EE, MS '43AE, professor of engineering at the University of California, returned in June from a sabbatical visit to Cambridge University in England and other points in Europe, where he devoted his time to the problem of gravity wave generation by turbulent winds. His work was sponsored by a Guggenheim Fellowship.

John Rubel, director of the airborne systems laboratories of the Hughes Aircraft Company in Los Angeles, is now assistant director of Department of Defense research and engineering for strategic weapons at Hughes. Succeeding him in his former position is *Alexander S. Jerrems* '42.

David A. Young, who was Aerojet-General's first employee when the company was founded in 1942 and who has recently served as chief of ARPA's space technology program, is now director of Aerojet's new corporate long range planning division.

Robert A. Spurr, PhD, research scientist at Hughes Aircraft Company, died of brain cancer on June 18. He was 46. For the past four years, Bob had been doing brilliant work on the research and development team at Hughes and was slated to direct the physics wing of the new Hughes laboratory at Malibu. Bob was formerly professor of chemistry at the University of Maryland.

He is survived by his wife and four children – Stephen, 14; David, 10; Sophia, 7; and Sarah, 4.

1943

John E. Cushing, PhD, professor of bacteriology and chairman of the biological sciences department at the University of California in Santa Barbara, took part in the recent International Oceanographic Congress in New York. The meeting was sponsored by the American Association for the Advancement of Science and *UNESCO*. *John* recently returned from Japan, where he spent a year with his family on sabbatical leave. At Tokyo University he did research on blood-typing whales, among other projects.

1944

Dean R. Chapman, MS '44, PhD '48, aeronautical research scientist for the National Aeronautics and Space Administration in the Ames Research Center at Moffett Field, Calif., has received a Rockefeller Public Service Award to study astronomy.

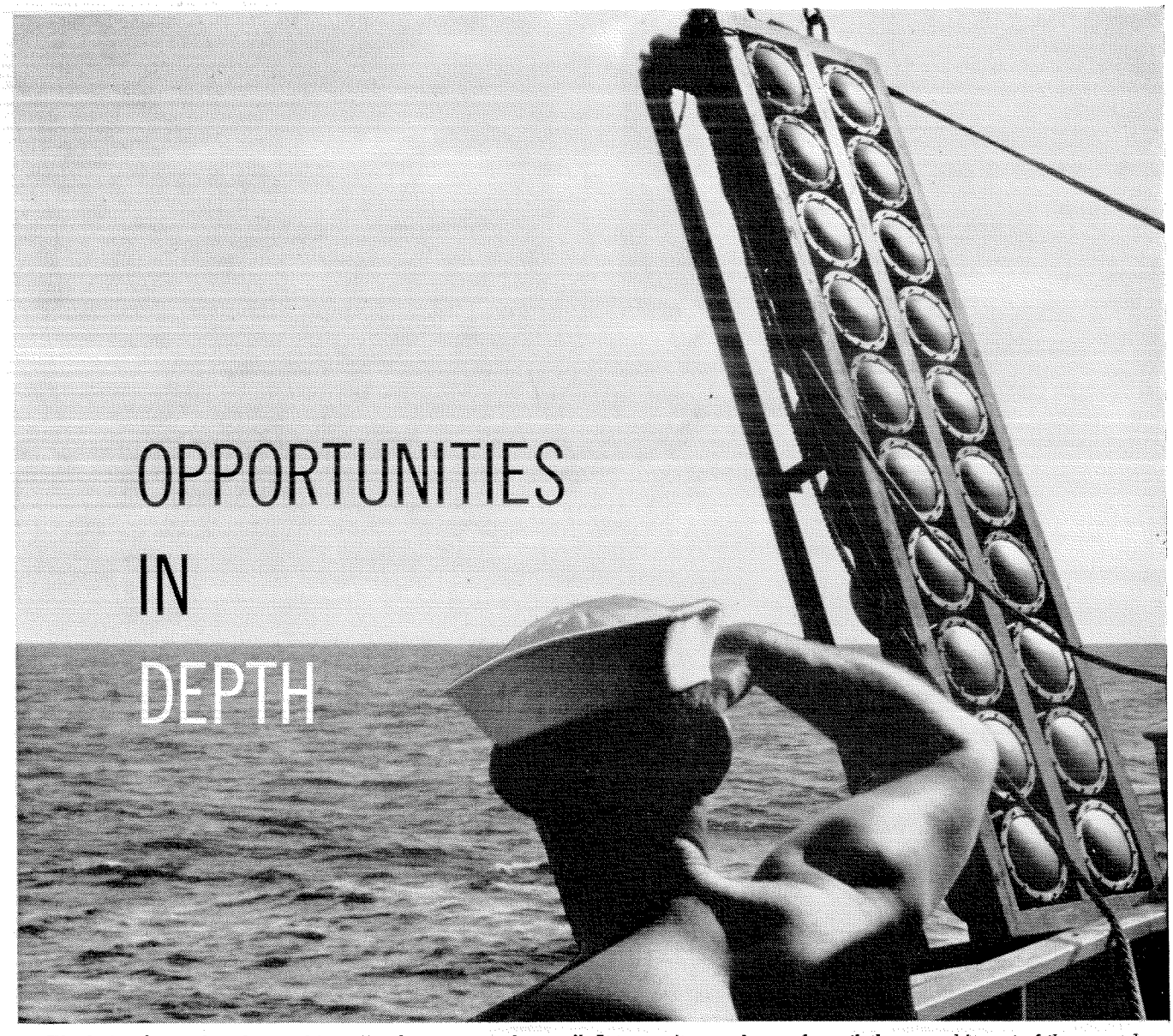
1945

Dudley B. Smith, formerly patent and trademark counsel for Cluett, Peabody & Co., Inc., is now an executive member of Clupak, Inc. He will specialize in activities connected with the licensing of foreign paper manufacturers to make extensible paper and to use the company's trademark.

Hugh S. West is now assistant secretary of the agency department in the field services division of the Connecticut General Life Insurance Company in Hartford, Conn. He joined the company in 1953 as an agent in San Francisco, and has been with the home office since 1956. The Wests have four children – Ruth Ann, 6; *Hugh, Jr.*, 5; *Kathryn*, 3; and Mary five months.

Joseph F. Hook received his PhD in physics from UCLA in June and is now a member of the technical staff of the

continued on page 44



The device about to be submerged is an "underwater sound source". It transmits sound waves beneath the sea and is part of the research equipment developed by Bendix Research Laboratories Division for use in the Bendix program of undersea acoustics research.

Bendix, America's most diversified engineering organization, offers challenging job opportunities in every area of man's scientific and engineering accomplishment—under the sea, on land, in the air and in outer space!

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Another important Bendix anti-submarine device is "dunked" sonar, lowered from helicopter into the sea to detect enemy submarines.

The spectacular "TV eye", which enabled the crew of the nuclear-powered submarine "Skate" to observe the underside of the Polar ice pack and locate areas for safe surfacing, was likewise a Bendix development.

The real "depth" of job opportunities at Bendix can best be measured by the many and diverse scientific fields in which Bendix is engaged.

For example—career opportunities are available in such fields as electronics, electromechanics, ultrasonics, computers, automation, radar, nucleonics, combustion, air navigation, hydraulics, instrumentation, propulsion, metallurgy, communications, carburetion, solid state physics, aerophysics and structures.

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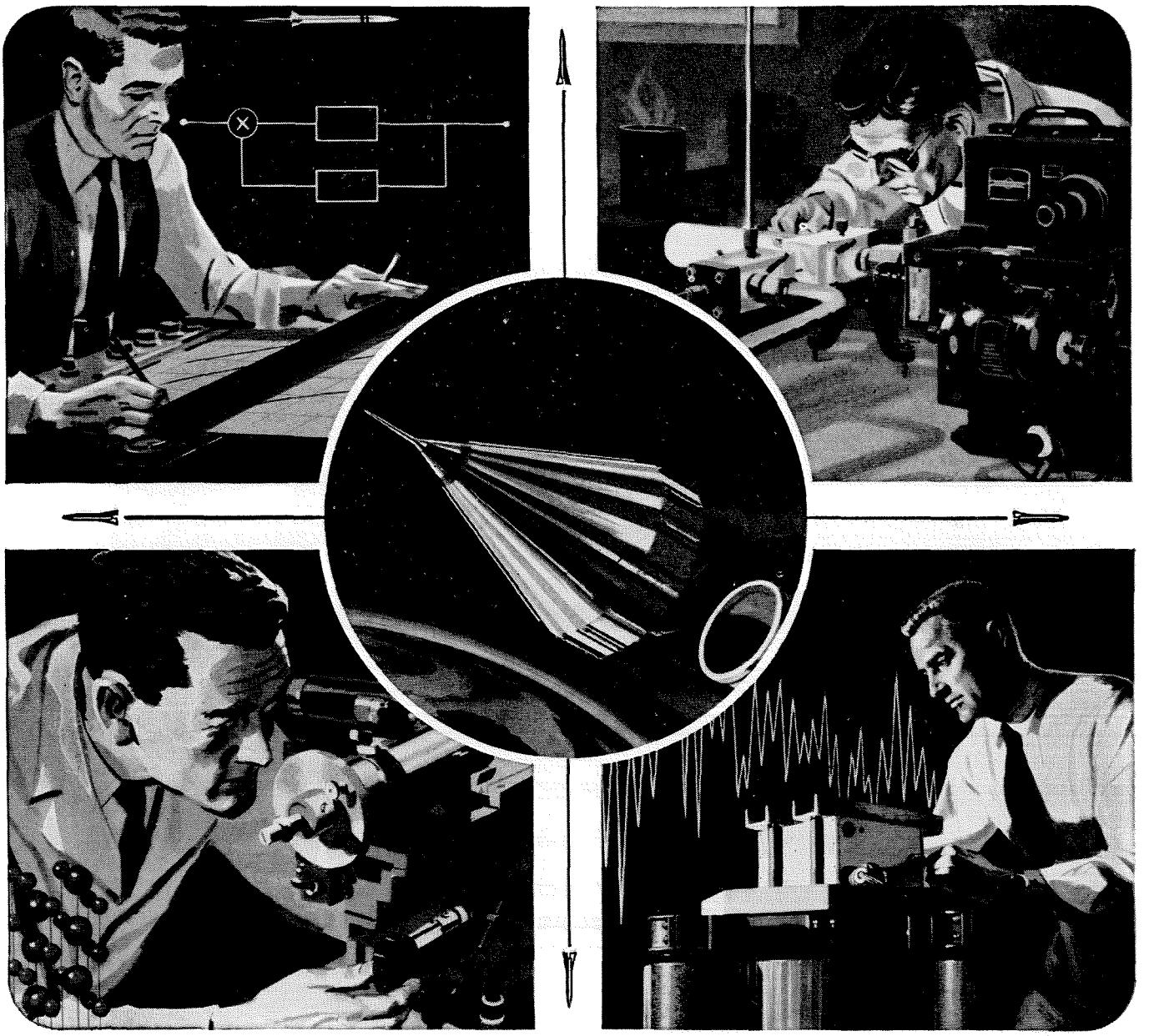

YOUR TASK FOR THE FUTURE

Since its inception nearly 23 years ago, the Jet Propulsion Laboratory has given the free world its first tactical guided missile system, its first earth satellite, and its first lunar probe.

In the future, under the direction of the National Aeronautics and Space Administration, pioneering on the space frontier will advance at an accelerated rate.

The preliminary instrument explorations that have already been made only seem to define how much there is yet to be learned. During the next few years, payloads will become larger, trajectories will become more precise, and distances covered will become greater. Inspections will be made of the moon and the planets and of the vast distances of interplanetary space; hard and soft landings will be made in preparation for the time when man at last sets foot on new worlds.

In this program, the task of JPL is to gather new information for a better understanding of the World and Universe.

"We do these things because of the unquenchable curiosity of Man. The scientist is continually asking himself questions and then setting out to find the answers. In the course of getting these answers, he has provided practical benefits to man that have sometimes surprised even the scientist.

"Who can tell what we will find when we get to the planets? Who, at this present time, can predict what potential benefits to man exist in this enterprise? No one can say with any accuracy what we will find as we fly farther away from the earth, first with instruments, then with man. It seems to me that we are obligated to do these things, as human beings!"

DR. W. H. PICKERING, Director, JPL

jpl

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A Research Facility operated for the National Aeronautics and Space Administration

PASADENA, CALIFORNIA

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The graduate training course helps you decide on your "Very Important Position," by giving you up to two years of theoretical and practical training. This course has helped set the pattern of executive progress since 1904. For details write to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

Personals . . . *continued*

Hughes Aircraft Company in Culver City.

1946

Philip H. Benton writes that "my firm, Benton Engineering, which was established in 1956, specializes in foundation engineering and soil mechanics and is now incorporated. A greatly increased staff has required moving to larger offices in San Diego. We live in La Jolla and have four children – Joan, 8; Paul, 5; John, 3; and Anne, who was born on July 14."

1947

Col. Charles M. Duke, MS, is now New York district engineer for the U.S. Army in New York City. In his new job he will direct the operations of 9 military officers and about 1400 civilian employees on flood control projects, harbor maintenance and improvements, beach erosion and hurricane control studies, and supervision of construction facilities at Army and Air Force bases and missile defense sites.

Milton D. Van Dyke, MS, PhD '49, who was formerly a research scientist at the Ames Research Center of the NASA at Moffett Field, has been appointed professor of aeronautical engineering at Stanford University.

Col. William M. Linton, MS, is now in command of the 151st Engineer Group at Fort Benning, Georgia. He came to Fort Benning in 1955, after commanding the 434th Engineer Battalion in Korea, and headed the U.S. Army Infantry School Command and Staff Department's Engineer Committee before becoming operations officer in 1957.

1949

William W. Ward, MS, PhD '52, writes that he recently finished a 7-year tour of duty in Airborne Radar Systems at MIT's Lincoln Laboratory. He is now leader of the Ground Radar Systems Group. The Wards have a 3-year-old son.

Frederic T. Selleck, senior research chemical engineer in the research division of the Fluor Corporation, Ltd., in Whittier, writes that he has a second child, a son, born in September '58. *Ed Bulkley,* '49, promptly presented the boy with a miniature Big T sweater. *William Lanz* '49, is also at Fluor as principal process engineer in the L.A. office. Fred has been working for the past two years in the nuclear energy field – helping with the process design of the large-scale, high-level radioactive waste calcination facility at AEC's National Reactor Testing Station in Idaho, and currently working on the design of a large nuclear reactor system to provide heat for the multistage flash evaporation of sea water for the Office of Saline Water and the State of California.

1951

Carl A. Hirsch received his MD degree from Washington University in St. Louis in June.

Earl C. Hefner, MS '52, writes that he has moved his family to the Bay Area, now that Holly-General Company has transferred him to San Francisco as district manager of the Northern California-Nevada division. The Hefners have two daughters – Paula, 2½, and Kim, 1½.

Francis R. Kramer writes that "since leaving school, I spent two years in the army, got married, had two children (Laura and Danny) and have completed requirements for my PhD in chemical engineering at Purdue University. I'm now located at Seaford, Delaware, with the Du Pont Company."

1953

Naoji Morishita, MS, is now senior engineer in the systems engineering department of the marine division of the Sperry Gyroscope Company in Great Neck, L.I.

Pierre Marien, MS, has received the degree of Docteur en Sciences Appliquées with highest honors from the University of Brussels, and is now in charge of the course in power reactors at the same university.

George Gartner, civil engineer with the Los Angeles County Flood Control District, was killed in an auto accident last June 13, when he failed to negotiate a turn in a detour and hit a telephone pole. He is survived by his wife and five children.

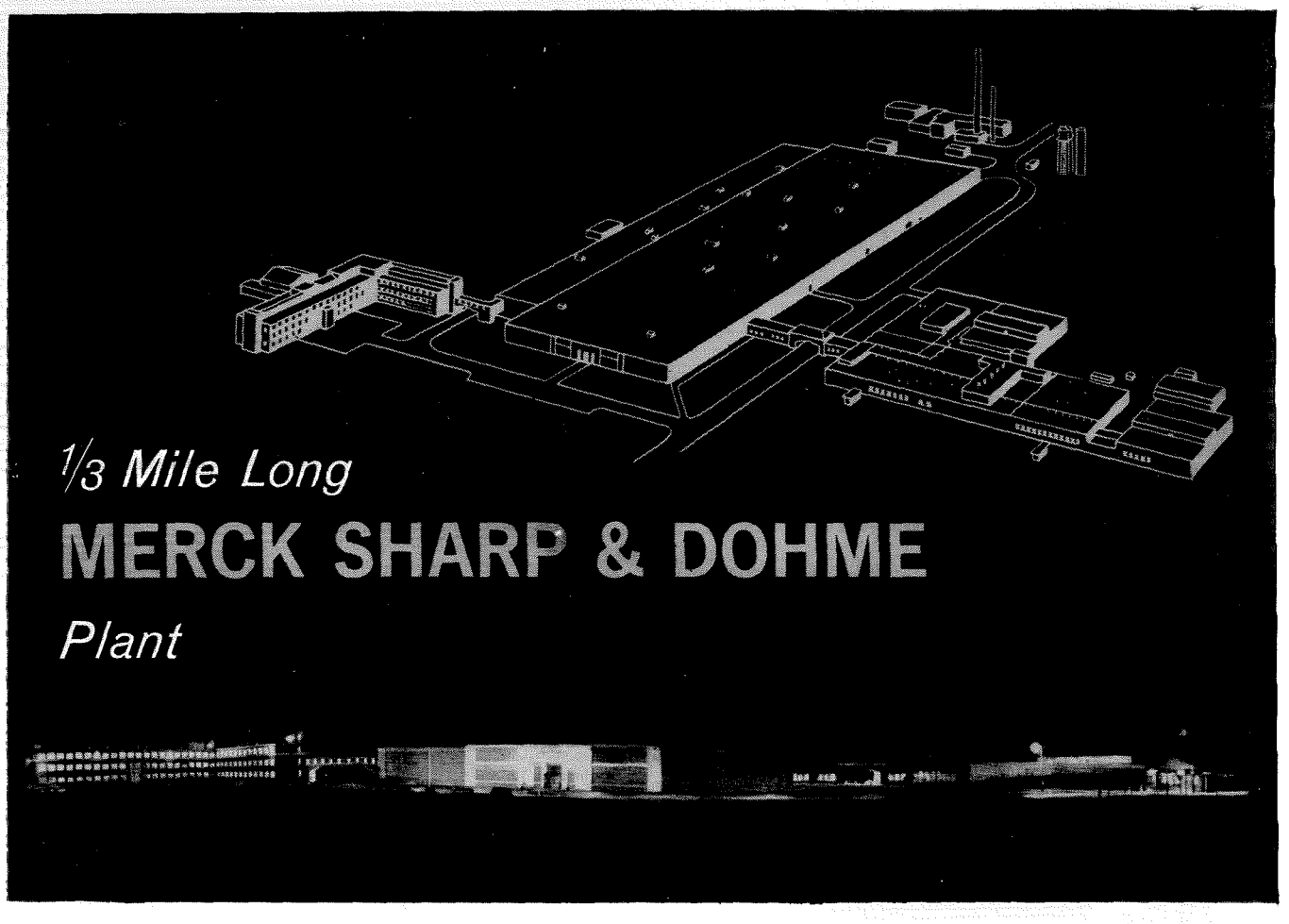
Gerald Graziani, MS, received his PhD in aeronautical engineering from Princeton University in June.

Howard Boroughs, PhD, wrote in July that "during the four years I spent at the University of Hawaii as associate professor of zoology, I annoyed so many of my friends in Los Angeles and Pasadena by my frequent trips to the mainland that I decided to move before I lost them all. I am now in Turrialba, Costa Rica, at the Interamerican Institute of Agricultural Sciences, which is a part of the Organization of American States. Next I either go to South America or along the east coast. *James Liverman,* PhD '53, and *Howard Teas,* PhD '47, were down here recently.

"I am in charge of an AEC sponsored Nuclear Energy Program for Latin America. We have a gamma field and an isotope laboratory. The country is beautiful, we don't pay rent or taxes, and get beer for 15 cents. Come on down."

Robert A. Koster is now an electrical

continued on page 48



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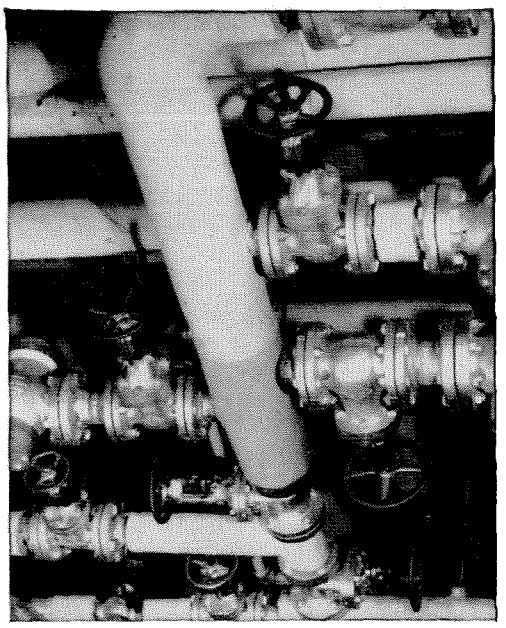

Jenkins Valves on main steam lines serving the Biological buildings

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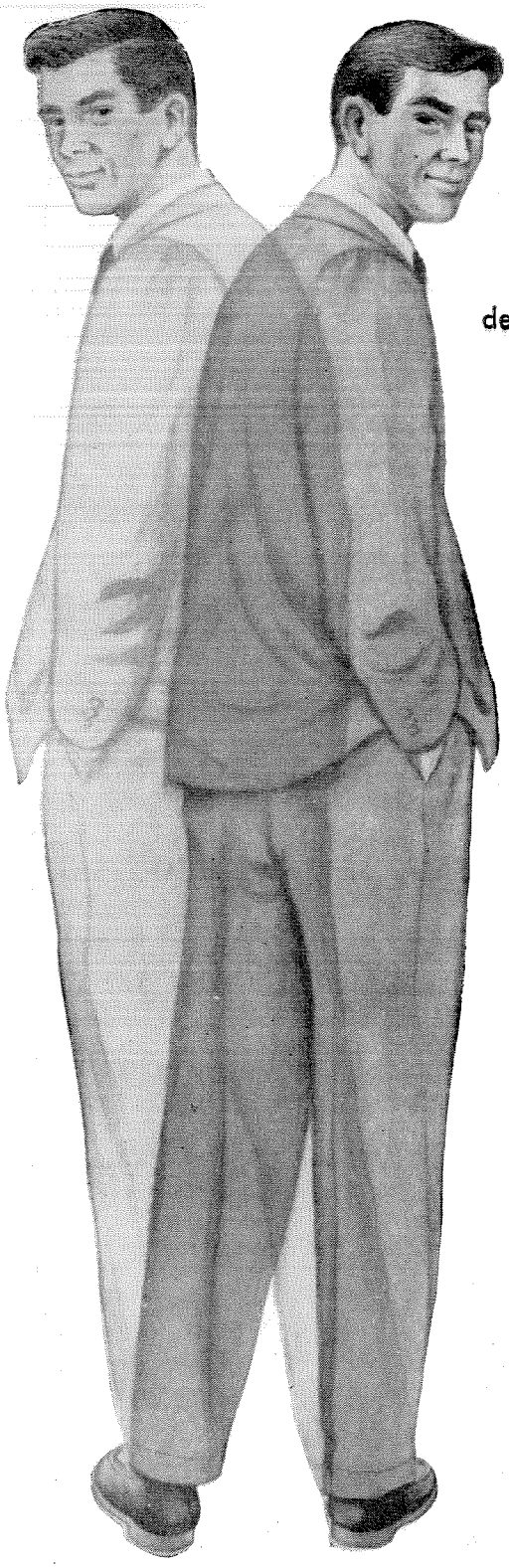

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Personals . . . *continued*

engineer in the reconnaissance systems department of the Ramo-Wooldridge Division of Thompson Ramo Wooldridge, Inc., in Los Angeles. For the past five years he has been in the civil service at the U.S. Naval Ordnance Test Station in China Lake.

1954

Paul Concus received his PhD at Harvard University last June.

Walter W. Lee, Jr., writes that he is now married and lives with wife Eve and Siamese cat Teakwood in Los Angeles. Walt is vice president of Technical Communications, Inc. — and *Leon Vickman*, '53, is president of the company, which produces motion pictures, publications, and audio-visual aids for engineering organizations and government agencies.

Edward J. Gauss writes that "Christy Ann, our first, was born on July 10. Inasmuch as I am working for my PhD in computers at UCLA I have her well programmed. Every time she cries she lets me pick her up."

1955

Frank B. Wallace, Jr., development engineer at the AiResearch Manufacturing Company in Phoenix, announced the arrival of a daughter, Rosalie, on August 19.

E. Vern Nogle writes that "while with Lockheed Missiles and Space Division, I spent a year at the MIT Instrumentation Laboratory working on inertial guidance electronics. I am now back at the Sunnyvale plant and live with my new wife in San Jose. The Eastern trip was profitable in more respects than one for I met and married a physical therapist graduate from Boston's Simmons College."

Vincent Marinkovich received his MD at Harvard University last June.

1956

William Purves writes that "on June 9 I married Jean McCauley of Hamden, Conn. *Delbert McCune* '56 was my best man. On the previous day I had received my PhD in botany from Yale University. We are now in Germany where I shall spend a year as a National Science Foundation Fellow at Universität Tübingen."

John Young received his LLB at Harvard University last June.

Theodore G. Johnson is now manager of the new West Coast sales office of the Digital Equipment Corporation at Maynard, Mass.

Hubert E. Dubb is now a research chemist at the Redstone Arsenal Division of the Rohm & Haas Company in Huntsville, Alabama. He writes that *Keith Booman*, PhD '56, has recently moved to Huntsville from the company's Philadelphia offices.

Thomas W. Donnelly, MS, received his PhD in geology from Princeton University in June.

1957

Lieut. James S. Sibley, MS, is now construction engineer at the U.S. Army Corps of Engineers' Eastern Ocean District in the Goose Bay Area Office in Labrador.

Lieut. Richard F. Smisek, MS '58, is now a First Lieutenant in the Air Force. He is serving as a mechanical engineer at Arnold Engineering Development Center in Tullahoma, Tenn. The Smiseks have two daughters.

Reuben Moulton, Jr., is now with the U.S. Army Chorus at Fort Myer, Virginia. He writes that he hopes to be returning to Pacific Telephone's management training program in 1961.

1958

Lawrence T. Gurley, MS, is continuing his graduate study in electrical engineering this year at the University of Paris, on a Fulbright grant.

1959

Robert Harmon has decided to enter the Methodist ministry instead of following a scientific career. He has already been granted a local preacher's license, the first step toward ordination to the Methodist ministry.

Sam Berman, PhD, is now at the University of Copenhagen for post-doctoral studies in physics on a National Science Foundation fellowship. Sam is associated with the Space Technology Laboratories in Los Angeles.

Rolf Engleman, Jr., PhD, is now a chemist in the GMX division at the University of California's Los Alamos Scientific Laboratory in New Mexico. His wife has joined him there.

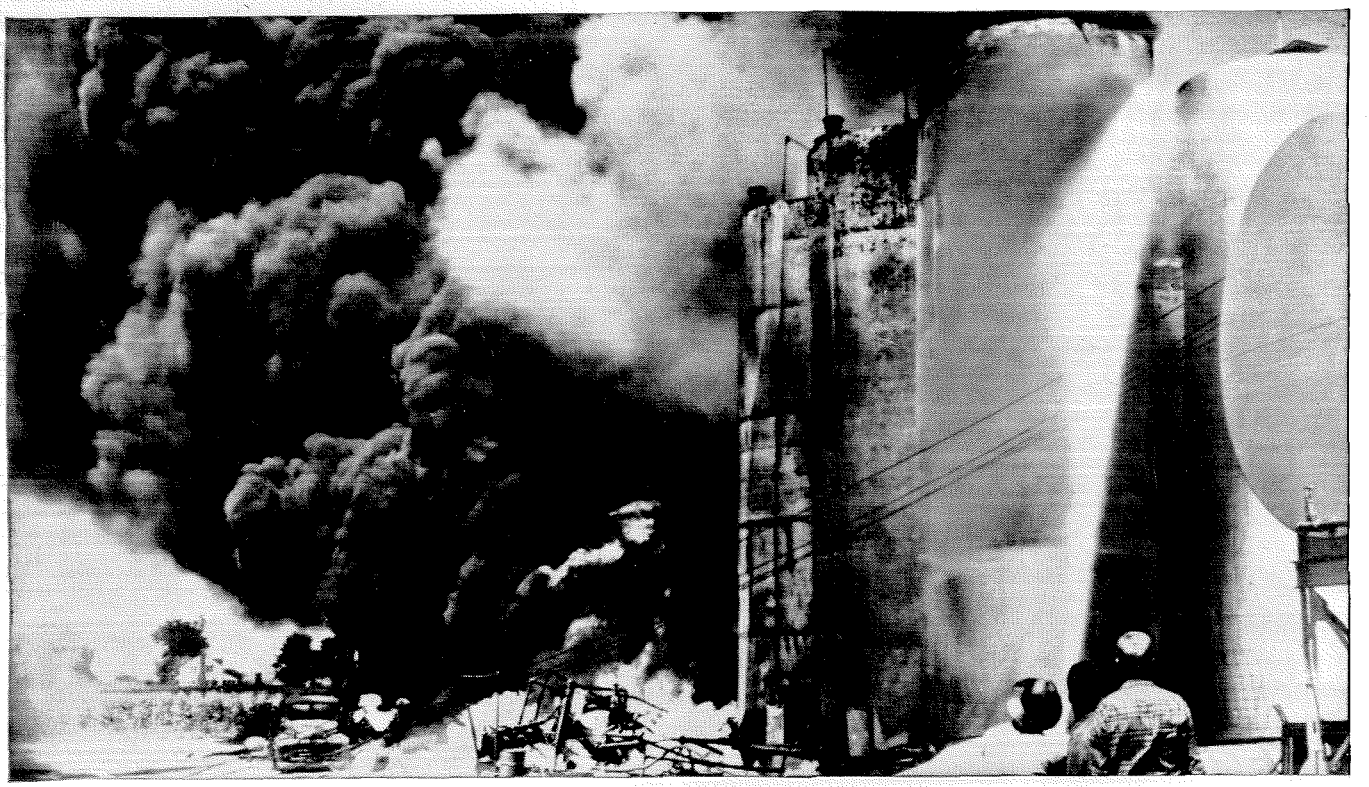
Neal de Gaston is now on the technical staff of Ramo-Wooldridge in Los Angeles, a division of Thompson Ramo Wooldridge, Inc.

John P. Wolf, III, PhD, is a research chemist with the DuPont organic chemicals research division at the Jackson Laboratory in Wilmington, Del. The Wolfs live in Wilmington with their three daughters.

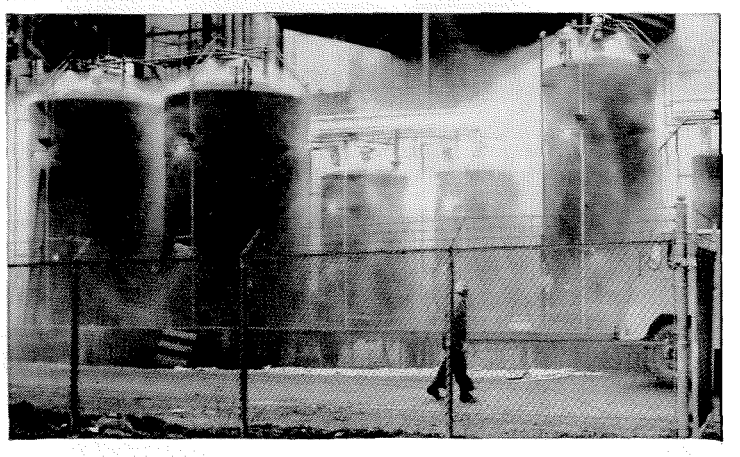
Roger M. Golden, PhD, is now studying at the Technical Institute in Eindhoven, the Netherlands, on a Fulbright grant.

Stanley Roth is studying at Universität Tübingen, Germany, on a Fulbright grant.

Two ways of providing
EXPOSURE PROTECTION



TOO LATE ▲
to prevent serious heat exposure, a valiant attempt is made by firefighters to prevent rupture of tankage, not already involved in flames, with relatively ineffective hose streams.



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shown under test at the Marietta, Ohio plant of the Bakelite Union Carbide Plastic Company, a division of the Union Carbide Corporation. Water – when it is applied in time and distributed over the surfaces efficiently by a properly engineered system – is most effective in limiting tank fires and controlling their spread.

Proper safeguards are uppermost in importance in protecting tanks which contain gases and flammable liquids in the event of fire. For example, tanks must be guarded against extreme heat exposure. Leaking gas, if it should develop, must be diluted to the point where it will not burn. And fire, if it should occur, must be localized and controlled or extinguished.

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Before heat raises tank temperatures dangerously, an enveloping spray of water provides instant cooling, reducing internal pressure which helps prevent rupture. In addition, air turbulence is created (even in still air) which, in conjunction with the water vapor from the spray, helps dilute the flammable vapors controlling or extinguishing the fire. Flammable products which cannot be safely extinguished can be burned off under the protecting water spray with no damage to adjacent protected equipment.

There is a Grinnell Fire Protection System for every fire hazard. Call on Grinnell for advice about the one suited to your needs. Grinnell Company, Inc., 277 West Exchange Street, Providence 1, R. I.

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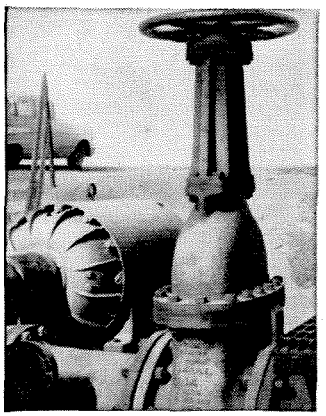
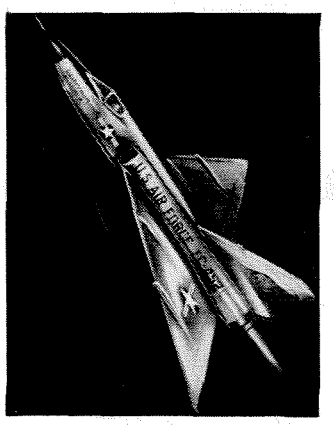
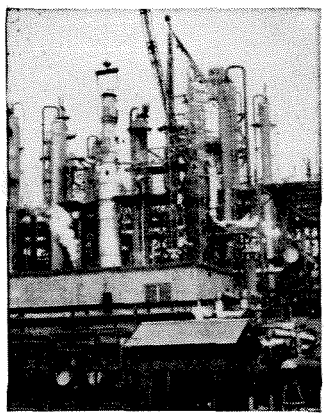


☐ **Refinery valve**—Needed: resistance to attack from petroleum products, thermal and hydraulic shock. Which alloy . . . ?



☐ **Turbojet afterburner shell**—Needed: strength plus corrosion resistance at high temperatures. Which alloy... ?

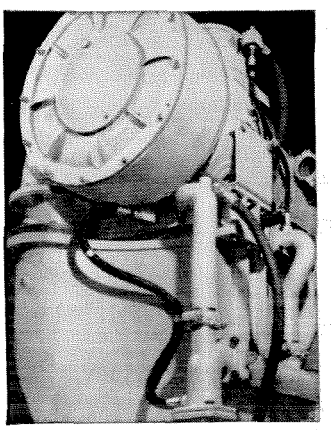


☐ **Recovery tower**—Needed: resistance to hot coke oven gases and aromatic chemicals, long service life. Which alloy... ?

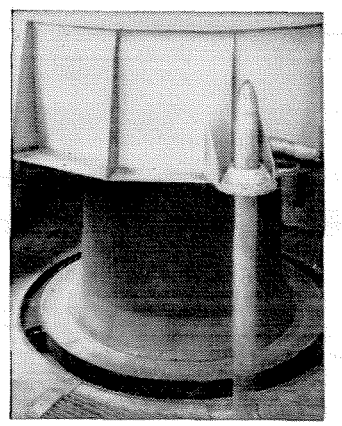
See if you can tell which of these nickel-containing alloys proved to be the answer to these problems. Put the right number in the right box.

1. Ductile Ni-Resist*
2. Nimonic "75"* nickel-chromium alloy
3. Nickel-aluminum bronze
4. Ductile iron
5. Monel* nickel-copper alloy
6. Inconel* nickel-chromium alloy
7. Type 316 chromium-nickel stainless steel

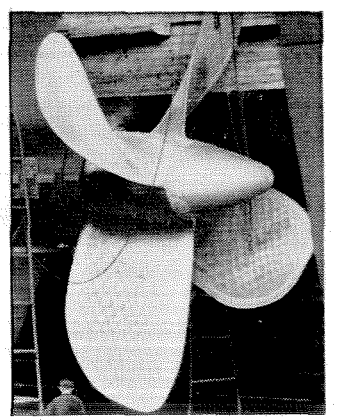
See answers below



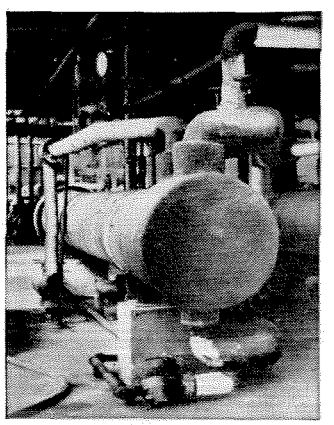
☐ **Diesel manifold**—Needed: scaling and oxidation resistance at 1200°F, resistance to thermal shock. Which alloy ?



☐ **Heat treating retort**—Needed: light weight, ability to endure destructive heating-cooling cycles. Which alloy... ?



☐ **Ship's propeller**—Needed: lighter weight and resistance to erosion and salt water corrosion. Which alloy... ?



☐ **Regenerator pre-heater**—Needed: trouble-free service handling hot caustics, fabricating ease. Which alloy... ?

When you start to design equipment, you'll have to select the proper material to meet given service conditions... a material that might have to resist corrosion, or wear, or high temperatures, or a combination of these conditions.

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*Registered trademark

ANSWERS:
- Refinery valve... Ductile Iron
- Turbojet afterburner shell... Nimonic "75"
- Recovery tower... Type 316 stainless
- Diesel manifold... Ductile Ni-Resist
- Heat treating retort... Inconel alloy
- Ship's propeller... Nickel-aluminum bronze
- Regenerator pre-heater... Monel alloy

Inco Nickel

makes metals perform better, longer

Alumni News

Southern California Social Program

The Social Program Committee for the coming year has been meeting in recent weeks and has discussed their ideas with the Board of Directors. The committee has examined the plan of the social program of recent years and has concluded that the format is basically good. The committee feels that due to the large number of alumni in southern California, and therefore the wide interests of alumni, that a program consisting of the three dinner meetings, a football game activity, a dinner-dance and a picnic provide the necessary variety to make a successful program. The main objectives, after deciding on the basic plan of the program, have been to develop ideas that would improve and make the overall program more interesting to all alumni in the area.

The football game activity will be the first one this year and will be under the chairmanship for the alumni of Dick Jaffe '53 and Ted Johnson '56. The students have selected the Claremont-Harvey Mudd game on November 20th in the Rose Bowl to be the big home game of the season. Although details have not been completed with the students, it is likely that an orchestra will be engaged for a dance following the game. Possibly a dinner, similar to that held last year prior to the game, will be planned for this year.

The fall dinner meeting this coming year will be held early in December, with arrangements being made by George Johnston '54. Considerable discussion has been devoted to bringing out new ideas for the dinner meetings. The committee feels that the ideas and possibilities discussed will make this one of the outstanding events of the social program. A unique location in the Pasadena area is under consideration for this event. The theme of the affair will be varied so that, instead of the usual brief cocktail hour before dinner and a serious speaker after dinner, there will be ample time to talk with old classmates and friends, and the speaker or entertainment will be on the lighter side.

Ralph Pastoriza '44 is chairman of the winter dinner meeting. Continuing along the idea of a change from the usual kind of dinner meeting, Ralph is considering using two speakers, or having a panel discussion on a controversial subject that would encourage audience participation. This dinner meeting will probably be held in the Los Angeles area in late January.

The dinner-dance activity for the coming year will be under the chairmanship of Rolf Hastrup '53. The committee felt strongly that the dinner-dance should be brought into the Los Angeles or Pasadena area if possible, inasmuch as outlying areas have been used during recent years. Serious consideration is being given to the Huntington-Sheraton Hotel in Pasadena. This event is being planned for late March.

The annual dinner meeting will be held on Wednesday, June 8, 1960, with Bill Karzas '49 as chairman. The committee hopes that President DuBridge will be available for his usual comments on the work of the Institute during the previous year. The committee felt that a speaker of prominence in the business or financial world would be desirable for this meeting. Five-year reunions will be held for the classes of 1900, 1915, 1920, 1925, 1930, 1935, 1940, 1945, 1950, and 1955.

From the discussion on the annual picnic, planned for late June, the committee feels that locations similar to Disneyland and Marineland have been well utilized, to the extent that another entirely different type of event would be desirable. Under the chairmanship of Pat Fazio '53, the committee is currently discussing the possibility of having a real picnic this time.

—John D. Gee,
Chairman, Program Committee

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Luncheon first Friday of each month
Visiting alumni cordially invited—no reservation necessary

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U.S. Navy Electronics Laboratory

ALUMNI EVENTS

November 20	Football Game and Dance
December	Fall Dinner Meeting
January	Winter Dinner Meeting
March	Annual Dinner Dance
May 7	Annual Seminar
June 8	Annual Meeting
June	Annual Picnic

ATHLETIC SCHEDULE

FOOTBALL

October 10
Caltech at Redlands

October 17
Caltech at Pomona

October 24
Caltech at Cal Western
(Point Loma HS)

October 30
Whittier at Rose Bowl

November 7
LaVerne at Caltech

WATER POLO

October 10
CIT Alumni at Caltech

October 13
Mt. San Antonio at Caltech

October 16
UC, Santa Barbara at Caltech

October 20
Santa Monica CC at Caltech

October 23
Caltech at Claremont-H. Mudd

October 27
Long Beach State at Caltech

October 30
Caltech at Pomona

November 3
San Fernando St. at Caltech

November 6
Caltech at Occidental

ALUMNI ASSOCIATION
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California
BALANCE SHEET – As of June 30, 1959

ASSETS

Cash in Bank		$ 4,340.47
Postage Deposit		11.13
Investments:		
Share in Consolidated Endowment Asset Portfolio of C.I.T. 6-30-59	$55,736.37	
Deposited in Savings Associations	14,539.43	
Total Investment		70,275.80
Furniture & Fixtures (at nominal amount)		1.00
Total Assets		$74,628.40

LIABILITIES

Accounts Payable	$ 220.93	
1959-60 Membership Dues Paid in Advance	8,805.15	
Total Liabilities		$ 9,026.08

RESERVES

Life Membership Reserves:		
Fully-paid life memberships	$53,200.00	
Total Reserves		$53,200.00

SURPLUS

Surplus, June 30, 1959	$ 9,642.19	
Provisions for Directory	2,760.13	
Total Surplus & Appropriated Surplus		$12,402.32
Total Liabilities, Reserves, Surplus and Appropriations		$74,628.40

STATEMENT OF INCOME
For the Year Ended June 30, 1959

INCOME

Dues of Annual Members		$15,086.72
Less: Subscriptions to Engineering and Science Magazine for Annual Members		10,561.25
Net Income from Dues		$ 4,525.47
Income from Consolidated Endowment Asset Portfolio of C.I.T.	$ 2,564.08	
Investment Interest Income	566.64	3,130.72
Program and Social Functions:		
Expenses	4,767.42	
Income	4,626.25	(141.17)
Annual Seminar:		
Income	6,734.75	
Expense	6,189.26	545.49
Sundry Income		18.10
Net Receipts		$ 8,078.61

EXPENSES

Engineering & Science Subscriptions for Life Members		$ 2,835.00
Administration:		
Directors' Expense	$ 195.04	
Postage & Miscellaneous	1,188.69	
Supplies & Printing	686.77	
Total Administration Costs		2,070.50
Alumni Membership Solicitation		388.62
Program Committee		13.68
Total Expenses		$ 5,307.80
Net Income		$2 770.81
Less: Directory Appropriation		1,500.00
Net Income to Surplus		$ 1,270.81

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, 1959, 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 & Expenses present fairly the financial position of the Alumni Association, California Institute of Technology at June 30, 1959, 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.

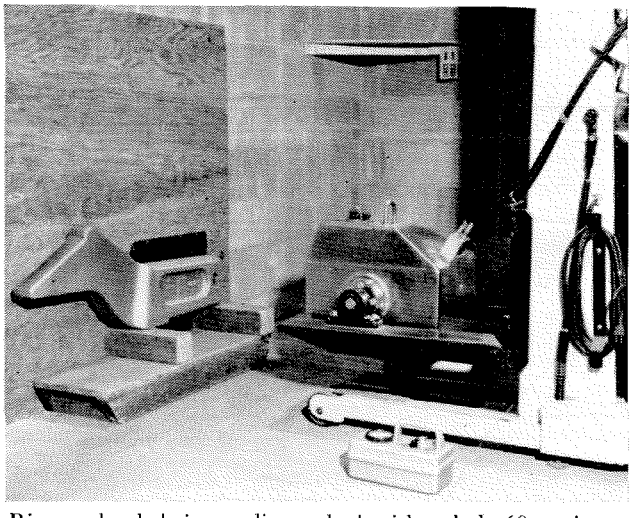
September 14, 1959

DALE J. STEPHENS, Public Accountant
3493 Cahuenga Blvd., Los Angeles 28, Calif.

Caterpillar D8 Tractor with ripper tearing through road material

Rippers really rough it—

So radiography checks their stamina



Ripper shank being radiographed with cobalt 60 projector

RIPPER SHANKS and clevises at the business end of a high-powered tractor lead a torturous life as they tear through overburden and rock.

No place here for a flaw to ruin performance! So Caterpillar makes sure of their stamina—has them radiographed at the foundry that casts them. This is the place for any imperfection to be shown up. For here Radiography can do two things. It can make sure that only sound castings go out. It can point the way to improving casting technique so that a consistently better yield can be had.

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TRADEMARK

One of a series*

Interview with General Electric's Charles F. Savage Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

Q. Mr. Savage, should young engineers join professional engineering societies?

A. By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

Q. How do these societies help young engineers?

A. The members of these societies —mature, knowledgeable men— have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

Q. Specifically, what benefits accrue from belonging to these groups?

A. There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?

A. First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

Q. How do you go about joining professional groups?

A. While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

Q. Does General Electric encourage participation in technical and professional societies?

A. It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.

***LOOK FOR** other interviews discussing: Salary • Why Companies have Training Programs • How to Get the Job You Want.*

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