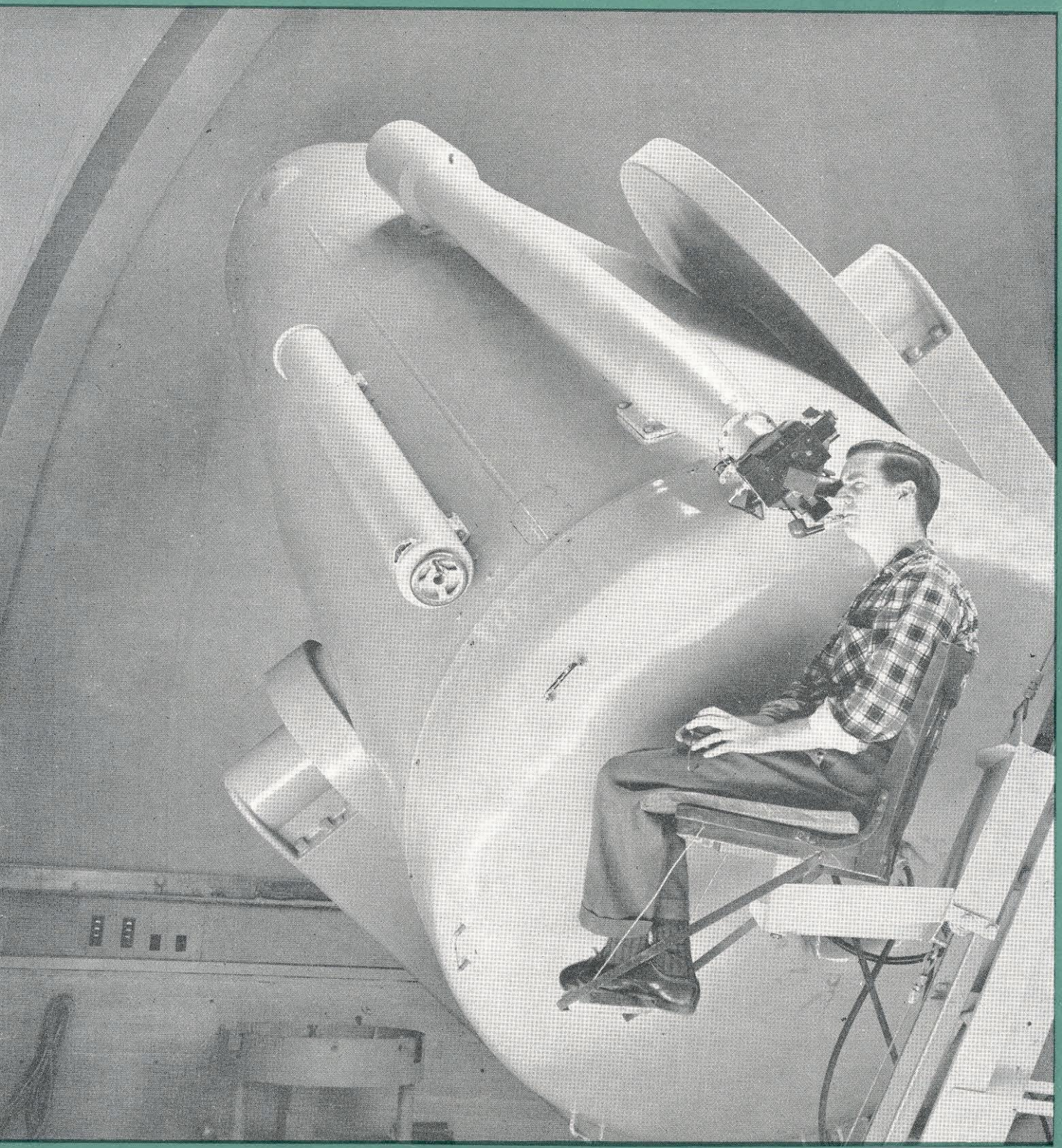
ENGINEERING | AND | SCIENCE

OCTOBER/1955

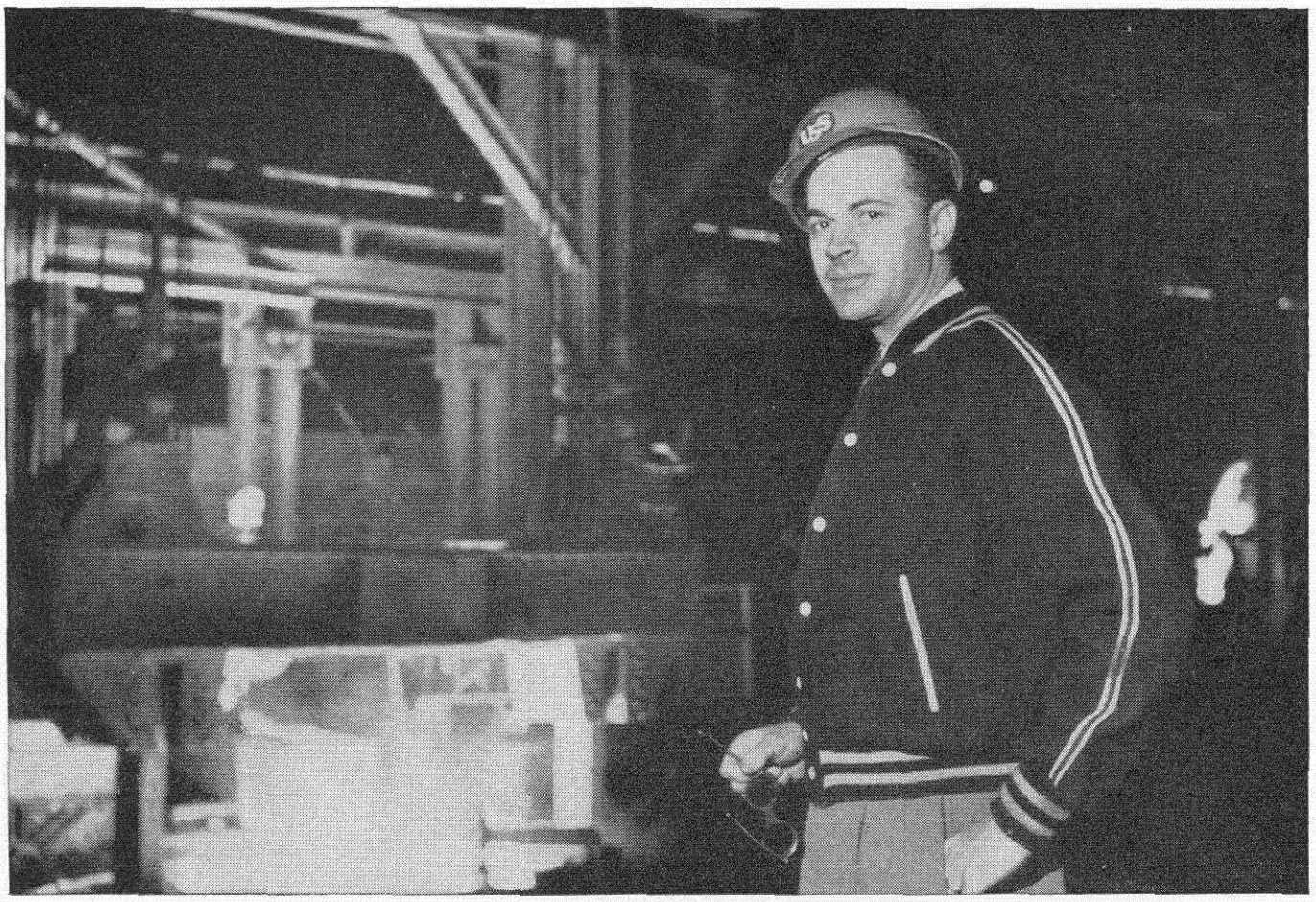


Sky Survey . . . page 13

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Richard S. Crowell, class of '48,
speaks from experience when he says . . .

"There's plenty of chance for advancement at U. S. Steel for today's engineer."



Immediately following his graduation as a B. S. in Metallurgical Engineering, Richard Crowell was recruited by the chief metallurgist of U.S. Steel's Clairton works. By 1951 he received his third promotion to Engineer-Operating Practices in the Open Hearth Division at Clairton. Recently he had his fifth promotion to his current position as *Assistant Superintendent* of Clairton's Open Hearth Department.

His responsibilities now include assisting in co-ordinating all Open Hearth Operations and incoming materials as well as improvement of methods.

Mr. Crowell knows from his own experience that there are . . . "unlimited opportunities for the young engineer who will apply himself and accept the *challenge of this great industry.*"

U.S. Steel's well-planned training programs offer men a chance to work in varied fields of engineering. Training plans of this sort make it possible for the young graduate to familiarize himself with many fields before devoting himself to one in particular.

The steel industry today offers a far more interesting career to men like Richard Crowell because of its unlimited possibilities for success.

If you are interested in a challenging and rewarding career with United States Steel and feel that you can qualify, you can obtain further details from your college placement director. Or we will gladly send you our informative booklet, "Paths of Opportunity," upon request. Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pa.

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by *United States Steel. Consult your local* newspaper for time and station.

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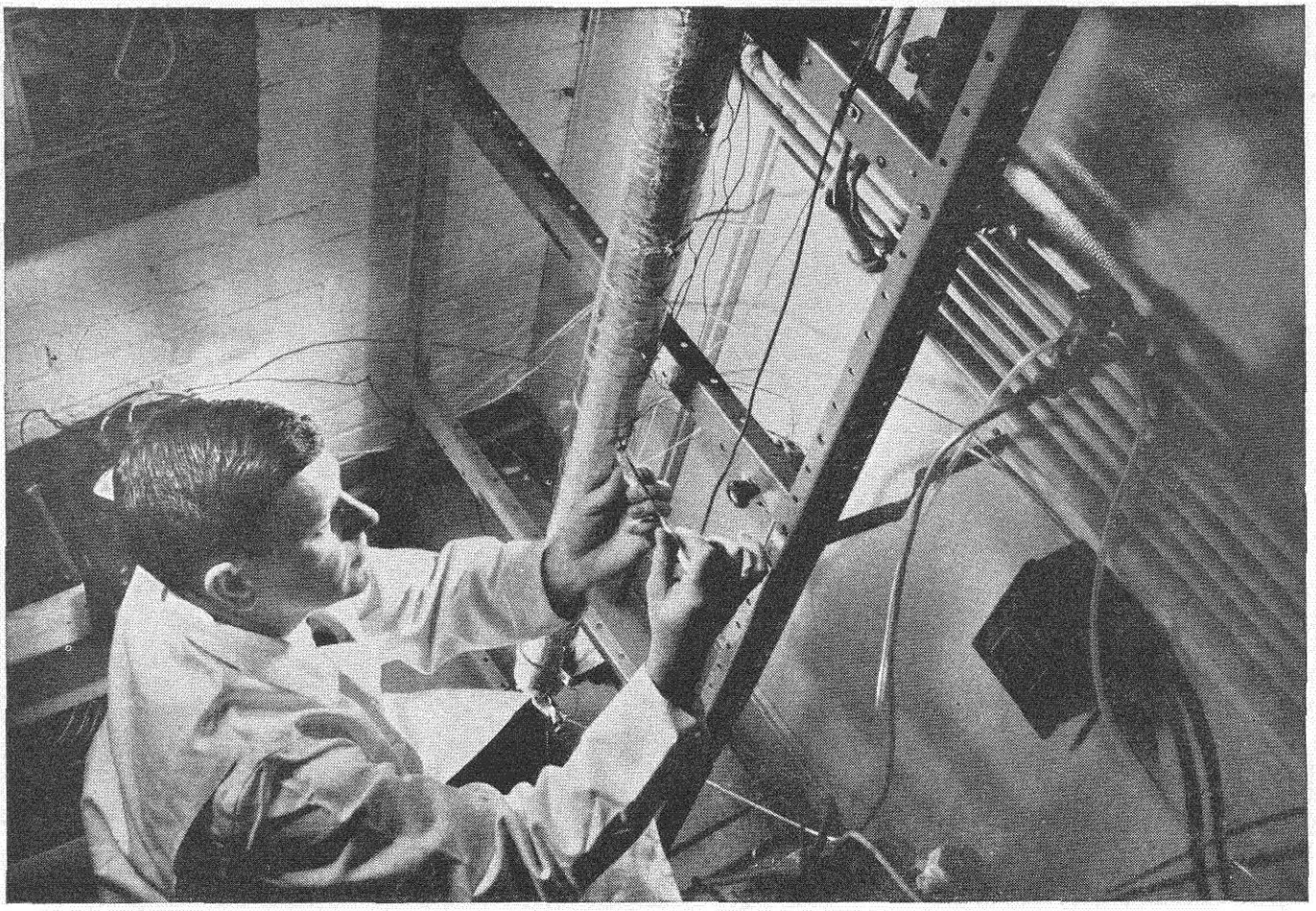

The chemical engineer in an industrial laboratory has an unparalleled opportunity for expressing his individual interests and ability. The challenge of keeping ahead of an ever-changing technology is a difficult one to meet. The illustration shows the initial stages of a project on thermal diffusion of liquids.

PICTURE OF A GM ENGINEER!

THAT'S right—he's a chemical engineer, and we show his picture in order to make an important point.

Here's what we're getting at—*General Motors seeks qualified young men trained in many different branches of engineering.*

About four out of ten engineers employed by GM are mechanical engineers—the rest, six out of ten, have backgrounds in other fields.

So please don't count yourself out of the running if you're a chemical engineer, electrical engineer, metallurgical engineer or the like. There's plenty of opportunity for you in an organization like ours that manufactures dozens of products, including not only automobiles and trucks, but also Diesel locomotives, Turbo-Jet airplane engines, radio equipment, storage batteries, fractional horsepower electric motors, even ice trays.

GM's 34 American manufacturing divisions are operating 119 plants in 64 U.S. cities!

You can find out all about these GM divisions—their locations, training programs, opportunities for advancement—in a valuable book entitled, "Job Opportunities in General Motors." Ask for it in your college library or placement office.

Why not arrange an interview with our representative the next time he visits your campus?

GM Positions Now Available in These Fields:

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Personnel Staff, Detroit 2, Michigan

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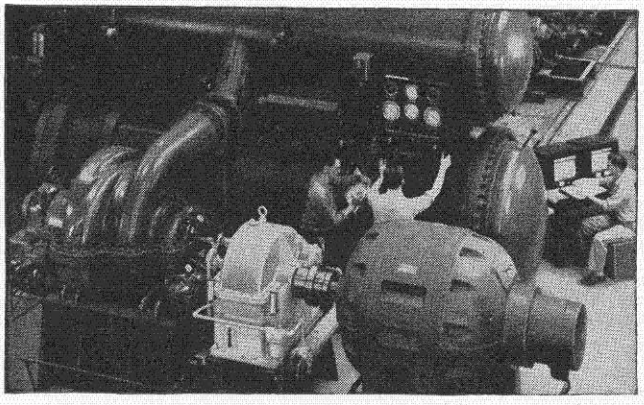
. . . the world's most versatile hydraulic proving ground



COMPREHENSIVE TESTS are run on a Worthington centrifugal refrigeration unit (lower left) now in service as one of the Arabian American Oil Company's central air conditioning units in Dhahran, Saudi Arabia.

When you make pumping equipment that has to stand up and deliver year after year anywhere in the world, you've got to be sure it will perform as specified.

That's why we built one of the world's largest hydraulic test stands at our plant in Harrison, New Jersey. Here, over a half-acre "lake," we can check the performance of anything from a fractional horsepower unit to pumps handling over 100,000 gallons a minute. When you realize there are thousands of sizes and types of centrifugal pumps alone, you get an idea of the versatility we had to build into our proving-ground.

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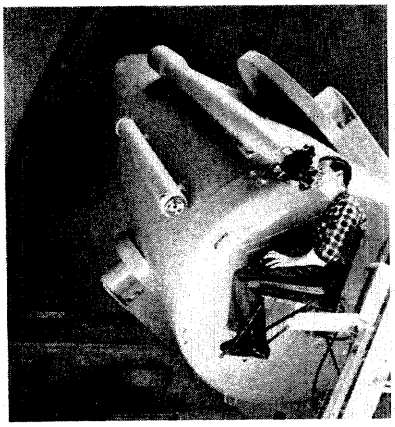
ENGINEERING AND SCIENCE

IN THIS ISSUE



On our cover this month is astronomer-observer George Abell, guiding the Big Schmidt telescope in its work of mapping the heavens for the National Geographic Society-Palomar Observatory Sky Survey. You'll find the story about this impressive atlas of the skies on page 13 of this issue.

Next to smog, water shortages present the most serious challenge to the ultimate growth of southern California. On page 24, in "Looking Ahead for Water," Jack E. McKee, Associate Professor of Sanitary Engineering, considers some possible new sources of water supply for this area. Dr. McKee, incidentally, has just completed the first year of research on one of the phases of the problem of sewage reclamation, in an effort to develop an economic engineering method for the disinfection of sewage.

Prizewinners in the 1954-55 *E&S* Science Writing Contest, for Caltech undergraduates and graduate students, were selected by the editors of *Scientific American* this summer. The $100 first prize went to Frank Salisbury for "The Inhabitants of Mars," which ran in *E&S* in April, 1955. Second prize ($50) went to James M. Kendall for "Hypersonic Research at Caltech," which we published in June, 1954.

Salisbury, who received his PhD from Caltech last June (in plant physiology and geochemistry) is now teaching at Colorado A & M. Kendall is still on campus, as a graduate teaching assistant in aeronautics.

PICTURE CREDITS

Cover, pps. 14-16	National Geographic Society-Palomar Sky Survey photos
p. 19	Pasadena Star-News
pps. 21-23	Stuart Bowen '56

OCTOBER, 1955 VOLUME XIX NUMBER 1

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

CONTENTS

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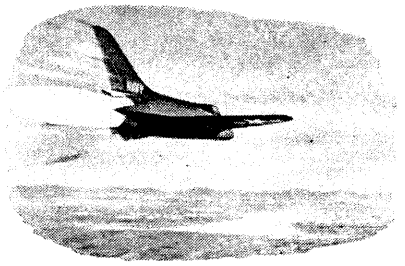
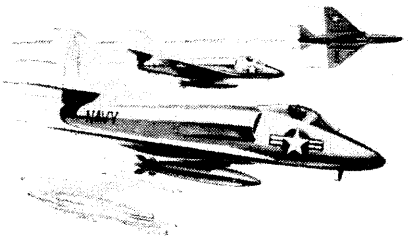
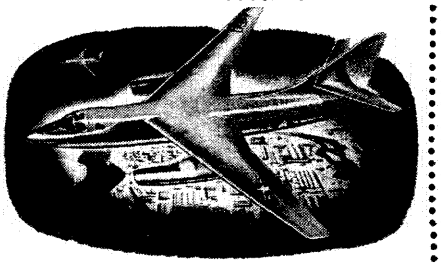


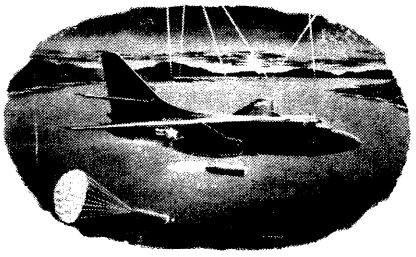
F4D, "SKYRAY"— only carrier plane to hold official world's speed record



A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier

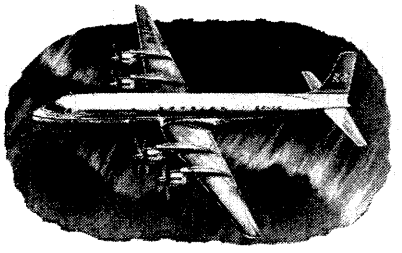


RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber

C-124, "GLOBEMASTER"— world's largest production transport



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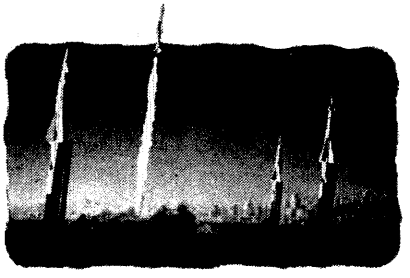
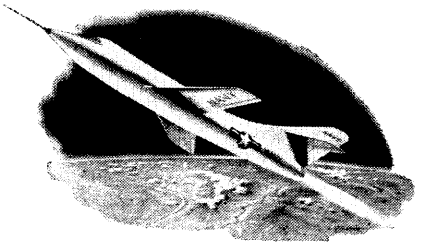


"NIKE"— supersonic missile selected to protect our cities



D558-2, "SKYROCKET"— first airplane to fly twice the speed of sound

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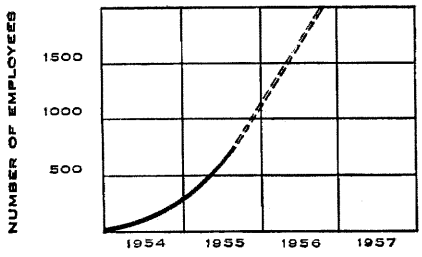
PROGRESS REPORT

After Twenty-One Months...



PROJECTS

Our eight current military contracts support a broad range of advanced development work in the fields of modern communications, digital computing and data-processing, fire-control, and guided missiles. This work is supplemented by non-military activities in the fields of operations research, automation, and data-processing.

FINANCES

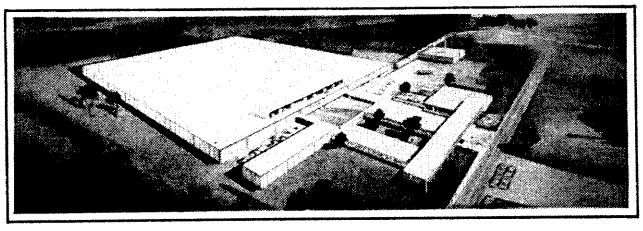
In 1954, our first full year of operation, we showed a good profit. Of greater importance, however, are the arrangements recently completed with Thompson Products, Inc., our corporate associate, whereby we are assured additional funds up to $20,000,000 to finance our expansion requirements of the next few years, and insure the long-range stability of the company.

RESEARCH AND DEVELOPMENT PERSONNEL

Total population figures, such as those displayed in the curve, tell only a limited story. Personnel quality factors are most important, in our kind of business. We believe we are doing well in this respect. Of the 90 Ph.D.'s, 65 M.S.'s and 75 B.S.'s or B.A.'s who today make up our professional staff, a gratifyingly high percentage are men of broad experience and, occasionally, national reputation in their fields.

FACILITIES

By mid-1956 our Los Angeles facility will consist of seven buildings totalling 300,000 square feet of modern research and development space. Two of the three buildings now complete and occupied are shown at bottom of this page; a fourth and fifth are presently under construction, the others are in the design stage.



MANUFACTURING

We are somewhat ahead of the usual systems development schedule, with some of our projects having arrived at the field and flight-test stages. We are now planning a facility for quantity production of electronic systems. Construction on the initial unit of 160,000 square feet (shown above) is expected to start in late 1955, with manufacturing planned for late 1956.

The Future

Our first year and a half of corporate history encourages us in the belief that our future will be one of expanding productivity. But whether we remain a small company or grow large, we plan not to lose sight of the fact that the continued success of The Ramo-Wooldridge Corporation depends on our maintaining an organizational pattern, a professional environment, and methods of operating the company that are unusually well suited to the very technical, very special needs of modern systems development and manufacturing.

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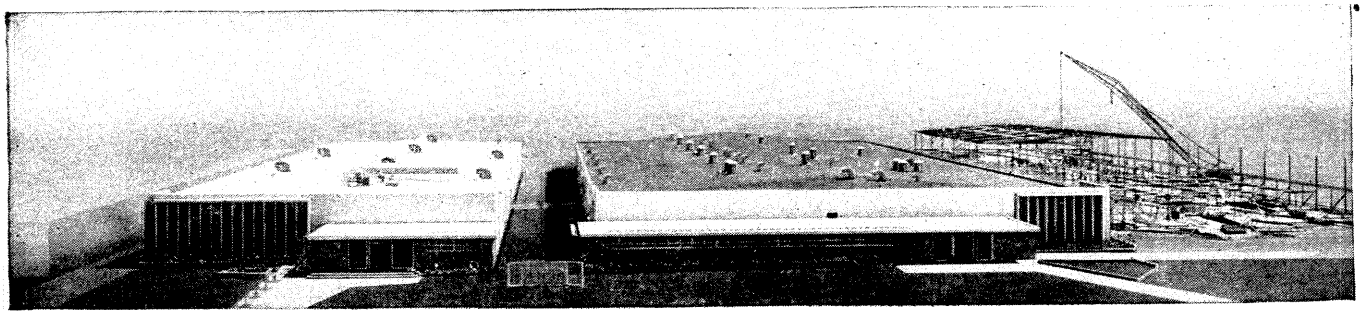

BOOKS

GEOLOGY OF SOUTHERN CALIFORNIA
Edited by Richard H. Jahns
California Division of Mines
Bulletin No. 170 $12.00

Reviewed by Clarence R. Allen, Assistant Professor of Geology

THIS BOOK is the first balanced treatment of southern California geology to become available. It represents years of painstaking planning and preparation by Dr. Jahns and the staff of the California Division of Mines, and includes contributions by 103 authors. The result is a monumental publication: 886 double-size pages (including over 500 diagrams and photographs), together with 63 folded geologic maps —many printed in colors.

The editor has attained admirable uniformity of style and continuity of subject matter, but has skillfully avoided elimination of controversial material; indeed, the widely differing opinions of some authors serve to emphasize current geologic problems of this area. The outstanding achievement of the editor has been the stimulation and solicitation of numerous manuscripts that otherwise might not have been published for many years, if at all.

The contributions are primarily for professional readers, but the coverage is so great that many non-geologists will find articles of interest. Chapter titles include: Geology of the natural provinces; Historical geology; Structural features; Geomorphology; Hydrology; Mineralogy and petrology; Mineral deposits and mineral industry; Oil and gas; Engineering aspects of geology.

In addition, five guidebooks have been prepared for persons interested in geologic excursions in the southern California area. These guides, each with detailed route maps, are entitled: Western Mojave Desert and Death Valley region; Ventura basin and adjacent areas; Los Angeles basin; Southwestern part of the Los Angeles basin; Northern part of the Peninsular Range province.

Any list of particularly significant individual contributions would certainly include: Levi Noble's map of a 50-mile strip of the San Andreas fault zone between Palmdale and Cajon Pass; Schoellhamer, Vedder, and Yerkes' 4-color geologic map of the Los Angeles basin; Dibblee's map and article on the hitherto-unknown geology of the Imperial Valley region; long-awaited contributions on the Death Valley area by Curry, Noble, and Wright; and the new Owens Valley map by P. C. Bateman and C. W. Merriman. Dr. Jahns himself has written or co-authored seven articles, and his drafting of the Transverse Range map is an artistic contribution in itself.

The 17 individual chapters and geologic guides have been bound separately and come shipped together in a labeled box. This format is probably more useful to the practicing geologist than would be a single 9½ pound tome; for librarians, on the other hand, it may be a headache.

Twelve dollars is a lot to pay for any book, but *Geology of Southern California* is a true geologic bargain at this price.

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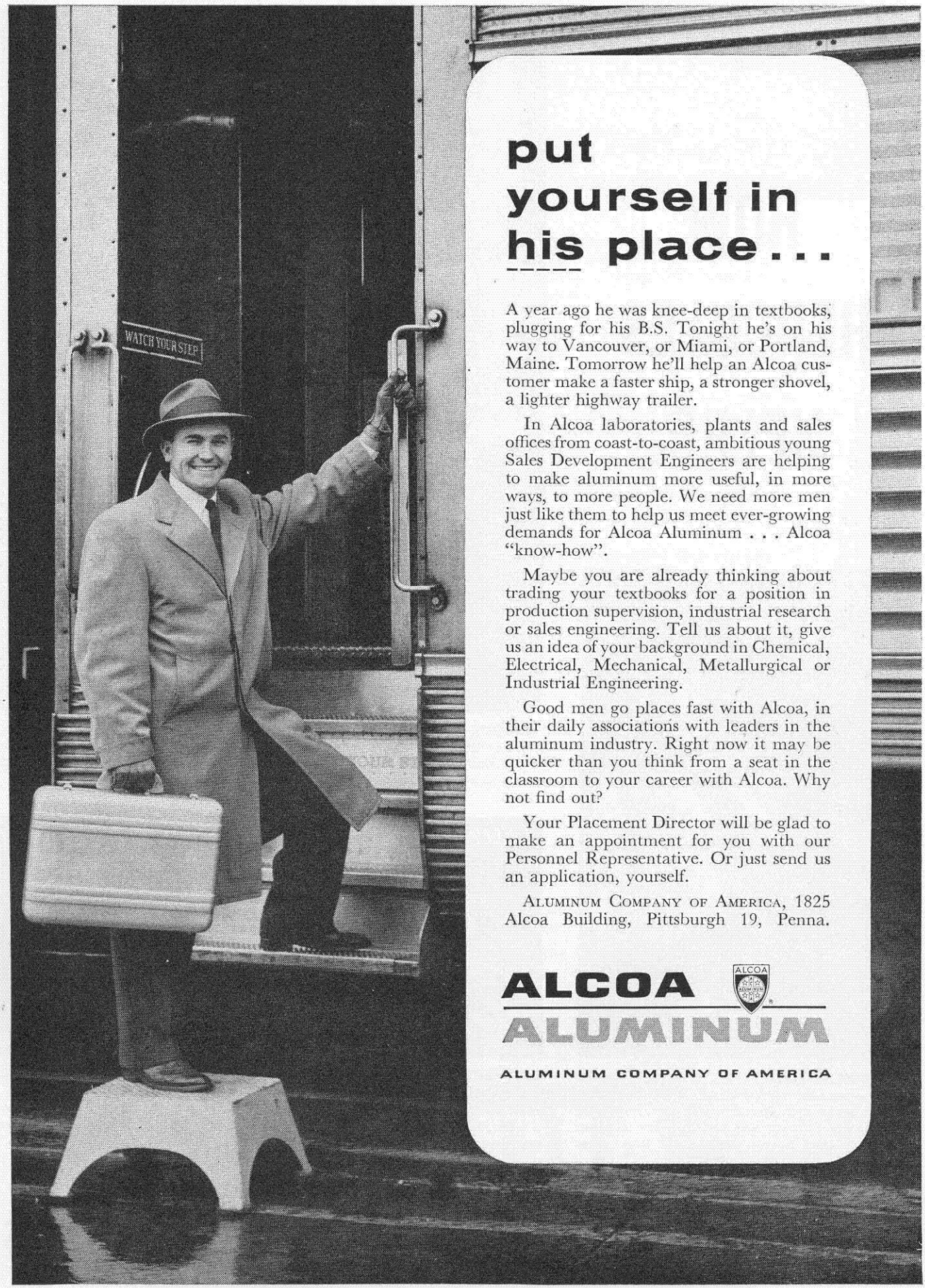
SOUTHERN CALIFORNIA EDISON COMPANY



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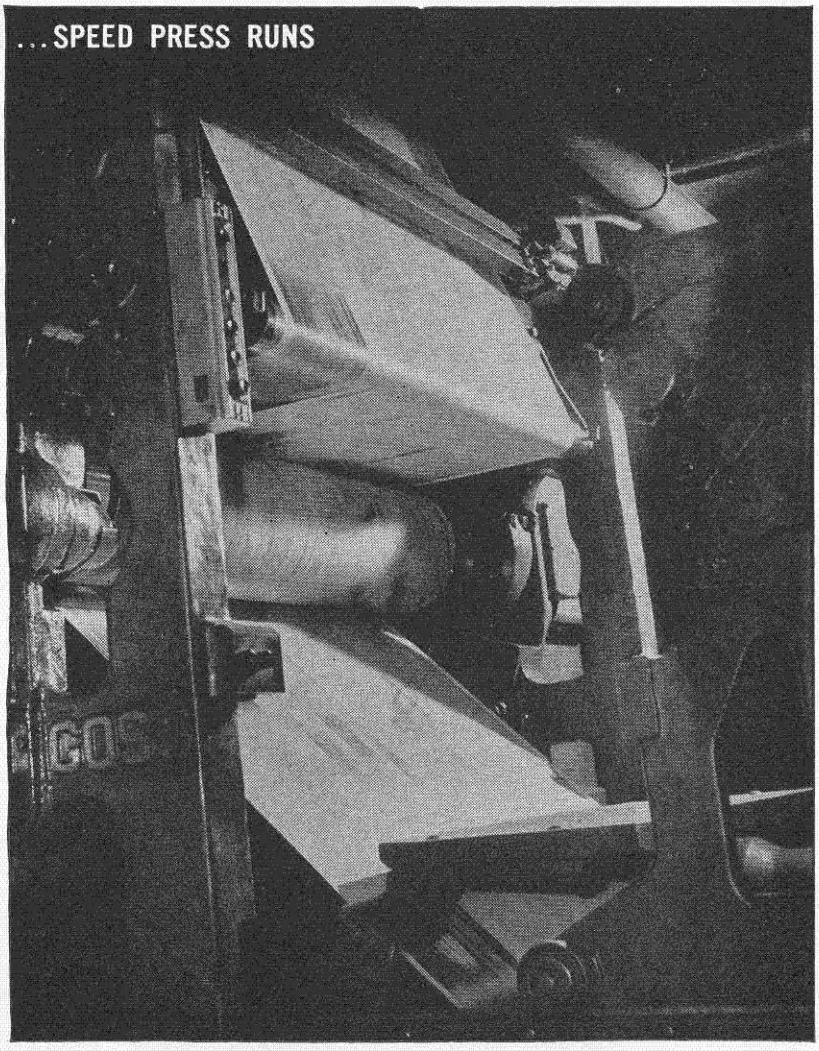

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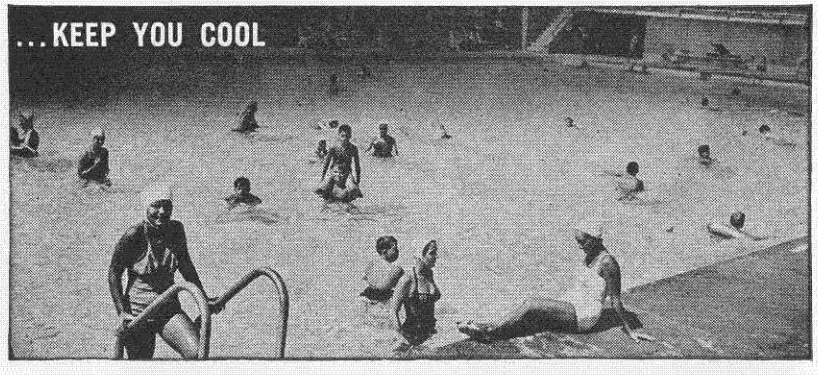

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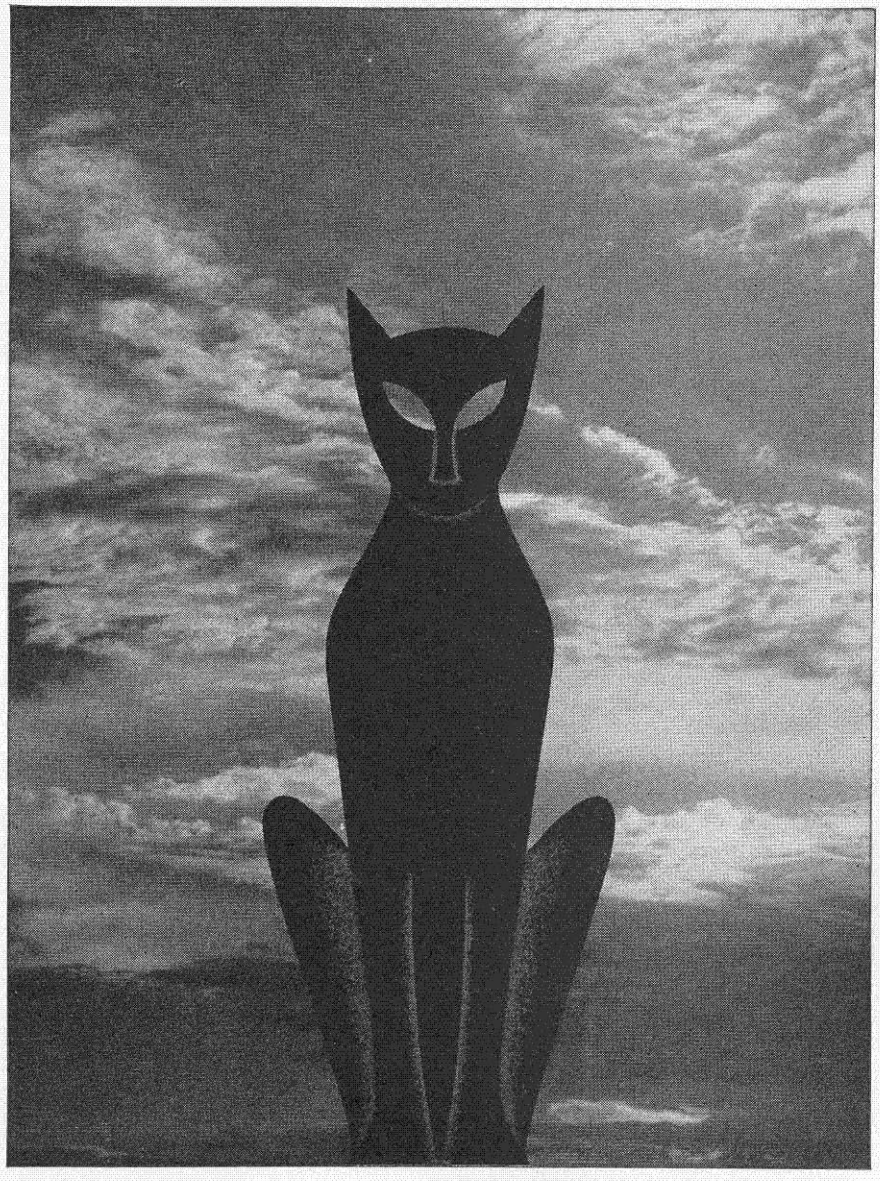

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A MAP OF THE UNIVERSE

After seven years of hard work, a milestone in astronomical history has been reached in this great photographic Sky Survey

THE FIRST PHOTOGRAPHS from their giant atlas of the universe were released this summer by the National Geographic Society and the Palomar Observatory. The 200 photographic prints went out to nearly 100 scientific institutions and observatories around the world—subscribers to this unique atlas which will consist of 1,758 pictures providing a comprehensive portrait of the heavens as they exist in the 1950's.

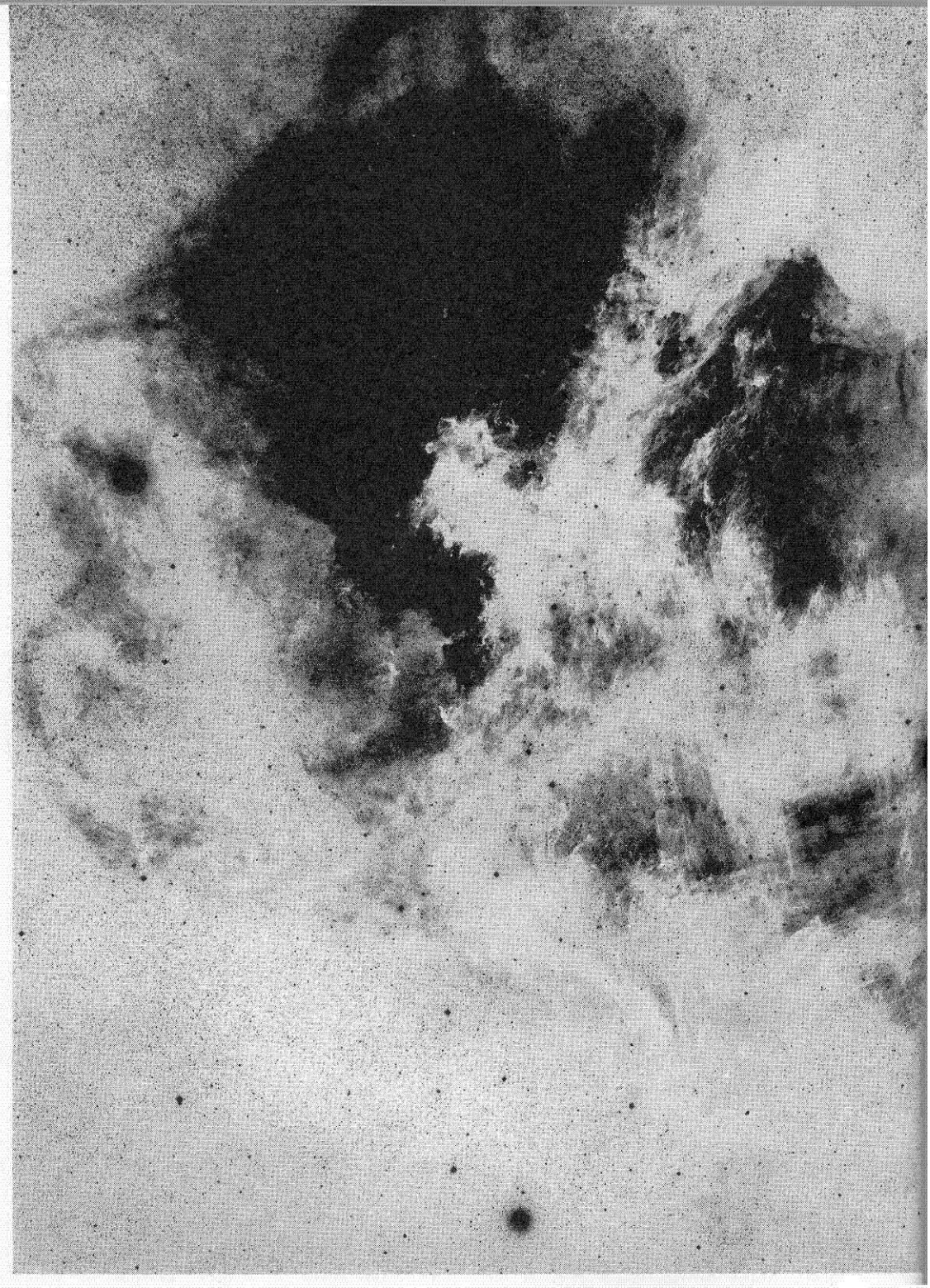
Millions of galaxies, stars, and clusters of stars far out beyond the Milky Way are pictured in detail in the atlas. Many of the space regions have never been seen by astronomers before, and scientists hardly exaggerate when they say that, with the new atlas, astronomers have a century of study before them.

Every photograph in this Sky Survey has been taken with the 48-inch Schmidt telescope. Designed primarily as a scouting camera for the larger telescopes, the 48-inch has proved ideal for the Survey, because though it can reach only about one-third as far as the 200-inch telescope, its wide-angle viewing power covers 500 times more sky. By 1956, when it makes its last picture for the Survey, the 48-inch will have taken seven years to cover every patch of the sky that can be reached from Palomar Observatory. With the 200-inch telescope this job would take almost 5,000 years.

For the Sky Survey, 14 x 14-inch plates are used in the Big Schmidt. Covering the three-quarters of the sky pictured in the atlas requires 879 of these large plates. Two photographs are taken of each field in quick succession—one red-sensitive, with an exposure time of from 40 to 60 minutes; one blue-sensitive, exposed from 10 to 15 minutes. These exposure times were chosen to reach the faintest stars which can be recorded by the instrument. Comparison of the two color plates allows astronomers to measure star colors and to pinpoint faint objects for later observation with more powerful telescopes. Length of exposure plus the extreme speed ($f/2.5$) and great light-gathering power of the telescope makes it possible to record stars down to a brightness of 1/1,000,000 of the faintest star that can be seen with the naked eye.

A very thin, fragile glass, .040 inches thick, is used for the photographic plates. Each plate is examined after exposure by the observer at Palomar for flaws in the emulsion, motion of the image during exposure, error in the focus of the telescope or even slight blurring of the star images due to disturbances of the air above the telescope.

Plates are then sent to Caltech where Dr. Rudolph Minkowski, who has directed the Sky Survey since its beginning, examines them once more and has the final decision on rejection or acceptance.



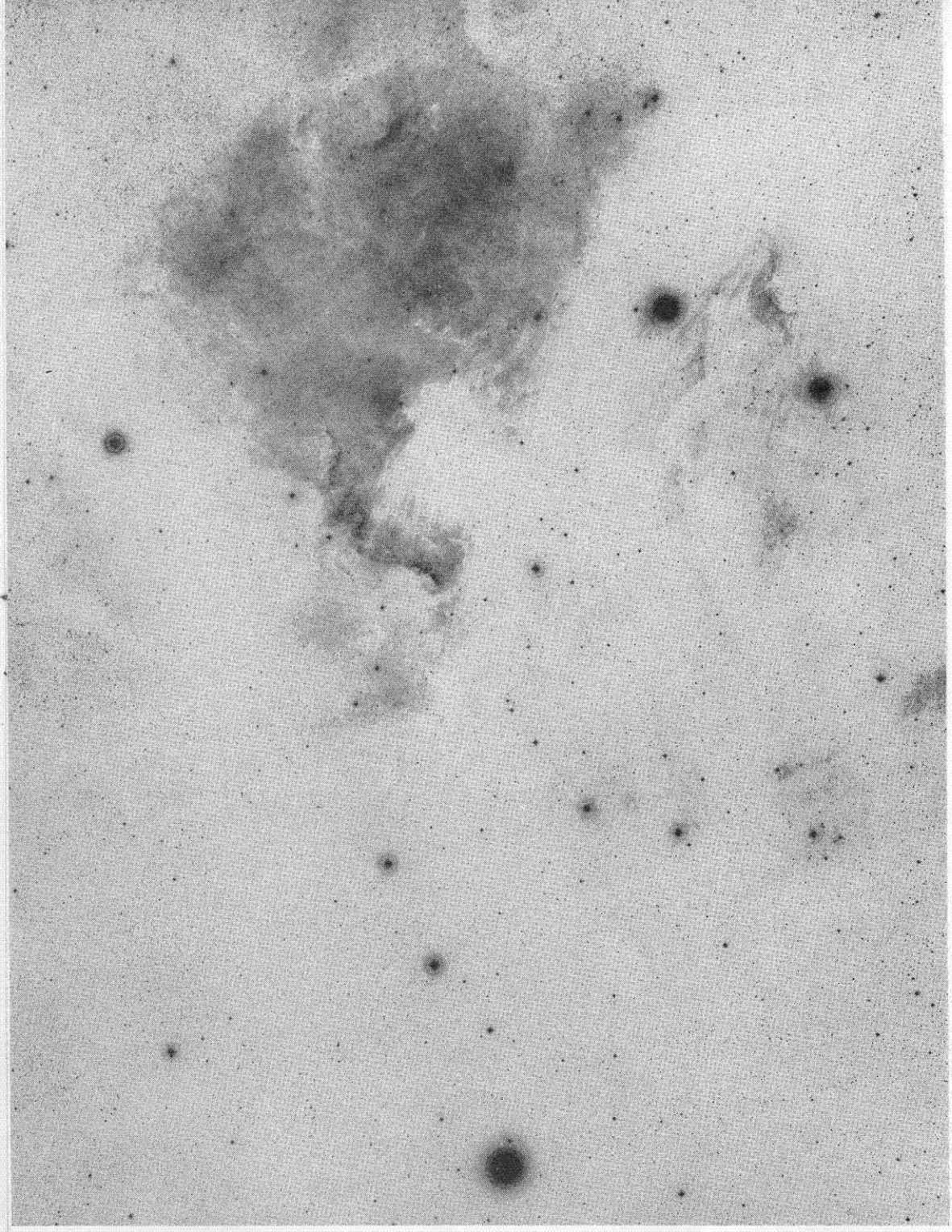
The North American Nebula in Cygnus, shown here as exposed with a red-sensitive plate, was the first nebula photographed in the Sky Survey. Red light is particularly sensitive in detecting dense gas clouds, which glow like neon signs from the reflection of nearby stars.

As an indication of the high standards set for the finished prints, almost 40 percent of the plates were rejected because of flaws or defective negatives. At times it seemed impossible to maintain such perfection of detail, but as Dr. Ira Bowen, director of Mount Wilson and Palomar Observatories, explains: "In the year 2000 A.D., astronomers wouldn't find much value in brown or faded photographs. Extreme definition of the faintest images is necessary."

All acceptable plates then go to James McClanahan of Caltech's Graphic Arts Department, who has charge of reproduction. From each negative plate, two glass positive plates are made, called intermediates, one of which is used to make the final prints at Caltech. The other plate goes to Palomar for safekeeping. All photographic prints which form the final atlas sheets are in negative form because faint stars and nebulae show up better when printed in black against a white sky.

Now that scientific institutions have received their first section of the atlas, the real work begins of counting and fixing the location of the thousands or millions of stellar images. During the actual photographing, there wasn't time for even the first superficial search of plates for new or unusual objects.

New comets and asteroids were found while production was going on, however. But as one Sky Survey observer says: "Actually these comets are a nuisance. Finding one simply means we must stop operations to



The North American Nebula in Cygnus photographed in blue light, eliminating all the density of red glow shown in the opposite picture. From these two photographs, astronomers can compare images, differentiate between hot and cool stars and point up faint objects.

make measurements and record all the material on it."

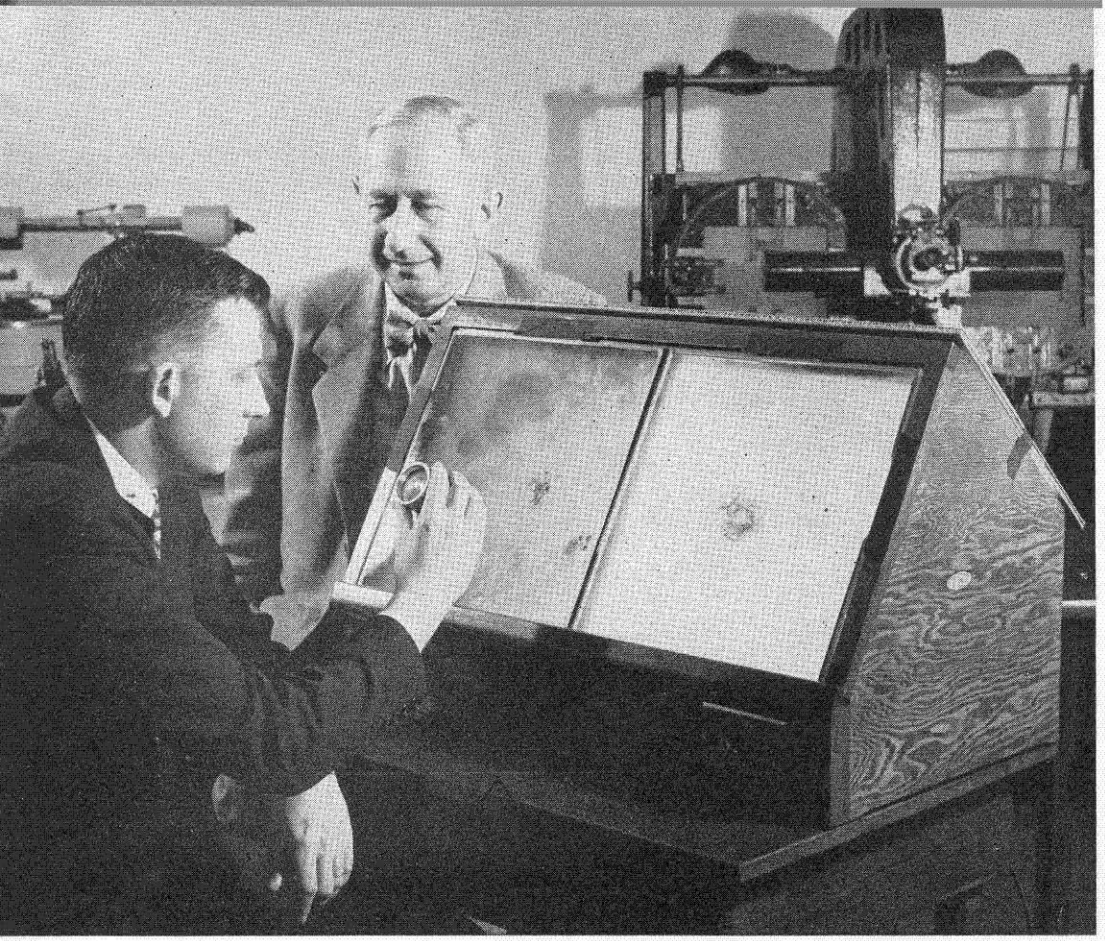
Out of the eleven comets found were two unusual ones. Though most comets approach the sun, then disappear for long periods of time or never reappear at all in our time, the Survey turned up one in 1949 that circles its orbit in only 2.3 years.

Another comet had two tails. This in itself is not unusual, for some comets have many tails, but Number 1950g not only had the standard tail streaming out behind but another one set at a forty-five degree angle.

Thousands of asteroids flashed across Survey photographs and, of these, four were found moving with execessive speed very close to the earth.

One of the chief values of the new sky map will be to highlight new objects such as these, the way a highway map highlights towns.

When an occasional star flares up to millions of times its original brightness to form a nova or "new" star in the future, astronomers will be able to refer to the Survey plates for a record of the original brightness and temperature of the star before the outburst occurred. Extensive study of the plates may reveal the reasons for these stellar explosions. It may furnish evidence for the theory that the stars are continually undergoing a process of birth and death. And it may even give us more knowledge about our own galaxy, the Milky Way—a great pinwheel-shaped system of probably more than a hundred billion stars, of which our sun is one. Because



Dr. Albert Wilson, one of the first Survey astronomer-observers, checking a photograph for defects. Dr. Walter Baade, staff member of the Observatories, is assisting in the selection of acceptable plates.

James McClanahan and his assistant, Hendrik Rubingh, using a vacuum printer to process Survey photographs.

our solar system lies in the galaxy we cannot see the whole of it, but studies of other galaxies may help us understand our own.

Almost 90 percent of the Sky Survey is now finished. The eight remaining sections will be sent out at intervals, so that the complete atlas should be in the hands of scientific institutions in about three years. Nearly 100 copies have been ordered, each at a cost of $2000, which only covers the price of printing. All expenses of the Survey, including the astronomers' salaries, are covered by the National Geographic Society, while Palomar Observatory donates the astronomers' time.

The close cooperation of a few people has been responsible for the perfection of the Sky Survey. Dr. Rudolph Minkowski has acted throughout as a guide and director. Albert Wilson, who was the observer during the first few years of the Survey, is now director of the Lowell Observatory in Flagstaff, Arizona, and George Abell is acting as astronomer-observer, with Robert G. Harrington as relief observer. Charles Kearns is serving as night assistant—the engineer who must always be on hand to assume responsibility for the general behaviour of the telescope. Reproduction problems are under the supervision of James W. McClanahan, with his assistants, Hendrik Rubingh and Gladys Harvey.

General supervision of the Sky Survey is under an advisory committtee represented by Dr. L. A. DuBridge, President of Caltech; Dr. Ira S. Bowen, director of the Mount Wilson and Palomar Observatories; Dr. John La Gorce of the National Geographic Society; and Dr. Lyman J. Briggs, director emeritus of the National Bureau of Standards.

A NEW SOURCE OF URANIUM

Caltech investigators find a way to extract the atomic energy fuels, uranium and thorium, from the ordinary granites of the earth's crust

CALTECH SCIENTISTS investigating possible new sources of the atomic energy fuels, uranium and thorium, have found that these elements exist in enormous quantities in the ordinary granites of the earth's crust. What's more, they can easily be extracted.

If atomic energy ever comes to supply much of the world's power requirements, the demand for uranium and thorium, already large, may amount to millions of tons. Looking ahead to this distant day, a group of Caltech scientists, under the direction of Drs. Harrison Brown and Leon T. Silver of the Department of Geochemistry, recently began a study of the possibilities of isolating uranium and thorium from ordinary igneous rocks.

An average granite, found in all parts of the world, contains only about 4 parts-per-million uranium and 12 parts-per-million thorium, but the Caltech researchers found that a large portion of the elements were usually present in easily soluble forms and could readily be removed by washing the pulverized rock with cold dilute acid.

If all the uranium and thorium could be extracted from one ton of rock, then converted to fissionable material and "burned" in a nuclear reactor, the energy released would be equal to that obtained from burning about 50 tons of coal. But the Caltech scientists found that, on the average, only about 25 percent of the uranium and thorium in granite rock is leachable, so that actually a ton of rock would produce releasable energy equivalent to about 10 or 15 tons of coal.

The energy required to process a ton of granite, leaching out the uranium and thorium, would cost within the range of 25 to 48 lbs. of coal—which is clearly less than the equivalent of the 20,000 lbs. of coal which could be extracted from a ton of average rock.

Solely from the energy point of view, then, our available reserves of uranium and thorium can power a highly industrialized world economy for a very long time.

From the monetary point of view, however, the cost of processing average granite is still prohibitively high. In the United States, today, uranium from an average granite might cost as much as $340 a pound, thorium as much as $147. But the Caltech research indicates that there are probably a number of igneous bodies in various parts of the world which possess higher-than-average concentrations of leachable uranium and thorium, and which might well be processed competitively in the near future.

In fact, this study makes it clear that no nation which needs uranium and thorium in quantity need be deprived of supplies of these elements.

Working with Drs. Brown and Silver on the research project were Wilbur Blake, Arthur Chodos, Richard Kowalkowski, Charles R. McKinney and Aiji Uchiyama, all of Caltech; and Dr. George Neuerburg of the United States Geological Survey.

THE SUMMER AT CALTECH

Faculty Additions

New members of the Institute's Staff of Instruction and Research for 1955-56 include:

FRANK PRESS, Professor of Geophysics, noted for his research on a wide range of geological subjects, including microseisms, the geological structure of the ocean floor, and several aspects of seismology. He was an Associate Professor of Geophysics at Columbia University, where he received his PhD in 1949.

TOYOKI KOGA, Senior Research Fellow in Engineering, from Nagoya University in Japan, where he is Professor of Engineering and Director of the Automatic Control Laboratory.

JOHN SEDDON, Senior Research Fellow in Aeronautics, here on a Commonwealth Fellowship in Aeronautics, formerly with the Principal Scientific Office in England.

LLOYD S. SHAPLEY, Senior Research Fellow in Mathematics, from the RAND Corporation, where he is a senior research investigator.

CLARENCE H. ALLEN, Assistant Professor of Geology, who received his MS here in 1951. He has been Assistant Professor of Geology at the University of Minnesota in Minneapolis, where he received his PhD in 1954.

PETER FAY, Assistant Professor of History, from Williams College, where he was Instructor in History.

ROY GOULD, Assistant Professor of Electrical Engineering. He received his BS here in 1949 and, since getting his MS at Stanford, has continued his graduate studies at Caltech.

ROBERT MIDDLEBROOK, Assistant Professor in Electrical Engineering, from Stanford, where he just received his PhD.

LEON T. SILVER, Assistant Professor of Geology, who has been working at Caltech as a research scientist in geochemistry. He received his PhD here in June, 1955.

MACK THOMPSON, Assistant Professor of History, from Brown University in Providence, Rhode Island, where he has been Instructor in History.

GERALD J. WASSERBURG, Assistant Professor of Geology, formerly a resident associate at the Institute of Nuclear Studies at the University of Chicago.

CHUJI E. TZUBOI, Visiting Professor of Geophysics, from Tokyo University, a top authority on earthquakes and the deformation of the earth's crusts.

DWIGHT THOMAS, Instructor in English and Public Speaking, from Kalamazoo College, where he was chairman of the Department of Speech.

CALVIN H. WILCOX, Instructor in Mathematics, from Harvard, where he received his PhD this year.

The campus took on a carnival air this summer when the Pacific Division of the American Association for the Advancement of Science held its 36th annual meeting here from June 20-25—the largest scientific convention ever held in Pasadena. The refreshment and exhibit areas are shown here.

Faculty Changes

The following promotions have been made in the Caltech faculty for 1955-56:

To Professor Emeritus:

Howard J. Lucas—Chemistry

To Professor:

Donald E. Hudson—Mechanical Engineering
Thomas Lauritsen—Physics
Lester Lees—Aeronautics
W. Duncan Rannie—Mechanical Engineering
Roger Stanton—English
Vito A. Vanoni—Hydraulics

To Associate Professor:

Julian Cole—Aeronautics and Applied Mechanics
Y. C. Fung—Aeronautics
D. S. Wood—Mechanical Engineering
Rolf Sabersky—Mechanical Engineering
M. L. Williams, Jr.—Aeronautics

To Senior Research Fellow:

F. H. Boehm—Physics
Donald Coles—Aeronautics
Henry Hellmers—Biology
H. S. Forrest—Biology
R. E. Marsh—Chemistry
W. S. McNutt, Jr.—Biology

To Assistant Professor:

R. A. Dean—Mathematics
H. E. Ellersieck—History
F. B. Fuller—Mathematics
R. S. Macmillan—Electrical Engineering
H. C. Martel—Electrical Engineering
D. E. Osterbrock—Astronomy
A. Roshko—Aeronautics
Frank L. Spitzer—Mathematics
T. Y-T Wu—Applied Mechanics

On Leave of Absence:

Lester M. Field, Professor of Electrical Engineering, to organize and direct the work of the Electron Tube Laboratory of Hughes Research Division for 16 months.

H. Victor Neher, Professor of Physics, for one year, to help in the establishment of work in cosmic rays at the Physical Research Laboratory in Ahmedabad, India.

Rodman Paul, Professor of History, for a year of studying in Europe on a fellowship from the Fund for the Advancement of Education.

H. P. Robertson, Professor of Physics, to continue to serve for another year as scientific advisor to SHAPE in Paris, at the request of General Gruenther, Supreme Allied Commander in Europe.

Robert L. Walker, Associate Professor of Physics, to conduct research in Italy on high-energy physics for one year on both Guggenheim and Fulbright Fellowships.

Departures:

Arthur W. Galston, Associate Professor of Biology at Caltech, left this fall to become Professor of Biology

U Nu, Prime Minister of Burma, visited Caltech in July, on a tour of the United States with his wife and entourage of 12. At the right, Caltech President L.A. DuBridge and Paul G. Hoffman are shown with the prime minister, as they attended a luncheon at the Athenaeum.

at Yale University. Dr. Galston came to Caltech as a research fellow in 1943.

Henry T. Nagamatsu, Senior Research Fellow in Aeronautics and director of Caltech's hypersonic wind tunnel research laboratory for the past six years, has joined the staff of the General Electric Research Laboratory in Schenectady, New York.

George K. Tanham, Associate Professor of History, to do full-time research for the RAND Corporation and the Air Force—though continuing to give his course here in the History of War.

Hsue-Shen Tsien, Goddard Professor of Jet Propulsion, resigned his post at Caltech and sailed for China last month. For the past five years he has continued his work with the Guggenheim Jet Propulsion Center while the government held him in this country under a deportation order.

Dr. Tsien came to Caltech as a graduate student direct from China in 1936, received his PhD in Aeronautics and Mathematics in 1939, and except for two years at M.I.T. as a Professor of Aeronautics, has been a member of the faculty here. During World War II, he served as a member of the Scientific Advisory Board of the Army Air Forces and in 1948 helped to set up the Guggenheim Jet Propulsion Center at Caltech, which he headed until his resignation.

AFROTC CHANGES:

First Lieutenant Henry L. Lanman has been assigned here in place of Captain Henry B. Gibbia, Jr., who is now based in Germany. Lt. Lanman was transferred from Ladd Air Force Base in Alaska.

Master Sergeant Leon E. Bemis, whose last assignment was at Truax Field, Wisconsin, is replacing Master Sergeant Harold L. Waugh, now assigned in French Morocco.

Top Sergeant Robert W. Freeman replaces Mr. Dominic J. Zangari as Supply NCOIC. His last assignment was at Beale Air Force Base in Marysville, California.

Top Sergeant Edward Obina, replacing Master Sergeant LeRoy G. Lee, now assigned in Alaska, was transferred from Amarillo Air Force Base in Texas.

New Trustee

HERBERT L. HAHN, treasurer of the California Institute Associates since 1943, was elected as a member of the Institute Board of Trustees last month. A native of Pasadena and an alumnus of Stanford University, Mr. Hahn has practiced law in the city for 38 years and is senior partner of Hahn and Hahn.

He also serves as a lecturer on the faculty of the Stanford University Law School and is on the Management Committee of the Huntington Memorial Hospital.

Edison Pettit Retires

DR. EDISON PETTIT retired this summer after 35 years as a staff member of the Mount Wilson and Palomar Observatories. A native of Peru, Nebraska, where he was born in 1889, Dr. Pettit has become noted for his work in solar observations, radiation measures on celestial objects, and photoelectric photometry.

In 1947 he started an extensive photometric study of galaxies which was just recently completed. Results of this study may add considerable knowledge to the expanding-universe theory.

Dr. Pettit came to the Mount Wilson Observatory after receiving his PhD in 1920 from the University of Chicago and since 1948 has been affiliated with both Mount Wilson and Palomar Observatories.

It is worth noting that he is not the only astronomer in the Pettit family. His wife has a PhD and their two daughters have Master's degrees—all in astronomy.

Clinton Judy

CLINTON K. JUDY, Professor Emeritus of English, died on August 29 at his home in San Marino.

When Caltech was still known as Throop Polytechnic Institute in 1909, Clinton Judy accepted an appointment here as Professor of English Language and Literature. For the next 40 years, as the Institute grew, he also handled the administration of the Humanities Department. The successful promotion of liberal arts training as a feature of the curriculum at Caltech was largely due to his efforts.

Born in Vancouver, Washington, in 1879, he was educated in California schools, graduated from the University of California in 1903 and received his MS there in 1907. Later he earned Master's degrees from Harvard and Oxford as well.

Professor Judy was appointed chairman of the Division of Humanities in 1923 and held this post until his retirement in 1949.

Jacob Chaitkin

JACOB CHAITKIN, Instructor in Russian and in Business Law, died at the Huntington Hospital in Pasadena on August 23.

Mr. Chaitkin, who spoke English, Russian and German fluently, translated many Russian poems and short stories for publication in the United States.

He was born on the shores of the Baltic in 1898 and attended a governmental school in Russia until he came to the United States at the age of 14. In 1919 he received his BS from the University of Pittsburgh and was graduated from Pittsburgh's Law School in 1921.

Mr. Chaitkin practiced law in New York City for 20 years. During World War II, he taught Russian for the Army Air Force Intelligence at the Pentagon and served as an interpreter for visiting Russian military missions.

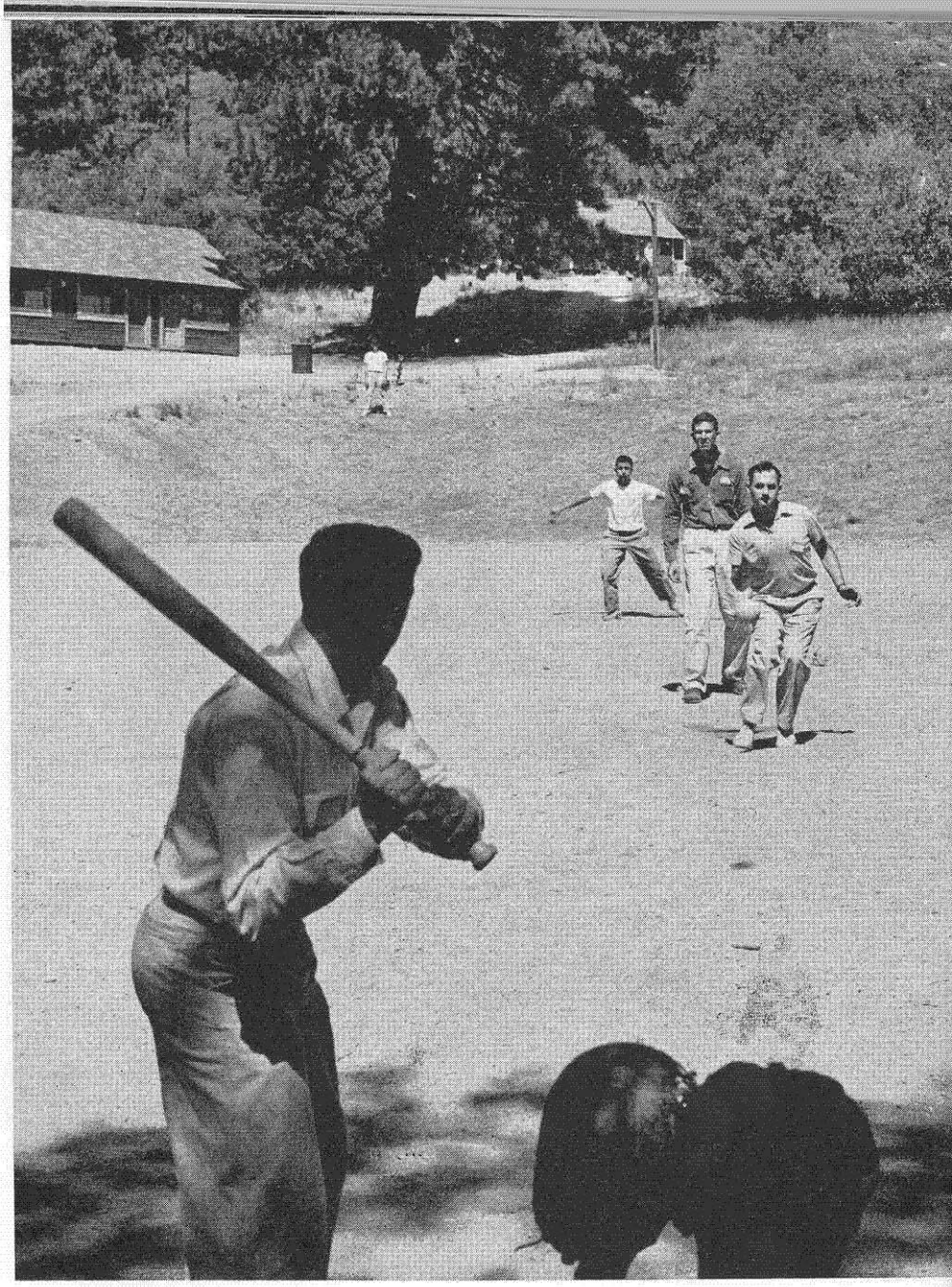
Mr. Chaitkin came to California in 1946. He was a partner in the legal firm of Chaitkin and Stapel in Pasadena, and had been a member of the Caltech faculty for nine years. He is survived by his widow, Janet, two sons and three daughters.

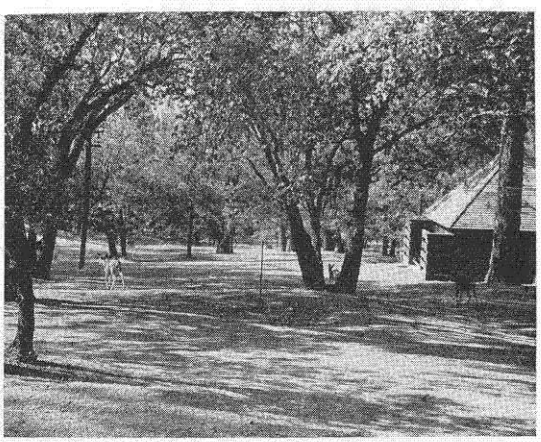
Harvey Eagleson, Professor of English, addresses the troops assembled around the fire circle at Camp Radford.

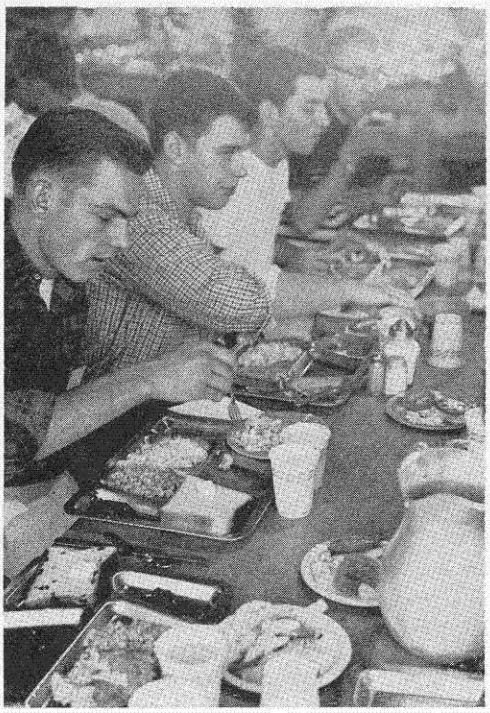
FRESHMAN CAMP

The class of '59 starts its Caltech career with the traditional three-day trip to Camp Radford in the San Bernardino Mountains.

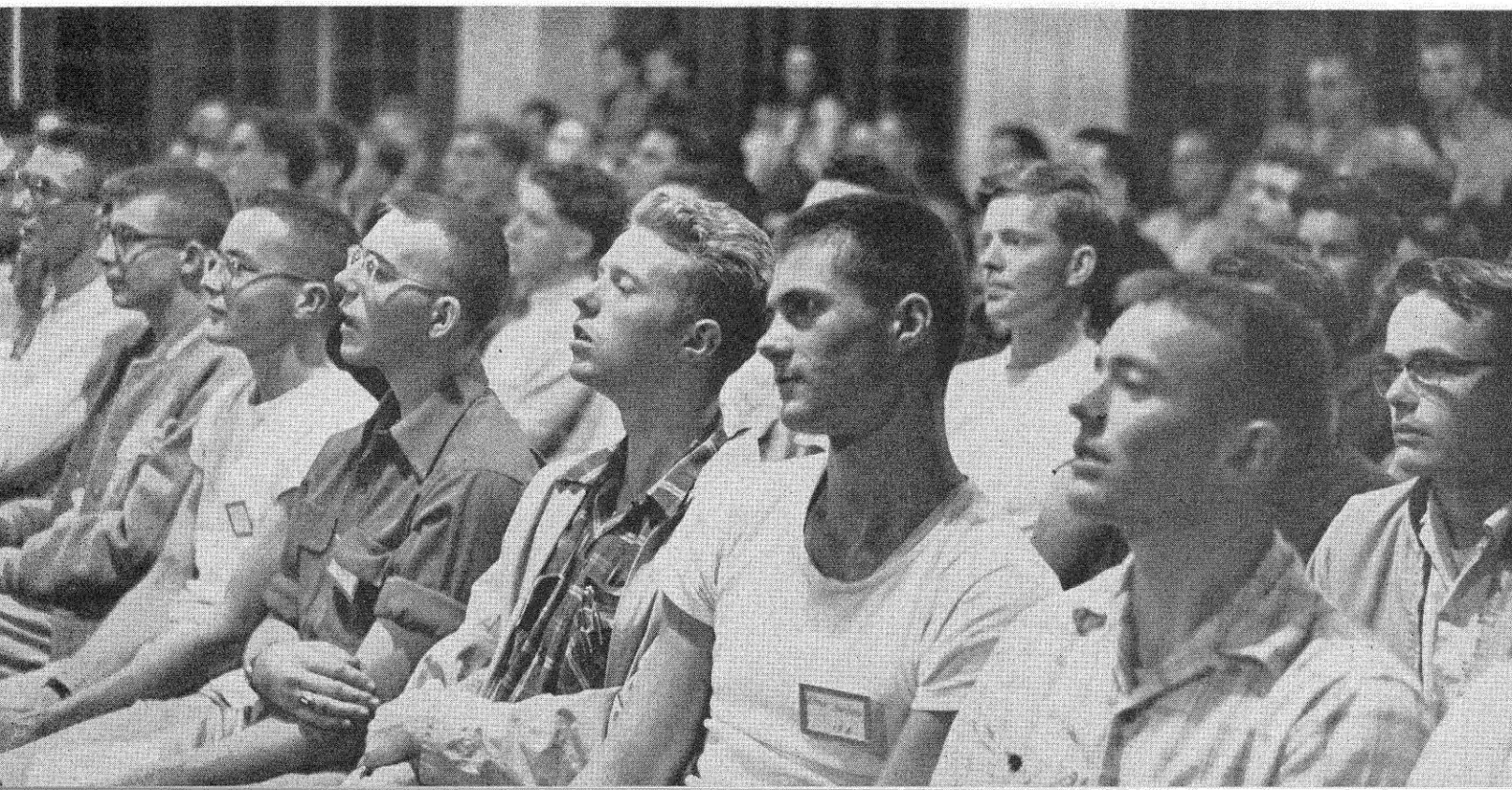
L. W. Jones, Dean of Admissions, surrounded by some of his charge







Aside from speeches by student leaders and faculty members about life at Caltech, freshman camp offered everything from a chance to meet President DuBridge to chess, softball, eating, swimming, and tame deer.



LOOKING AHEAD FOR WATER

Can southern California keep growing indefinitely without fear of a water shortage? Here's what engineers and scientists are doing to meet the inevitable problem.

by JACK E. McKEE

WATER, OR RATHER THE SHORTAGE thereof, is a problem of continuing and growing importance in the western states and especially in southern California. Next to air, water is the most critical substance for man's existence and development. And, next to smog, water shortages present the most serious challenge to the ultimate growth of this region.

Do we have enough water for the next decade or two? Can southern California continue to grow indefinitely without fear of a water shortage? Will there be enough water for industry, or must the economy remain predominantly agricultural? If more water is needed, where can it be obtained and at what cost? What needs to be done now? These are questions that this paper attempts to answer, with the aid of a crystal ball and data from many sources.

The history of water supply for southern California is a long and fascinating story, ably told by Remi Nadeau (1) and by Vincent Ostrom (2). This article, however, is concerned not with the past nor even the present, but with the future and ultimate problem.

In any discussion of water-supply problems in arid regions, it is important to recognize the distinction between water "use" and water "consumption." Water is considered to be "consumed" when it is irretrievably lost by transpiration from plants, by natural or man-made evaporation, by percolation into aquifers too deep for recovery, or even by mixing with ocean or other saline waters. Water is "used" but not consumed when it drives a power turbine, when it floats logs down a flume or sluices minerals from a hill, when it passes through cooling coils and returns to a stream, and even when it serves domestic purposes and flows to a cesspool or an inland sewage treatment plant. In general, water is "consumed" by agriculture but merely "used" by municipalities and industry unless they discharge to the ocean. This distinction is important when one is considering the transition of southern California from a rural to an urban economy.

It is common in waterworks practice to assume that water requirements will be a function of population growth, with per capita demands remaining constant or increasing only slightly with time. For many eastern cities this assumption has been relatively valid; but where industry or irrigation is a dominant influence, water requirements may far outstrip, or even run counter to, population growth. In Los Angeles, for example, the per capita use was 200 gpd (gallons per day) in 1905 when the supply was unmetered, but it dropped to 128 gpd by 1928 as a result of metering and to 110 gpd by 1935 because of economic depression. It has been rising steadily since 1935 to about 150 gpd now. An an example of high per capita requirements, the nearby industrial community of Vernon uses 14,000 gpd per resident, and the number of residents decreased by about 50% during the last census decade! In contrast, troops on desert maneuvers have subsisted on as little as one gpd per man for all purposes. It is difficult, therefore, to try to base the future and ultimate water requirements of southern California on population.

A better yardstick in regions of mixed demands by cities, industries, and irrigated agriculture is based on area to be served and the "duty" of water—duty being defined as the water supplied in acre ft. (AF) per acre per year (or ft. per year)—because the duty tends to approach a predictable asymptote for each type of use, and the number of habitable and irrigable acres is limited. Moreover, duties for agricultural and domestic purposes are

quite comparable in magnitude. When an orange grove in the San Gabriel Valley, for example, is replaced by a subdevelopment of five or six houses per acre, the total annual water requirement per acre is not increased and, what is more important, the consumptive use by vegetation is replaced partly by non-consumptive domestic use.

Typical duties of water requirements on an areal basis for southern California are shown in the table below, along with some of the reasons for the variability of the figures. The requirements for irrigation and for single-family dwellings are comparable, but in apartment-house zones and crowded business districts the areal use may reach or even exceed 100 ft. per year. Most industries, on the other hand, are generally quite moderate in their demands for water. At the Kaiser Steel Co. in Fontana, for example, the demand is only 2.8 ft. per year. At eastern mills, 65,000 gallons of water are used to make one ton of steel, but at Fontana this figure has been reduced to 1100 gallons per ton by conservation and the reutilization of waste water. When faced with the necessity of reducing water use and preventing pollution of streams or groundwater basins, most other industries can adapt their operations to a rigid economy that will not greatly exceed municipal or irrigation requirements on an areal basis.

The South Coastal Basin of California, (roughly the Ventura-San Bernardino-San Diego triangle) represents a geographical subdivision that can be considered as a unit in planning for water supply. The total area in this basin suitable for municipal, industrial, and agricultural use is approximately 2,800,000 acres. For a mixed economy it is probable that the ultimate mean annual water requirement will approach 2.0 ft. and hence the total ultimate water requirement is estimated at 5,600,000 AF per year.

How well can the existing sources of water meet this requirement and where can additional fresh water be developed? Local supplies have their origin in the limited precipitation on the valley floors and in the heavier rainfall of the nearby mountains. The mean seasonal precipitation on valley and mesa lands in the South Coastal Basin is 2,084,000 AF, but very little of this water is available for water supply, either as surface run-off or as groundwater replenishment. Most of it is consumed by evaporation and transpiration, over and above the water requirement by irrigation. Approximately 400,000 AF per year (as a mean figure) escapes to the ocean during floods or heavy storms, but very little of this amount is recoverable.

More useful for water supply is the surface run-off from local mountains, for which the long-time mean is 1,227,000 AF per year. This is only 1.7% of the total for the state, yet the basin constitutes 6.9% of the state's area and contains about 55% of the population. Although this surface run-off is sporadic and subject to prolonged wet and dry periods, the extensive groundwater basins of this region provide tremendous underground reservoirs to store heavy run-off during wet years. In a depth of 50 ft. above and below normal water tables, these groundwater basins can store more than 7,000,000 AF of withdrawable water.

With allowances for losses during floods and for some augmentation by valley-floor precipitation, it is estimated that the mean safe yield of local supplies is only 1,000,000 AF per year. At present, however, the draft on these supplies is about 1,400,000 AF per year, representing an annual overdraft of 400,000 AF from local groundwater basins. This is analogous to withdrawing from a savings account each year more money than is deposited, a procedure that obviously cannot be continued indefinitely.

Thanks to the far-sighted planning of waterworks engineers of the City of Los Angeles and the Metropolitan Water District many decades ago, imported water is now available from the High Sierras and the Colorado River to overcome present deficiencies in local supplies. As shown in the table above, the Owens Aqueduct of the City of Los Angeles is operated up to its capacity of 307,000 AF per year; but the Colorado River Aqueduct, which has a capacity of 1,200,000 AF per year, has been used only as a standby supplement. In recent years, however, the demand for MWD water has been increasing rapidly. The total safe yield of local and imported supplies, listed in the table above, is only 2,500,000 AF

TYPICAL WATER REQUIREMENTS IN SOUTHERN CALIFORNIA
(in feet per year or acre-ft. per acre per year)

USE	MIN.	MEAN	MAX.	VARIATION DEPENDS ON
1. Agricultural	0.5	1.5	3.0	Total Annual Rainfall Rainfall Distribution Type of Crop Type of Soil
2. Residential	0.5	2.0	3.5-5.0	Population Density Standard of Living Economic Conditions
3. Business-Commercial	0.1	5.0	100	Type of Use Size and Occupancy of Bldgs.
4. Industrial	0.5	2.5	5-10	Type of Industry Measures for Conservation Cost and Availability of Water and Sewers
5. A Probable Mixed Economy	1.0	2.0	3.0	

PRESENT SOURCES OF WATER SUPPLY FOR SOUTH COASTAL BASIN
(in acre feet per year)

	PRESENT USE	ULTIMATE
Safe Yield of Local Supplies	1,000,000	1,000,000
Overdraft of Local Ground Water	400,000	.....
Owens Aqueduct (L.A. City)	300,000	300,000
Colorado River Aqueduct (M.W.D.)	200,000	1,200,000
TOTALS	1,900,000	2,500,000

Area Utilized at Present = 1,200,00 ACRES
Water Used at Present = 1.58 Ac. Ft. /ACRE/YEAR
Ultimate Habitable Area = 2,800,000 ACRES
Ultimate Water Requirement = 5,500,000 Ac. Ft./YEAR
Anticipated Ultimate Deficit = 3,100,000 Ac. Ft./YEAR

per year—or less than half of the estimated ultimate requirement.

To meet the shortage that is sure to occur ultimately, and probably before 1990, consideration is being given to several new sources of water supply; viz, desalting of sea water, augmentation of rainfall by cloud seeding, sewage reclamation, and further importation from distant rivers. Each of these plans is described briefly below and compared with the others as to probable cost.

Sea water

The tremendous volume of water at the doorstep of coastal cities has always stirred the imagination of man, but to date the cost of converting sea water to fresh water has been prohibitive. Some attempts have been made to use saline water directly; indeed, industry in southern California is already using about 750,000 AF per year for cooling, sluicing, and other purposes. Dual distribution systems for cities, analogous to those of ocean vessels, have been proposed to provide fresh water for cooking, washing, or irrigation, and salt water for flushing toilets. Two important factors militate against this proposal: first, it is not economically feasible inasmuch as 60-70% of the total cost of any waterworks is attributable to the distribution system; and second, the drainage would cause saline pollution of groundwater basins.

How much does it cost to convert sea water to fresh water? The minimum free energy required to separate one AF of fresh water from sea water has been computed to be about 850 kilowatt hours. This is based on an "ideal" process, infinitely slow, with a fraction of fresh water from a huge volume of sea water, and no inefficiencies. When one AF of fresh water is taken from 2 AF of sea water, the figure rises to 1150 kwh, and with 50% overall efficiency (which is optimistic) the energy cost would be 2300 kwh per AF. Since other changes (amortization, labor, etc.) run about twice the power cost for this type of operation, and with power at ½ cent per kwh, the minimum cost under optimum conditions would be about $35 per AF. This value is not prohibitive, but how close can it be approached by known processes?

There are two general ways to convert sea water to fresh water: remove the water from the brine, or remove the salt from the brine. The first category comprises: (a) simple distillation, (b) multiple-effect distillation, (c) vapor-compression distillation, (d) solar distillation, (e) temperature-difference evaporators (Claude process); and (f) freezing. Included in the second group are: (a) straight chemical precipitation, (b) ion exchange by means of synthetic resins, (c) simple electrolysis, and (d) electro-dialysis with ion-permeable membranes. These ten processes are described and discussed ably by Aultman (3), DeHaven et al. of the RAND Corporation (4), Ellis (5), and Sherwood (6). The table below is a summary of their cost estimates, including allowances for amortization, power, and labor. The most promising methods appear to be vapor-compression distillation, the Claude process, and electro-dialysis with ion-permeable membranes; but it is highly improbable that any of these methods will ever produce fresh water from the ocean at less than $125 or $150 per AF at sea level.

Cloud seeding

Among meteorologists and hydrologists there does not appear to be much unanimity as to the effectiveness of cloud seeding for rainfall augmentation. If it works as well as its proponents claim, cloud seeding is certainly the cheapest source of additional water for any region. Its application to the South Coastal Basin, however, is restricted by the rapid run-off from mountain areas and by the danger of floods in areas of high property value.

The best application of cloud seeding appears to be for increasing the snow packs of the High Sierras and the Rocky Mountain watershed of the Colorado River. If winter precipitation can be augmented by 20%, the run-off will be increased by 30 to 60%, thereby improving the reliability and quality of the present imported supplies. Indeed, southern California can claim a part of any excess flow in the Colorado River.

Sewage reclamation

With the progress of urbanization and industrialization in southern California, there is a steady shift in the ultimate destination of water from evapotranspiration by vegetation to waste water in sewers. This waste water, or sewage, is still fresh water, containing less than 1000

ESTIMATED COSTS FOR LARGE-SCALE SALT WATER CONVERSION PROCESSES

(in dollars per acre foot)

PROCESS	T. K. SHERWOOD (M.I.T.)	ELLIS	AULTMAN	RAND REPORT PRESENT	RAND REPORT POSSIBLE FUTURE
Simple Distillation	1600-3200	.....	820*	.....	.....
Multiple-Effect Distillation	1200	220	340*	1200	900
Vapor-Compression Distillation	540	220	400	700	200
Temperature Diff. (Claude)	.....	.....	.....	150	100
Solar Evaporation	900	.....	.....	350	100
Freezing	235-400	220	.....	.....	400
Ion Exchange	6300	.....	8000*	.....	8000*
Chemical Precipitation	9500	.....	.....		.....
Ion-Permeable Membranes	235-315	100	.....	500	130

* = partial costs, for fuel or chemicals only

parts per million by weight of solids, in contrast with sea water, which has about 35,000 ppm of solids. Indeed, sewage is over 99.90 percent pure, which is purer than a well-advertised brand of soap. When discharged to the ocean and diluted in sea water, however, sewage is lost forever as a source of fresh water.

Sewage from most of the City and County of Los Angeles is now treated and discharged to the ocean at a total rate of about 550,000 AF per year. Including similar discharges from Ventura, Orange, and San Diego Counties, the total is about 700,000 AF per year, or about 35% of the water supplied. Ultimately, this proportion may reach 50%, or as much as 2,800,000 AF per year. Herein lies a potential source of fresh water to help meet the anticipated ultimate deficiency.

There is nothing new about the reclamation of waste waters. It occurs locally when drainage from thousands of cesspools helps to replenish the groundwater basins, or as inland sewage plants discharge to dry river beds or to percolation basins. It occurs along eastern rivers where each city in turn takes its water from the river and returns its sewage to be used by downstream communities. It occurs at the federal installation at Grand Canyon National Park where treated and reclaimed sewage is used for toilet flushing and at plush hotels in Las Vegas where treated sewage is used to irrigate the decorative vegetation. It occurs in Baltimore where the Bethlehem Steel Co. purchases much of the effluent from the city's Back River sewage treatment plant. It will continue to occur whenever reclaimed sewage is the cheapest source of additional fresh water.

Reclamation costs

The cost of water reclaimed from sewage is difficult to assess. Part of the cost is rightfully chargeable to waste disposal, for the sewage must be treated to a certain degree before it can be discharged inland or even to the ocean. The cost of additional treatment to render the sewage suitable for direct use by industry or agriculture, or to recharge ground-water basins, is chargeable to water supply. This additional cost will vary from about $10 per AF at large installations to $100 per AF at small installations, with median values of $20-35 per AF.

There are several obstacles to the early reclamation of sewage in southern California. At present, extensive reclamation is neither necessary nor economically advisable inasmuch as the Colorado River Aqueduct is not being used to capacity. Second, there are health hazards involved in the direct use of improperly treated sewage for irrigation. Until these hazards are overcome by effective procedures for disinfection, the State Health Department will continue to enforce rigid rules of precaution. Third, there is a natural reluctance on the part of the public knowingly to use reclaimed sewage, unless the merits of such use are carefully explained in a public-relations program. For this latter reason, it is probable that most reclamation will involve groundwater recharge rather than direct use, so that the sewage will lose its identity.

Even if sewage reclamation is carried to the utmost extent, it will still not provide sufficient additional water for the South Coastal Basin. Outfall sewers to the ocean will always be needed to discharge some sewage and much of the industrial wastes which are not amenable to treatment and reuse. These outfall sewers will be needed also as "bleed" valves to prevent an excessive build-up of salts from the recycling of groundwater. Consequently, additional water will be needed to augment present sources even with the reclamation of sewage.

Imported water

Twice before in its phenomenal growth, southern California has reached out to distant sources for supplemental water. It appears now that a third major aqueduct will be needed to bring more imported water to this region. Fortunately, California will not have to seek water from the Columbia River or other remote streams, for there are sufficient water resources within the state boundaries. Recent reports from the State Division of Water Resources indicate that the mean total run-off of California streams is about 70,000,000 AF per year. If only half of it is recovered and used, this annual volume will support 30 million people and three times the present irrigated agriculture. The problem, however, is to transfer water from northern regions of excess to southern areas of deficiency.

A plan for accomplishing this transfer has been developed by the State Engineer as part of a comprehensive California Water Plan. Known as the Feather River Project, it comprises (a) a dam and power plant on the Feather River near Oroville for flood control, low flow regulation, and power supply, (b) diversion and pumping of Sacramento River water from the delta region near Tracy, (c) a main canal along the west side of the San Joaquin Valley, through the San Bernardino Mountains, and past Hemet to the headwaters of the San Diego River, and (d) diversions to Santa Clara Co., Ventura Co., and Santa Barbara Co. Alternate routes are still being considered, but the most likely plan involves about 567 miles of aqueduct and a total lift of about 3500 ft., with some power recovery on this side of the mountains.

This plan will provide 1,773,000 AF per year of additional water of high quality to the regions south of the Tehachapi Mountains. The initial and ultimate costs of this water per AF have not been determined definitely as yet. Depending on methods of financing and periods of amortization, it appears that the cost will be $40 to $60 per AF.

There is no danger of an acute overall water shortage in southern California during the next 20-30 years, owing to the far-sightedness of the engineers who conceived the Metropolitan Water District. Ultimately, however, the total water requirements for the South Coastal Basin will

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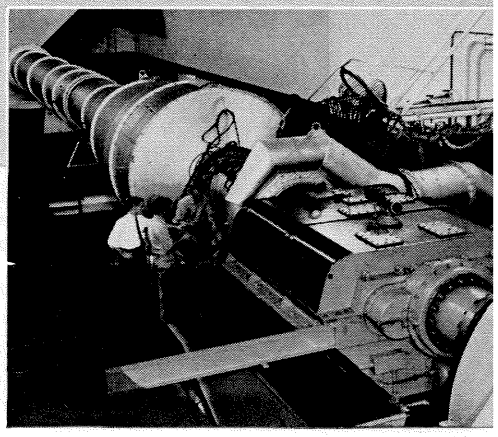


J-57 POWERED AIRCRAFT

MILITARY

F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135

COMMERCIAL

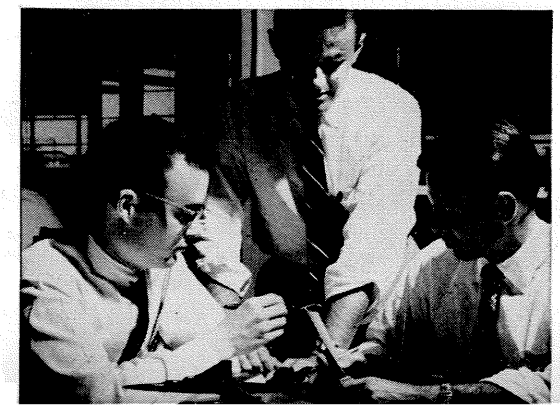
Boeing 707

Douglas DC-8

MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribute their specialized skills to the analysis and development of controls, systems and special instrumentation. An example is the "Plottomat" which automatically integrates and plots pressures, temperatures and air angles in performance testing.



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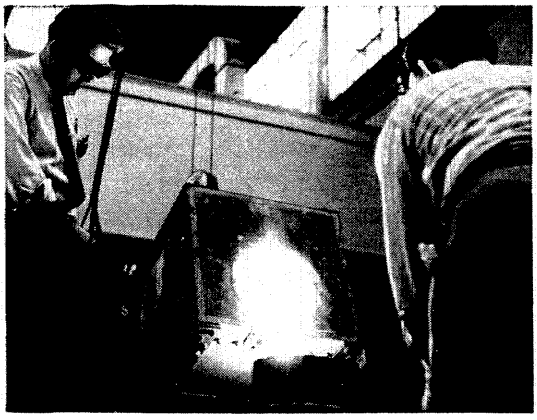
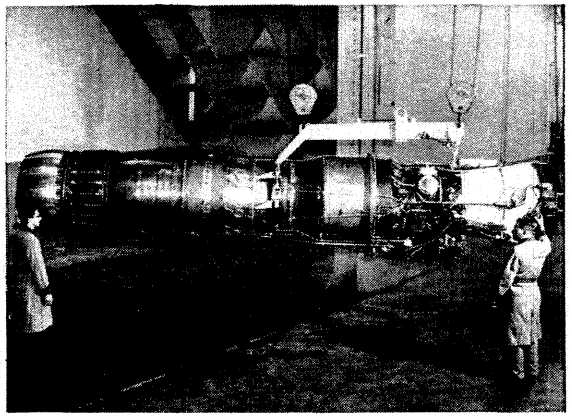
CHEMICAL ENGINEERS, too, play an important role. They investigate the chemical aspects of heat-producing and heat-transferring materials. This includes the determination of phase and equilibrium diagrams and extensive analytical studies.



METALLURGISTS investigate and develop high temperature materials to provide greater strength at elevated temperatures and higher strength-weight ratios. Development of superior materials with greater corrosion resistance is of major importance, especially in nuclear reactors.



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APPROXIMATE COSTS OF WATER SUPPLIES FOR SOUTH COASTAL BASIN

(in dollars per acre foot, including amortization)

Local Runoff and Ground Water	$ 3.00 - 10.00
Owens Aqueduct	19.00
Colorado River Aqueduct	35.00 - 45.00
Reclaimed Water (estimated)	20.00 - 35.00
Feather River Project (estimated)	40.00 - 60.00
Salt Water Conversion (estimated)	125.00 - 200.00

be more than twice the available supply from local resources and present aqueducts. Part of this deficiency can be met by the reclamation and reutilization of waste waters, but an additional source of new fresh water is needed. The cost data shown in the table above indicate that the Feather River Project is the logical answer to this problem. The desalting of sea water does not appear to be economically feasible for this region, barring a miracle of thermodynamics or a cheap source of power.

Although no critical water shortage looms for the next few decades, engineers and scientists cannot neglect planning and research to meet the inevitable problem. About 20 years were required from the initiation of the MWD until the first Colorado River water reached southern California. A similar period or longer may be necessary to secure additional water from the Sacramento Basin. In the meantime, the active program of research and development to improve methods of salt water conversion should be encouraged. More important, perhaps, investigations must be accelerated to find cheaper, safer and more efficient ways to reclaim and reutilize sewage and other wastes.

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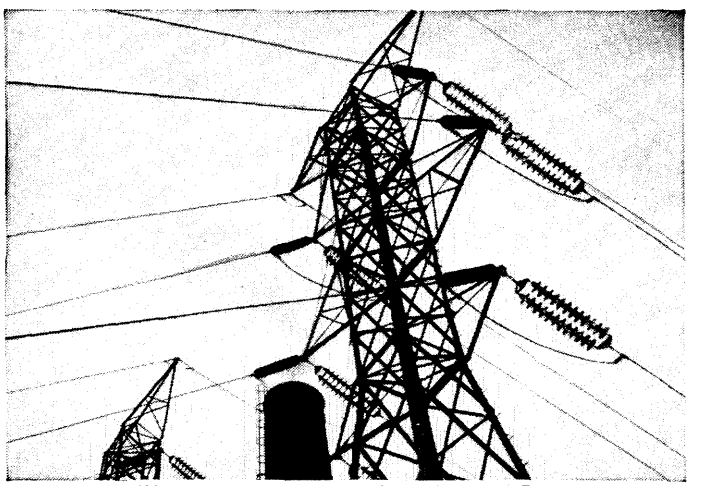

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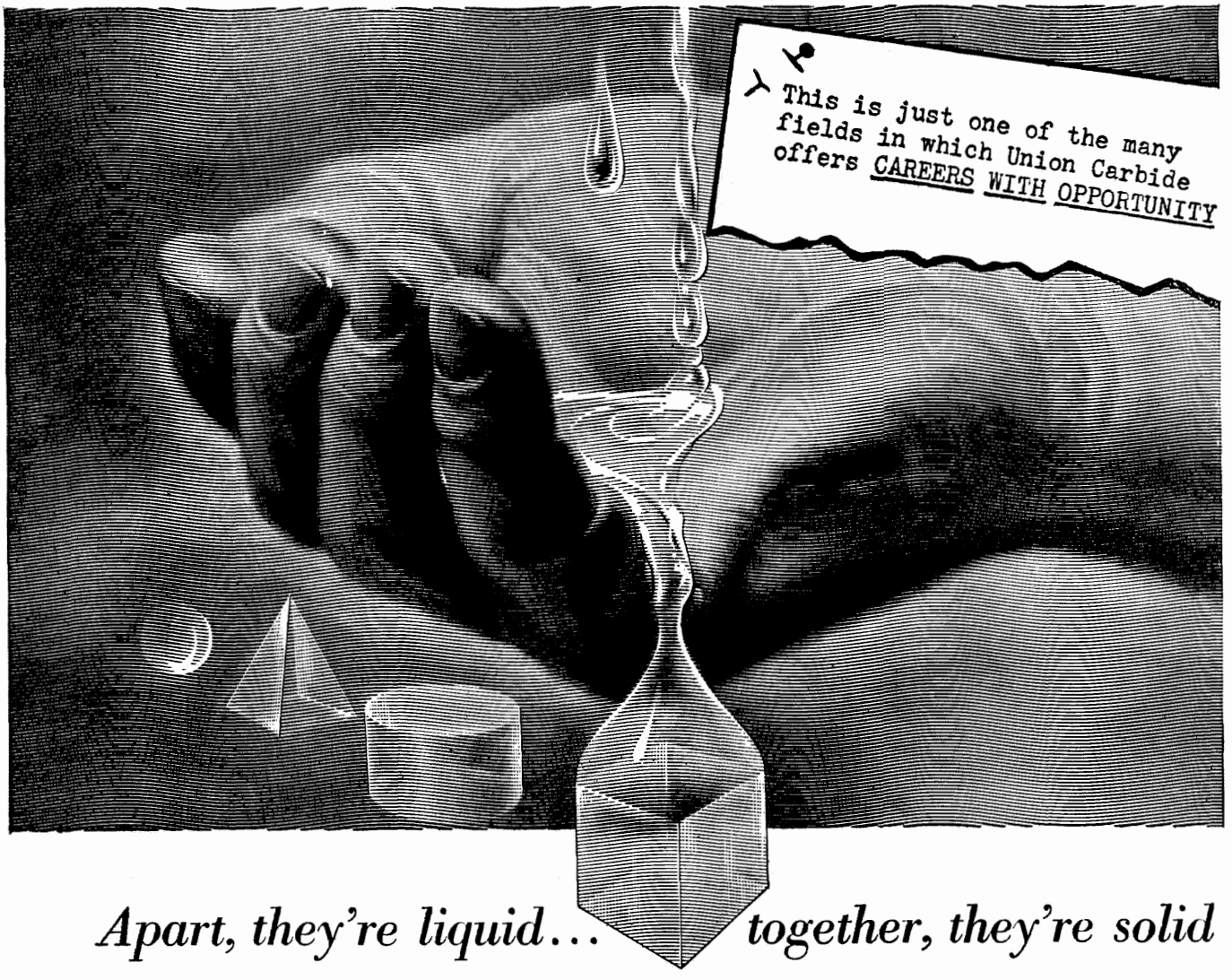

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WHAT'S NEW ABOUT THE NEW CARS

by PETER KYROPOULOS

AFTER SPENDING ANOTHER SUMMER in Detroit I have summarized the local gossip concerning the new models. Allowing for the fact that, even after copious draughts of Scotch, people don't tell me everything they know, and allowing also for the fact that I don't tell everything I find out, here is the story for what it is worth:

New models will be out sooner this year. Lincoln was announced in September. The tentative dates for other cars are as follows:

Ford: September, October, November
G.M.: Chevrolet, October (?); others, November
Chrysler: November
American Motors: Nash and Hudson, November; Rambler, December
Studebaker-Packard: October

Nothing very dramatic seems to be in the offing, except the dealers' hassel to sell about 1.5 million 1955 cars before the new models are out.

Except for Lincoln and Rambler and the Continental, which have new bodies, only face-lifting is expected. Colors are supposed to be toned down and two-tones will now be the upper limit.

One leading stylist gave me this as the safe rule for styling in general: "If you can't make it look good, make it look like Cadillac." The tailpipe-in-bumper is perhaps the least fortunate example of this practice. Aside from this, however, I could name a few cars that would do well to put in a little more of Cadillac and a little less of their own haphazard styling.

There will be some new four-door hardtops and there is talk of retractable hardtops.

Experiments are being made with body trim other than chrome and stainless. Anodized aluminum die castings are being used. There is an atrocious-looking Plymouth running around Detroit with bright copper instead of chrome.

General emphasis on safety will be reflected in the widespread offering of safety belts. Chevrolet has already announced that they will make seat and shoulder belts available.

The '56 engines will have more power, and in one instance a greater displacement. Compression ratios will go up also.

Everybody is working on fuel injection, not because it offers any striking advantages, but because it is different. So far it is a struggle to make the injection system break even with a good carburetor. The systems under development use manifold injection. Mercedes SL 300 is still the only cylinder injector engine. A V-6 is talked about, but not for '56. It also has essentially the merit of being a novelty.

Gas turbines will not appear except in experimental cars.

Transmission selector levers on Chrysler and Packard are supposed to be replaced by buttons.

A new and smoother hydramatic is in the mill and will be available soon.

Interest in a variety of novelty suspension systems is very lively but specific plans are hard to pin down. There is much experimentation. Packard's torsion bar suspension will be put into more Packards, but did not start a stampede for Packards in '55.

Power accessories are growing in popularity and are making an excellent service record for themselves.

Air conditioning is getting to be quite the thing. System size and efficiency has been materially improved in '55 (e.g. Chevrolet) and will lead to further increases next year.

The dressed-up station wagon, led by the Chevrolet Nomad, has proven very popular, and sportier and more elaborate versions will be offered in various lines.

The year '57, rather than '56, should bring quite a few major body changes as well as some other advances in engineering details.

Dr. Kyropoulos, Professor of Mechanical Engineering, was in Detroit this summer as consultant for the Automotive Engines Department, Research Laboratories Division, General Motors Corporation.

A Campus-to-Career Case History

Emmett Smith, E.E., '50, supervises operation of the training switchboard which he originally helped to design.

"I Didn't Know There Was Such a Job"

"Communications have always been one of my main interests—in the Navy and at the University of Michigan. So I was very happy when the Michigan Bell Telephone Company invited me to visit their headquarters to talk about a job.

"In Detroit I had a chance to look at a number of departments, including one I'd never heard of before, the Traffic Department. I found that, in addition to the engineering of switchboards, it involved the supervision and handling of calls. *It struck me like a wonderful opportunity to combine staff engineering and field management.*

"My first impression was right, too, because my work covered both. First, I had on-the-job training assignments in several different kinds of offices —local, Long Distance, dial and manual. Then I worked in engineering, translating estimates of future growth into the actual number of circuits and switchboard positions required.

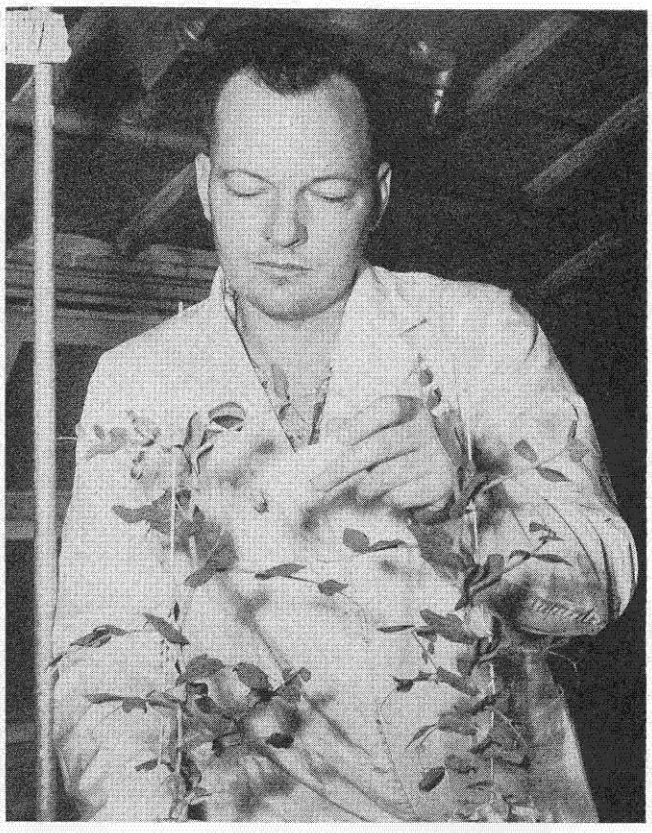
"Now I'm supervising the operation of one of the boards I helped engineer. Briefly my job is to see that my district gets the kind of equipment it needs and that what we have is working properly. Another major part of my job is advising the supervisors of the Long Distance operators. I like this because it means working with people, too.

"Needless to say, I'm happy with my job. A job I didn't even know existed."

Emmett Smith's job is with a Bell Telephone Company. There are similar opportunities for engineers with Bell Telephone Laboratories, Western Electric and Sandia Corporation.

BELL TELEPHONE SYSTEM

McCallum Fellow Elizabeth Betani is Caltech's first woman graduate student in biology.



James Liverman, another of Caltech's McCallum Fellows, now teaches plant biochemistry at Texas A & M.

FAMILY ALBUM

An informal report on some of the biology students whose graduate work has been financed by the Arthur McCallum Fellowship and Scholarship program.

WHEN A CANDIDATE for a PhD degree submits his doctoral thesis, he customarily includes a page of acknowledgements—to the professor who supervised his research, to other colleagues, and (if he has one) to his wife, for sitting home alone night after night while he has worked at the laboratory.

In addition to these expressions of gratitude, many PhDs in biology at Caltech also append a note of thanks "for the Arthur McCallum Fellowship, without which it would not have been possible to continue my graduate education."

These Fellowships were established in 1950, at the suggestion of C. G. King of the Nutrition Foundation, by the late Arthur McCallum of New Brunswick, N.J., and Mrs. McCallum, who now lives in Riverside, California.

Almost a quarter of a million dollars has been contributed to the McCallum Fellowship and Scholarship Fund. From it, individual Fellows have received up to $2500 annually—for subsistence, tuition, and research supplies.

Other graduate students have received summer scholarships of $300 each, primarily to sustain their research during the "fourth quarter" of the year. This is the season when tuition grants and other means of support dry up, leaving a student stranded—unless he has a wife who is not only willing to sit home nights but who also

has a paying job good enough to support both of them.

To the great majority of the graduate students in biology, therefore, the McCallum scholarships make possible a full-time continuation of thesis research during the summer months.

From the outset of the McCallum Fellowship and Scholarship program, there has been a pleasant personal relationship between the McCallums and the young men who have been recipients of their help.

One of Mrs. McCallum's favorite Christmas gifts, last year, was a fat bundle of 30 letters bringing season's greetings from former McCallum Fellows or Scholars—letters bearing Austrailian, French, English and South American as well as U.S. postmarks.

Now back in Australia, for example, is Bruce Holloway, who came 9000 miles from his native Adelaide to study the genetics of fungi. A recent letter to Mrs. McCallum reports that he is now doing research on microbial genetics and teaching at Canberra with the Commonwealth Scientific and Industrial Research Organization.

Another regular correspondent is Ohio-born Dale Kaiser, now continuing his studies on the genetics of viruses at the Pasteur Institute in Paris. With him is his wife, the former Mary Durrell, whom he met when she was a lab assistant at Kerckhoff, and their small daughter Jennifer.

Mary writes that Dale's French is steadily improving, but that he has given up wearing a beret until he speaks the language better. It has been too embarrassing for him to try to give street directions to native Frenchmen—and, somehow, it's only when he's wearing the beret that he gets approached for advice.

Roy Sachs, whose graduate work in plant physiology concluded in June, is now in Italy with his wife, the former Marilyn Murphy, whose experience in the comptroller's office at Caltech is proving useful in handling Fulbright Fellowship grant funds.

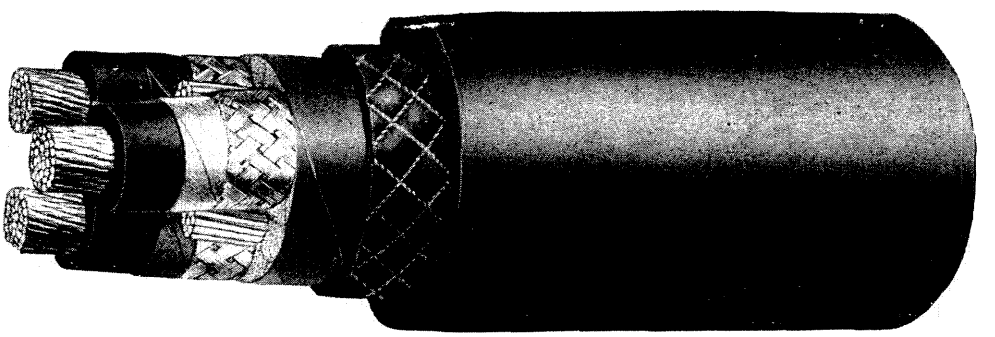
(Caltech not only educates them; it finds wives for them, too.)

Also in the McCallum "family album" are snapshots of Norman Good, who is back in Canada after two years of postdoctoral research training in England; plant physiologist Howard Burroughs, now in Hawaii; and Jose Reissig, native Argentinian, who is studying chemical genetics in Scotland.

Among the 33 PhD theses by McCallum Fellows or scholarship recipients, many have titles that might seem pretty esoteric to the uninitiated.

For example, Colorado-born Glenn Fischer, now in Puerto Rico, reported on *Genetic and Biochemical Studies of the Cysteine-Methionine Series of Mutants in Neurospora crassa*—not so academic a study as one might think, for the metabolic processes Fischer studied

CRESCENT BUILDS FOR THE FUTURE



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At Azusa and Sacramento, California, Aerojet is in the process of expanding its research, testing and manufacturing facilities to keep pace with the constant advance in the rocket engine and guided missile field. The diversification of projects, both government and civilian, insures you of not just a job but of intriguing and varied activity in an organization that is a leader in a highly interesting field. Aerojet-General represents an outstanding opportunity for a man who has his eye on the future — a challenging and productive future — a challenging and productive future in rocket power.

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A Subsidiary of the General Tire & Rubber Co. — THE GENERAL TIRE — Positions available at Azusa or Sacramento Facilities

MORE POWER FOR AIR POWER

in bread mold are essentially the same in humans.

Harold McRae, a native of Vancouver, B.C., now working for the large drug manufacturer Rohm & Haas, was awarded his PhD degree on the basis of research which culminated in *Studies on the Kinetics of Auxin-Induced Growth.* The weed killers and other chemicals responsible for revolutionary advances in agriculture are related to plant auxins (hormones), and studies like McRae's tell us how they work.

From Africa to Arthopods

Sherman Ripley, another McCallum Fellow, journeyed 10,000 miles from his native South Africa to study the neuro-muscular physiology of arthopods at Caltech and is now back in the Union of South Africa--at the University of Natal in Durban.

In addition to remembering his records amplifying the sound of the wing beats of a house fly, the Biology Division remembers Sherman as the expert mountain climber who paced Professor Beadle at breakneck speed up the east face of Mt. Whitney and back to Pasadena in two days, travel time included.

New Yorker Henry Gershowitz is another well-remembered McCallum Fellow. His research on the heredity of blood groups culminated in *Immunogenetic Studies of the Pigeon, Columba livia.*

Henry kept as many as 200 pigeons in a large air-conditioned room in the animal annex at Kerckhoff, each bird banded to indicate his pedigree. His daily exercise consisted of chasing a swirling mass of pigeons, butterfly net held high, whenever he needed a blood sample from a particular bird.

On Henry's departure for the University of Washington, his pigeons vanished, too. Shortly thereafter, pigeon breasts, at five cents each, were discreetly offered to Kerckhoff workers. One biologist's wife, on obtaining six for a family dinner, complained that in spite of all her culinary skill, they tasted (and cut) like leather. This was due, no doubt, to Henry's vigorous daily pursuit of his thesis material.

Future Fellows

As time goes on, the work of McCallum Fellows and Scholars will be extended to cover all the biological sciences. The program is now permanently and generously endowed, and will provide for scholarships and fellowships for undergraduate and postdoctoral workers, as well as graduate students.

And although Arthur McCallum's name will be perpetuated in the McCallum Conference Room at the new Norman W. Church Laboratory of Chemical Biology, his greater memorial is in the financial assistance and encouragement given to so many promising young scientists.

RCA's New Orthophonic High Fidelity Sound Opens a New World of Music

From Ceylon to Chile, people of the world can now enjoy a wonderful new kind of recorded music.

This is made possible by RCA's development of New Orthophonic Sound that weds the beautiful tone of RCA Victor records with the superb performance of new high fidelity "Victrola" phonographs. Born of RCA's acoustical and electronic research, New Orthophonic Sound reproduces a noticeably wider range of sound frequencies, perfectly balanced for musical realism.

The experience and skill behind this achievement are inherent in all RCA products and services. And continually, RCA scientists at the David Sarnoff Research Center in Princeton, N. J., are working toward new thresholds of "Electronics for Living" — electronics that make life easier, safer, happier.

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RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

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HOW DO YOU LIKE YOUR JOB?

A reminder that Caltech's Alumni Placement Service can help you do something about it

by DONALD S. CLARK
Director of Placements

TWENTY YEARS AGO a placement service was established at Caltech, under the joint auspices of the Institute and the Alumni Association, aimed primarily at assisting alumni when a new job was necessary or desirable. It has always been called the Alumni Placement Service, though it has for many years included both students and alumni in its activities.

In time, the Placement Service became a fair-sized operation, requiring funds that were considerably above the resources of the Alumni Association. Today it is completely supported by the Institute, and through a small amount contributed by alumni receiving employment through the service. The staff consists of a Director, who is a member of the faculty; an Assistant to the Director, who is employed full-time to administer the detail work of the office; and three office assistants.

A placement service in any college or university has four areas of activities: (1) placement of students in part-time work while attending school; (2) placement of students in summer work between academic sessions; (3) placement of students receiving degrees in their first full-time positions; (4) placement of alumni in new positions.

The first of these services has been very helpful to Caltech students in financing their way through school, even though they are limited to 10 or 12 hours a week because of the heavy academic load here.

Greater effort is being devoted each year to helping students find summer work, which is valuable not only for the financial assistance but for the experience. Alumni could assist in this program by notifying the Placement Service of openings in their organizations during the summer months.

The placement of students receiving degrees is a good-sized job, for it entails interviews by many large organizations on campus. In 1954-55, exactly 120 different organizations visited Caltech and interviewed 209 men who were receiving degrees and 211 men who were looking for summer jobs. These interviews took up 165 working days and involved 2,437 appointments.

The placement of alumni is really one of the most important functions of any placement service—but the assistance we can offer alumni here at Caltech is not being utilized to its fullest extent.

The placement of alumni involves a matching procedure—matching the qualifications of the man with the job. An alumnus advises the Placement Service that he is considering a change of position. He is asked to fill in an application form which will supply information about his qualifications and interests. The man is then listed under each type of employment in which he indicates interest, and after this listing a search is made in each of these fields for job openings that have been given to the Placement Service by organizations. The man is then notified of the openings for which he is qualified.

A similar system is employed when a request is received from an employer—*but* when the Placement Service has on file the applications of only about ten or fifteen men, the probability of finding a Tech graduate for that opening is very small. The fact is that, in the year 1954-55, there were 1162 requests for 2453 Caltech alumni—but only 109 alumni registered with the Service during the year. The placement record—i.e., the number of men placed on jobs—was not particularly good, of course, because the men did not match the jobs.

How can this condition be improved?

Men who are thinking about changing jobs seem to be reluctant to register with the Placement Service. Some of these men realize that they have reached a block to further advancement in their present jobs. Others believe that a different position might give them a better salary and a greater chance for advancement. Most of these men do not take any active steps to survey the field. One of the easiest ways of making this survey is to register with the Placement Service.

At present, with the small number of applicants, the Placement Service is reduced to contacting members of the Caltech faculty to get the names of men who might be interested in a particular opening. Such procedure means complete dependence upon memory, and is neither orderly nor effective.

Probably a most satisfactory method would be to have an IBM card on every alumnus. With the proper information on the cards, it would be possible to pull cards on those men who meet the requirements of each job opening. However, a system of this character involves an expensive operation that seems to be greater than the operating funds available. The next best thing is to have more registrants.

The Howard Hughes Fellowships

IN SCIENCE AND ENGINEERING

Eligible for these Fellowships are those who have completed one year of graduate study in physics or engineering. Successful candidates must qualify for graduate standing at the California Institute of Technology for study toward the degree of Doctor of Philosophy or post-doctoral work. Fellows may pursue graduate research in the fields of physics or engineering. During summers they will work full time in the Hughes Laboratories in association with scientists and engineers in their fields.

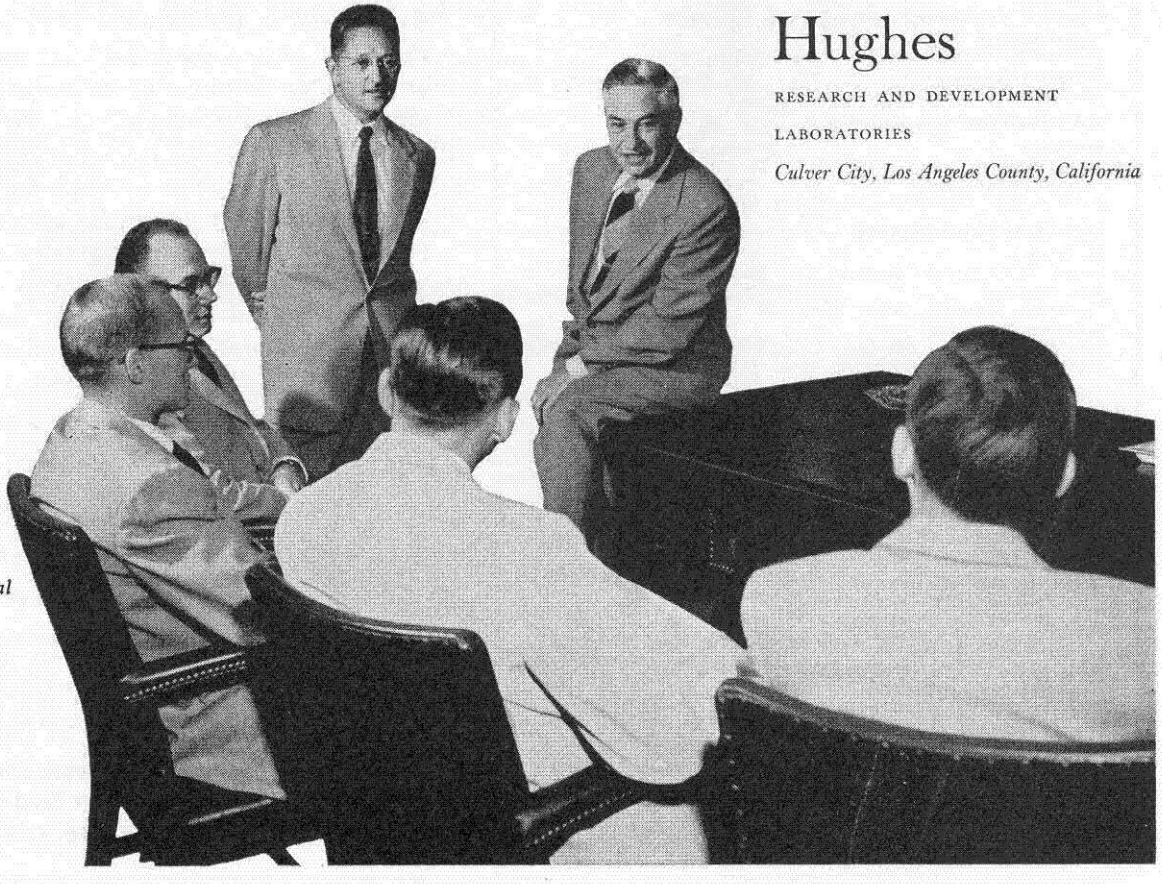
Each appointment is for twelve months and provides a cash award of not less than $2,000, a salary of not less than $2,500, and $1,500 for tuition and research expenses. A suitable adjustment is made when financial responsibilities of the Fellow might otherwise preclude participation in the program. For those coming from outside the Southern California area provision is made for moving and transportation expenses.

FOR APPLICATION FORMS AND COMPLETE INFORMATION, ADDRESS CORRESPONDENCE TO THE HOWARD HUGHES FELLOWSHIP COMMITTEE, OFFICE OF SCIENTIFIC STAFF RELATIONS,

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

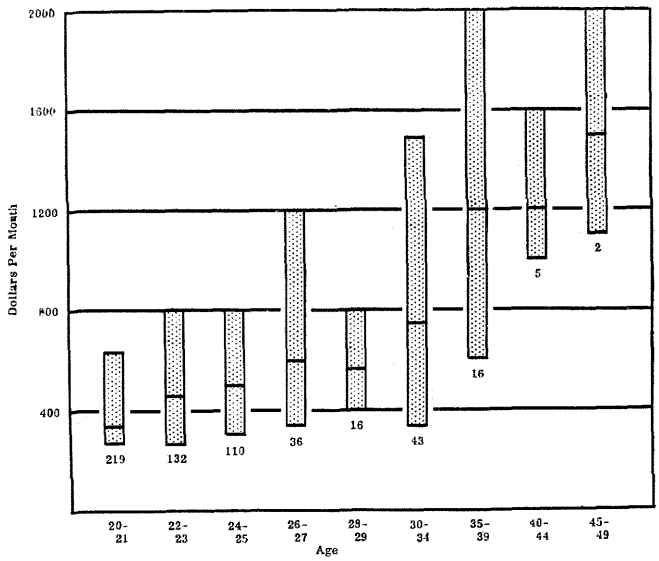
Culver City, Los Angeles County, California



Dr. Lee A. DuBridge, President, California Institute of Technology (center), welcomes several recipients of the Howard Hughes Fellowships. Dr. A. V. Haeff, Vice-President, Director, Hughes Research Laboratories (standing), is Chairman of the Fellowship Committee.

The Placement Service gets a great number of requests for men with a minimum of experience, but some very choice positions become available for older, more experienced men. In many instances the salary is not specified, but is dependent upon the qualifications of the applicant. In some cases a minimum salary is given. The minimum, median, and maximum of minimum salary specified on 579 job orders where the BS degree was required are shown for the year 1954-55 on the accompanying graph as a function of age. A look at the graph will show that positions with quite suitable salaries have been available.

It should be apparent by now that to make the alumni portion of the placement activities more effective at Caltech, more applicants are needed. There is no reason for alumni to consider the Placement Service as the place of last resort when a job is needed. There is no reason for alumni to feel that it is beneath their dignity



Minimum, median, and maximum of minimum salary specified on job orders where a BS degree is required.

to file with a placement service. It doesn't cost anything to file an application, and there is every possibility that some good might come of it. (Though there is no fee connected with the placement operations, it has been customary for anyone obtaining employment through the efforts of the Placement Service to contribute 10 percent of his first month's salary to the Institute for support of the service. Such a contribution is completely voluntary.)

What about participating in the work of the Caltech Placement Service? If an alumnus is an employer, he should send in his requests: if he is thinking about a change of job, or wondering what opportunities may be available, he should send for an application form. All information is confidential, and the present employer will not know that the market is being surveyed. There have been several cases in which the applicant decided, after surveying the market for several months, that the present employment had the greatest opportunity for advancement and recognition.

Comments and suggestions on the operation of the Caltech Placement Service are solicited. Address your comments and questions to the Director of Placements.

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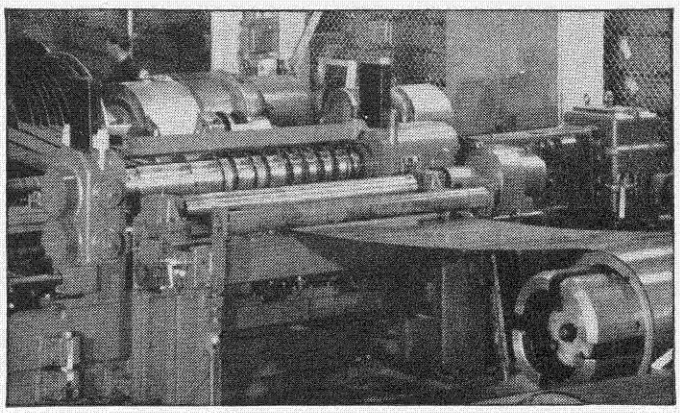
Another page for **YOUR BEARING NOTEBOOK**

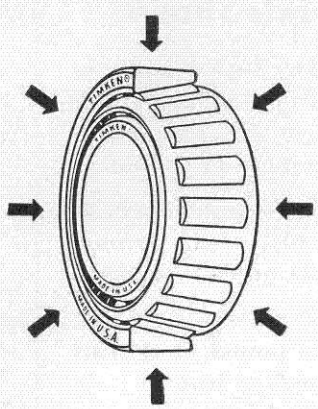
How to keep cutters aligned on high-speed coil slitter



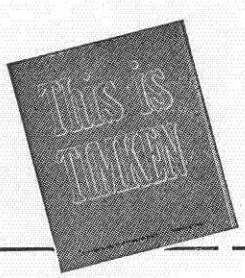
Company engineers had the problem of keeping the cutters on this Stamco Coil Slitter operating accurately at high speeds. It meant keeping them in rigid, positive alignment. To take the heavy combination of radial and thrust loads required, they specified mounting the cutter arbors on Timken® tapered roller bearings.

Tapered design lets Timken® bearings take both radial and thrust loads

Because of their tapered design, Timken bearings can take radial or thrust loads or any combination. And because the load is carried along a full line of contact between rollers and races, Timken bearings have extra load-carrying capacity.



Want to learn more about bearings or job opportunities?



Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This is Timken". The Timken Roller Bearing Company, Canton 6, O.

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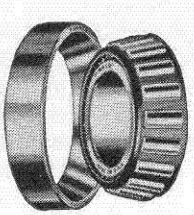

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃
BEARING TAKES RADIAL ⊕ AND THRUST —⊕— LOADS OR ANY COMBINATION

the challenge ahead

Industry's demand for lower costs of manufacture offers a promising future to the progressive-minded engineering graduate.

The machine designer who knows how to utilize materials to best advantage will find great demand for his services. That's because the cost of material constitutes a good share of the ultimate cost of a product.

An efficient machine design is one that utilizes the fewest pounds of the least expensive metal that will give required service life.

A basic comparison of materials shows:

1. Steel is 2 to 3 times stronger than gray iron. Only one-third the amount of metal is needed for equal strength in tension.

2. Steel is 2½ times as rigid as iron. Only 40% of the amount of material is needed for equal rigidity.

3. Pound for pound, steel costs a third as much as iron.

As a result, when steel is used to its best advantage, the cost of material amounts to approximately 15% of the cost of iron required for equal rigidity. (40% x ⅓)

The large initial saving in material cost provides a wide margin in which to fabricate the steel and still realize a substantial savings in overall cost.

Engineering students wishing to keep abreast of rapid developments in design may obtain literature on application of welded steel by writing:

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PERSONALS

1924

Edward E. Dorresten, who attended Caltech for several years with the class of '24 before transferring to Stanford, died last July. His entire professional career had been in the field of petroleum refining and chemical plant engineering, and at the time of his death Ed was a vice-president of the Bechtel Corporation, responsible for the company's petroleum and chemical activities.

1926

Robert B. Bowman spent the month of August vacationing in eastern Quebec, Nova Scotia, Newfoundland, and points in between. Bob is an associate director of the California Research Corporation in San Francisco, and is a frequent visitor to southern California in connection with the operation of the company's laboratory at La Habra.

1927

Ralph M. Watson, MS '28, recently accepted appointments as Associate Dean of the L. C. Smith College of Engineering and as Chairman of the Department of Mechanical Engineering at Syracuse University, N.Y. Ralph had been serving as Director of Research for the Worthington Corporation of Harrison, New Jersey —having been associated with that company for the past 19 years.

1928

John W. Thatcher, MS '30, has joined the ElectroData Corporation of Pasadena as Customer Service Manager, heading a department of computer engineers and technicians, responsible for installation and maintenance of "Datatron" high-speed electronic data processing machines. John was previously employed as an engineer with Western Electric, where he worked for 15 years.

1929

Leslie O. Scott, who was just retired as an Army Engineer Colonel, has stepped into another active career, operating his own engineering equipment distributing companies — Valesco, Inc. and Air-Floor Sales & Engineering. Family-man Scott writes: "I have a beautiful wife and three children—David, 14, Christopher, 9, and Heidi, 6."

James W. Dunham was sent to Pakistan last year by the Point Four Program to serve as an advisor on the engineering of a new government fishing harbor. From Karachi, where the harbor is being constructed, Jim reports: "Am now on the last 6 months of my two-year hitch over here with the U. S. Foreign Operations Administration, under a contract with the Ralph M. Parsons Co.

"The fish harbor that I came here to advise on as my primary assignment finally got under way last week after 18 months of wrangling over the site location and over which agency of the Pakistan government would do the work. One either learns the patience of the Orient in these parts or becomes a patient in a psychopathic ward."

1931

Glenn M. Webb has been named director of the hydrocarbon research division of the Standard Oil Company of Indiana. He joined the organization in 1948.

1932

Patrick B. Lyons, who has been with the Western Electric Company since 1942 was recently made superintendent of the company's Chatham Road Shops at Winston-Salem, North Carolina.

1934

Edward B. Doll, MS '35, PhD '38, has joined the staff of the Ramo-Wooldridge Corporation, Los Angeles, as Director of the Project Control Staff, Guided Missile Research Division. Ed has had long experience in the electronics and instrumentation fields, and was technical director for two major special weapons programs for the Army Air Force. Last February he was director of the military effects group at the atomic tests held in Nevada.

1936

Clarence L. Dunn, PhD, was sent to the Netherlands in July on a one-year assignment by the Shell Development Company's Research Center at Emeryville, California. He is head of the physical chemistry department at Emeryville.

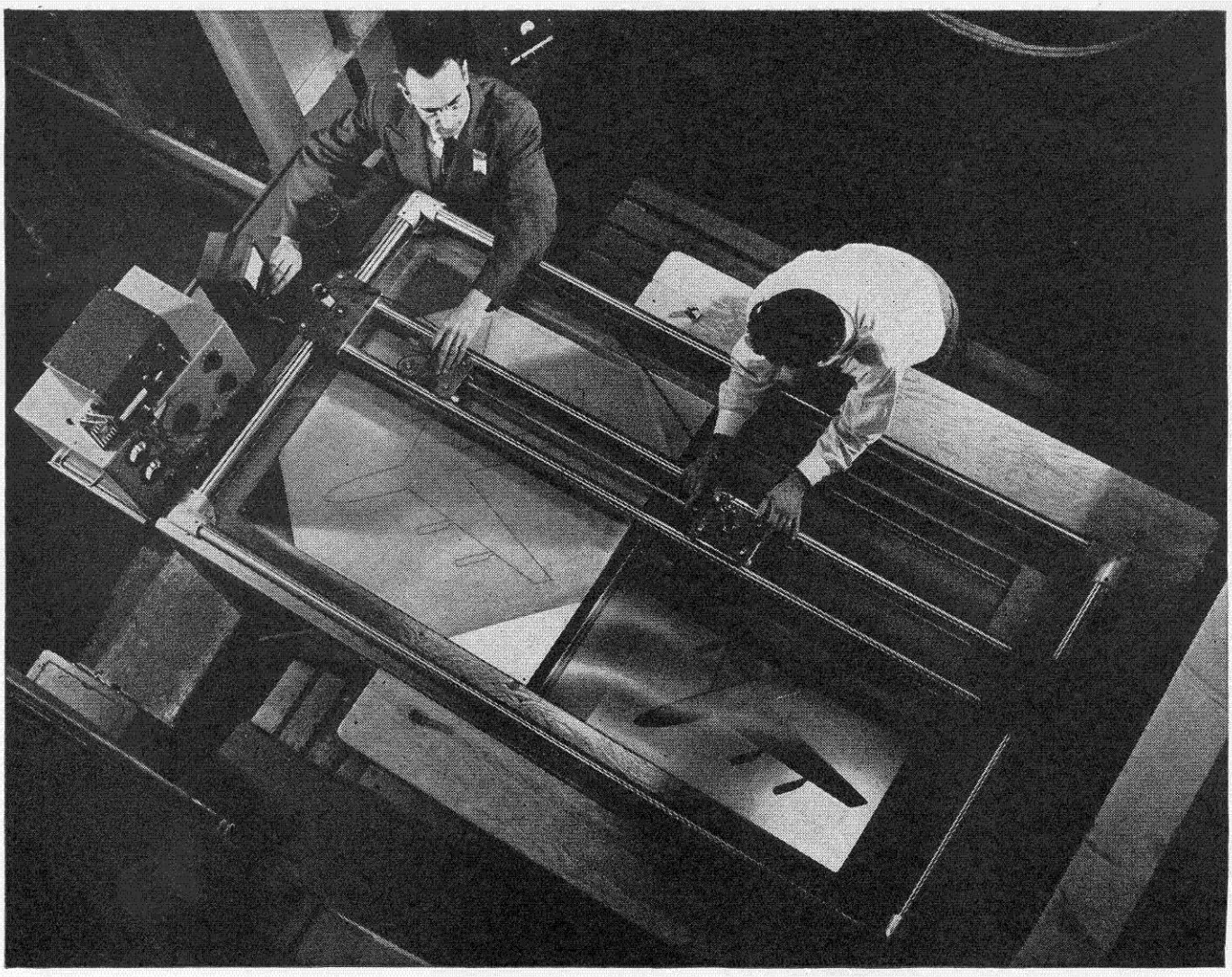
Meral W. Hinshaw is president of his own company, Diamond Tool Associates, in Hawthorne, California. "Started a year ago, and going strong!" Meral writes.

1937

Walton A. Wickett, married after long years of lively bachelorhood, writes: "Married on February 5, 1955, to Hiltgund Tekusch Vorsteher, a Viennese who, passing through the United States en route to India, was side-tracked by English literature at the University of California and the writer, (who interrupted her transit at that institution's Faculty Club). We are home owners in Atherton . . . I teach physics and mathematics at the Menlo School and College, Menlo Park, California."

1938

J. Kneeland Nunan, MS, has been named vice-president and staff adviser to the president of the Consolidated Engineering Corporation in Pasadena. He will act as special adviser to President Phillip Fogg on company policy matters relating to management, marketing, and public relations. Succeeding Kneeland as president of Consolidated's subsidiary, the Consolidated Vacuum Corporation of Rochester, N.Y., is another Caltech grad, *Hugh*



Boeing engineers are kept free for creative assignments

Thanks to draftsmen and engineering aides, Boeing engineers are free to handle stimulating projects like this: determining antenna properties in an electrolytic tank. Results taken with the three-dimensional plotter will influence the configuration of "years-ahead" Boeing airplanes and guided missiles now in the design stage.

At Boeing, engineers have the same relationship to draftsmen and engineering aides that doctors have to technicians and laboratory assistants. The abilities of a Boeing engineer are fully utilized: in investigating heat, compressibility and other problems of supersonic flight; in jet, ram-jet, rocket and nuclear power; in electronic control of missiles, and much more—calling for a variety of skills in all the engineering fields.

This electrolytic tank is one example of the superb equipment at Boeing engineers' disposal. Other facilities include the world's most versatile privately owned wind tunnel, a new tunnel under construction, capable of velocities up to Mach 4, the latest electronic computers, and splendidly equipped laboratory and test equipment in the new multi-million-dollar Flight Test Center.

Achievements of each Boeing engineer are recognized by regular, individual merit reviews, and by promotions from within the organization. Boeing offers exceptional career stability and growth: this soundly expanding company now employs more than twice as many engineers as at the peak of World War II.

Of technical graduates at Boeing, 30% are mechanical engineers, 24% electrical, 19% aeronautical and 9% civil engineers. The remainder are chemical, metallurgical, and other kinds of engineers, and physicists and mathematicians with advanced degrees.

In planning for your professional career, look to Boeing for a truly creative job. Begin now to prepare for a place on one of Boeing's engineering teams in design, research or production.

For further Boeing career information consult your Placement Office or write:

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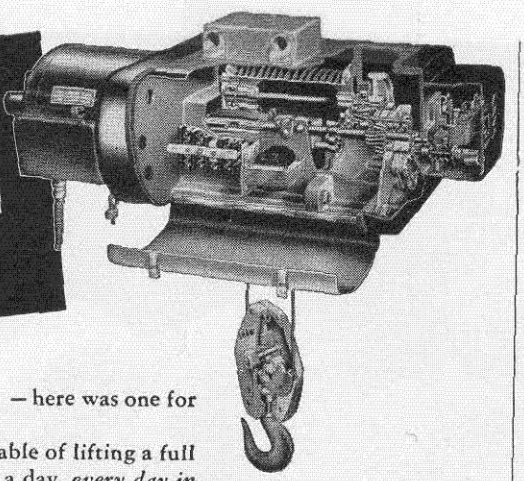

Keeping the "kinks" out of an "industrial muscle"!

Talk about engineering "brainteasers" — here was one for the books!

Design a one-ton capacity hoist capable of lifting a full load thirty feet a minute, three shifts a day, *every day in the year.* Make certain that the power you require will be concentrated on lifting and not shared in overcoming friction. Be sure, too, to provide for smooth, steady performance with a minimum of maintenance. This was the problem facing Manning, Maxwell & Moore's team of electric hoist designers. They solved a big part of it by installing dependable, Fafnir Ball Bearings at every possible source of friction — on the rope drum, trolley assembly, gear shafts, and other critical turning points.

The ready availability of precision anti-friction ball bearings for all types of industrial machinery is but one of many reasons why more and more engineers specify Fafnir for every bearing need. The Fafnir Bearing Company, New Britain, Connecticut.

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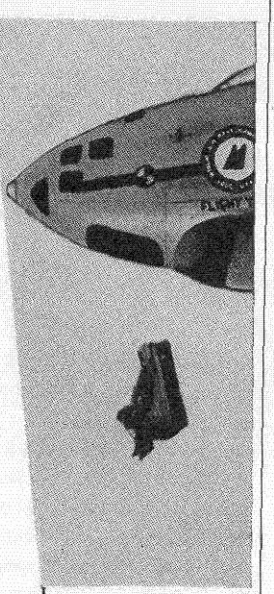

Stanley Downward Ejection Seat

Contact Personnel Director, Stanley Aviation Corp., Buffalo 25 or Denver 8

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Personals . . . CONTINUED

F. Colvin, '36. Hugh, *who is also vice*-president and general manager of Consolidated, will continue to make his home *in Pasadena, commuting to Rochester* when necessary.

Newman A. Hall, PhD, who has been at *the University of Minnesota since* 1947, and where he was serving most recently as Professor of Mechanical Engineering, *has accepted a position as Assistant Dean* in charge of the Graduate Division of the College of Engineering of New York University. *Newman, his wife, and* two children, are now making their home in New Hartford, Connecticut.

1939

Fred Hoff has completed the MBA course at the Harvard Graduate School of Business Administration, and is now chief engineer of Basic Vegetable Products, Inc., a vegetable dehydrating company in Vacaville, California.

1940

Clark W. Gould, MS, PhD '42, has been appointed a research associate in the analytical chemistry unit at the General Electric Research Laboratory in Schenectady, N.Y. He was previously a research associate in the General Aniline and Film Corporation at Easton, Pennsylvania.

1941

Gilbert A. Jones has two major events to report. First, the birth of a daughter, Carol Elizabeth, last February, and secondly, receipt of his MS in EE from USC in June. Gil has been working for the Metropolitan Water District in Los Angeles for the past two years.

Bill Schuberg, Commander, U S N, received his MBA from the Harvard Graduate School of Business Administration, and is now on duty as a technical officer at Point Mugu, California.

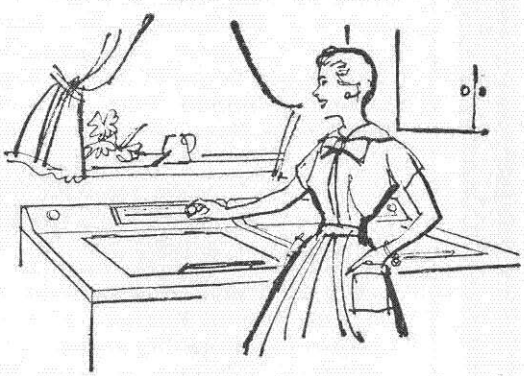
1942

Carol Veronda has been transferred to Gainesville, Florida, by the Sperry-Rand Corporation, to head the Engineering Development Department of Sperry's new microwave tube plant. Carol likes Florida fine so far, but is reserving final judgment until he sees what takes the place of smog there. The Verondas have two sons; Bill, 9, and Chris, 3.

1944

Knox Millsaps, PhD, will be a visiting professor in mechanical engineering for the 1955-56 academic year at MIT. Since 1947 Knox has held faculty positions at Ohio State University in aeronautical engineering, and at Alabama Polytechnic Institute in physics. Most recently he has been chief of the Applied Mathematics Research Branch at the Wright Air Development Center, Wright Patterson Air Force Base, Dayton, Ohio.

NEW **DEPARTURES OF TOMORROW**



Today, New Departure *ball* bearings are used by 14 leading manufacturers of washers and driers. Wherever there's a moving part, New Departures assure accuracy, low upkeep, longer life.

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NEW DEPARTURE
BALL BEARINGS

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1945

Robert Schmoker was discharged from the Navy last summer and is now employed as a sales engineer with the American Blower Corporation, working out of the San Francisco branch office. Bob and his wife have two daughters, and are living in Berkeley.

Burton L. Henke, MS, PhD '53, has received a promotion to Assistant Professor of Physics at Pomona College. He has also been awarded a Guggenheim Foundation Fellowship for the second semester of 1955-56, at which time he will visit Spain and Sweden.

William R. Burns joined the staff of the National Life Insurance Company last June as a member of the personnel and purchasing department, primarily concerned with office operations planning. Before joining National he was with the Homesteaders Life Company of Des Moines, Iowa, where he had been directing personnel and office administration for the past five years. Bill, his wife, and two children now make their home in Montpelier, Vermont.

1947

Joseph Rosener, manager of manufacturing control for G. M. Giannini & Company in Pasadena, reports that his second child, Doug, was born last January. The Roseners' daughter, Lynn, is now 2½.

1948

Byron L. Youtz has started his third year at the American University of Beirut, Lebanon, as Assistant Professor of Physics. Byron enjoys the teaching very much, and takes every opportunity to do as much travelling as possible. "Last September Margaret Elizabeth escorted us into the happy state of parenthood." Byron writes. "She has been most cooperative in accompanying us on some very interesting journeys into Egypt, Jerusalem, Damascus and Allepo. We were brave enough this past summer to try a two month trip in Europe, with the International School on Nuclear Physics, Lake Como, as our principle objective. We shall probably see some of the Tech graduates when we return to the U. S. next summer."

George W. Roe, Jr., at last report, was in Japan—one of his stops on a leisurely three-year world tour.

1949

Dennis V. Long, MS '55, has accepted a position as civil engineer with Harrison and Woolley, consulting engineers of Santa Ana, California.

David Hogness is now at Washington University in St. Louis, Missouri, working in the Department of Microbiology. Dave made this transfer from the New York University Medical School, where he was doing research work.

Gene D. Six and wife Phyllis announced the arrival of Brian David on July 19.

1950

David B. MacKenzie reports the following reunion, which took place on a street in Paris last month. "*Wes Hershey*, in Paris to attend the YMCA Centennial, and *Bob Crichton*, '50, on summer vacation from his teaching job at the Friends Boys School, Ramsallah, Jordan, were sipping aperitifs at a sidewalk cafe when along came *Martin Walt*, '50, stopping in Paris on his way to Geneva as a delegate to the conference on the peaceful uses of atomic energy. All three ran into me wheeling my daughter, Kathy, born April 20.

"We are still part of Catex's petroleum exploration group in Paris, but expect to be transferred to greener (blacker?) fields in the new year."

1952

Thomas W. Hamilton was married last August to Barbara Joanne Stunden, of Sierra Madre, California, and they now make their home in Arcadia. In the wedding party were three of Tom's Tech classmates: *Frank Ludwig*, '53, *Moises Levy*, '52, and *Richard Jaffe*, '53.

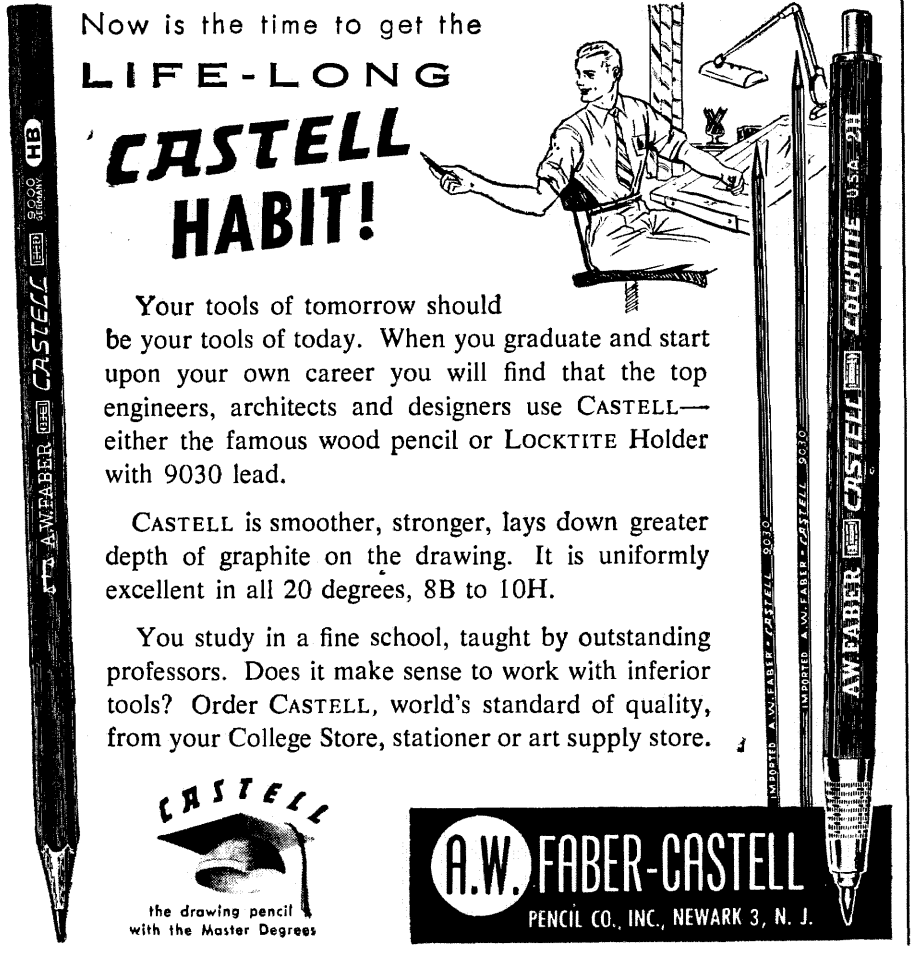
1953

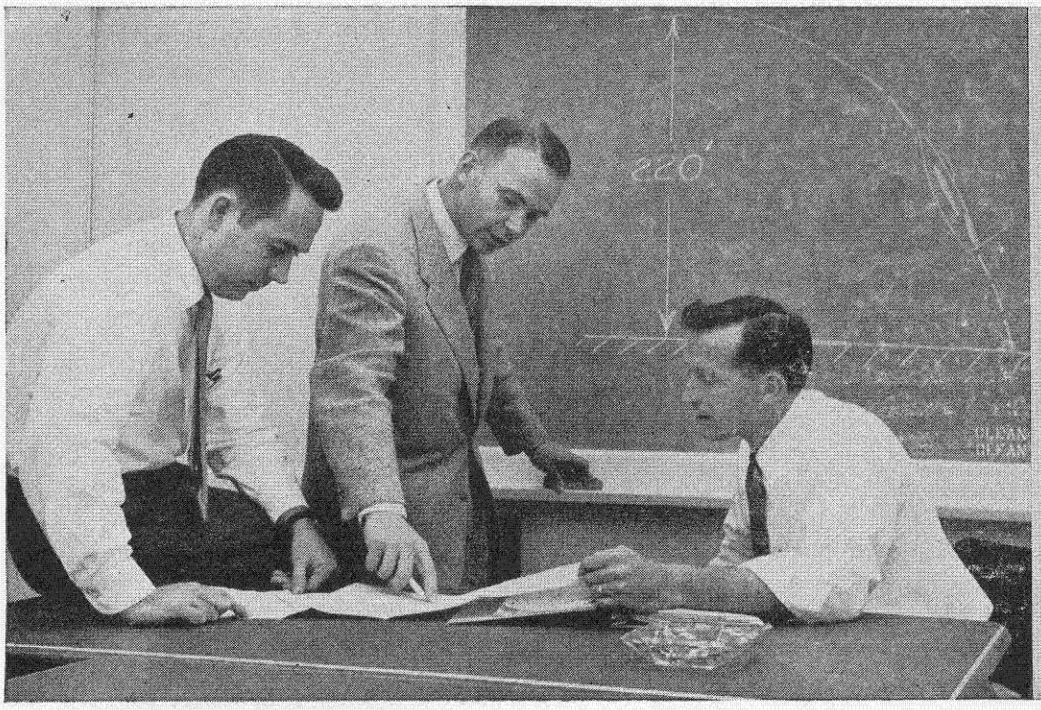
Robert D. Inglis and Georgia Wagner, of Pasadena, announced their engagement in August. Wedding plans are going to wait, however, until Bob gets through serving his Army hitch. At present he is stationed at Ft. Monmouth, New Jersey.

Donald C. Curran, Lt. Commander, USN, has been flying P2V Neptune Patrol Bombers at Barber's Point Naval Air Station, Oahu, Hawaii, ever since graduation from Tech.

Charles E. Benjamin was married in June to Louise Lowenthal of Highland Park, Illinois. Chuck and his bride are now living in Pittsburgh, where he is working as an engineer in the device development group of Westinghouse's newly formed Semiconductor Department.

Robert E. Gillingham is another '53 man who gave up his bachelor status in June. Bob reports, "I am still at Northrop Aircraft in Hawthorne. Dorothea Ellenor Dixon of Occidental became my bride June 12. We are living in the veteran's housing on the Oxy campus. I ushered at the wedding of *Gordon Zentner*, '54, to Elizabeth Walker on the 26th of June. They are now living in Texas."





N. T. Avant, aerodynamicist (left), R. R. Heppe, Aerodynamic Department head (center), and C. F. Branson, aerodynamicist, discuss wind tunnel tests to determine transition height of a supersonic superiority fighter.

Hovering to High Speed Flight:

Lockheed Aerodynamics Projects Offer Advanced Problems

Aerodynamics Engineers at Lockheed are working on advanced problems that cover virtually every phase of aircraft. The full scope of their work can be seen in the wide range of aerodynamics problems encountered in Lockheed's diversified development program.

Among the advanced problems are:

1. Determine means of controlling a supersonic vertical rising aircraft through the transition flight stages from horizontal to vertical flight.
2. Determine the dynamic response of supersonic aircraft in high rate rolls by application of five degrees of freedom analysis procedures.
3. Study optimum operating descent procedures to minimize costs on a new turboprop commercial aircraft.
4. Conduct and analyze wind tunnel research on new and radically different external radomes to be carried at high speed by early warning aircraft.
5. Perform generalized aeroelastic analysis combining structural and aerodynamic knowledge to determine optimum lateral control devices for use on very high speed, low load factor aircraft.

These—and many other—significant problems have created new positions for experienced Aerodynamics Engineers and Aerodynamicists in Lockheed's expanding program of diversified development.

You are invited to contact your Placement Officer for a brochure describing life and work at Lockheed in the San Fernando Valley.

Additional information on these problems and data on Lockheed's Aerodynamics Division is available to interested engineers. Address inquiries to R. R. Heppe.

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ALUMNI FUND

Report of the 8th Year — 1954 - 1955

OUR PRESENT GOAL for the Alumni Fund is four full-tuition undergraduate scholarships. These scholarships will be completely endowed. There will be one for each of the four undergraduate classes.

We have just completed our second year with scholarships as a goal. Two scholarships have been endowed. One went into its second year last month. Another started a freshman on his way.

To date you alumni have contributed $42.000 for scholarships. This puts us past the mid-point of our goal of $75.000. We can possibly reach our goal this next year. To do this no one need give more than he did this past year. But more must give. We need two contributors out of every five alumni—rather than our present one in five.

Undergraduate contributions are tabulated below. The names of all contributors to the Alumni Fund for 1954-55 are listed on the following pages.

—Robert R. Bennett
—William F. Nash, Jr.
Directors in charge of the Alumni Fund 1954-55

EIGHTH YEAR — 1954-55
(As of July 1, 1955)
Alumni Who Took Undergraduate Work at C.I.T.

CLASS	AMOUNT	NUMBER GIVING	AVERAGE GIFT	MEDIAN GIFT	NUMBER ELIGIBLE	PER CENT OF ELIGIBLE GIVING
Prior 1915	$ 60.00	7	$ 8.57	$10.00	24	29.2
1915	120.00	3	40.00	10.00	8	36.5
1916	25.00	2	12.50	12.50	7	28.6
1917	25.00	1	25.00	25.00	7	14.3
1918	106.17	6	17.70	10.00	30	20.0
1919	0	0	0	0	3	0
1920	95.00	8	11.88	10.00	26	30.8
1921	176.00	11	16.00	10.00	34	36.6
1922	2,490.00	20	124.50	22.50	59	33.9
1923	135.00	9	15.00	10.00	48	18.7
1924	185.00	11	16.82	10.00	73	15.1
1925	570.00	21	27.14	10.00	78	26.9
1926	1,120.00	14	80.00	10.00	99	14.1
1927	131.00	14	9.36	10.00	89	15.7
1928	222.50	17	13.09	10.00	59	28.8
1929	315.00	19	16.58	10.00	84	22.6
1930	599.18	25	23.97	10.00	102	24.5
1931	413.00	18	22.94	10.00	97	18.6
1932	2,397.00	23	10.42	10.00	93	24.8
1933	169.00	12	14.08	10.00	93	12.9
1934	422.00	30	14.07	10.00	103	29.1
1935	352.50	30	11.75	10.00	110	27.2
1936	1,412.00	27	52.30	10.00	115	23.4
1937	200.00	16	12.50	10.00	111	14.4
1938	356.00	30	11.87	10.00	125	24.0
1939	186.50	19	9.82	10.00	112	17.0
1940	525.00	43	12.21	10.00	140	30.7
1941	259.00	27	9.59	10.00	128	21.1
1942	438.50	47	9.33	10.00	149	31.6
1943	476.00	42	11.33	10.00	124	33.9
1944	603.00	54	11.17	10.00	208	26.0
1945	399.50	33	12.11	10.00	190	17.4
1946	173.00	21	8.24	5.00	163	12.9
1947	317.00	32	9.91	5.00	144	22.2
1948	387.00	51	7.59	5.00	192	26.6
1949	435.00	56	7.77	5.00	211	26.6
1950	363.50	35	10.39	5.00	183	19.1
1951	271.50	32	8.48	5.00	159	20.2
1952	177.50	23	7.72	5.00	126	18.3
1953	213.91	28	7.64	5.00	135	20.8
1954	103.00	15	6.87	5.00	104	10.4
TOTAL	$17,425.26	932	$18.70	$10.00	4145	22.4

CONTRIBUTORS TO THE ALUMNI FUND, 1954-1955

1896
Haynes, Diantha M.

1900
Harris, Irving C.

1906
Canterbury, H. H.

1911
Hill, Harold C.
Ward, Royal V.

1913
Koch, Louis J. Jr.

1914
Lavagnino, Emanuele

1915
Holmes, William M.
Holt, Herbert B.
Wilcox, Charles H.

1916
Allen, Robert N.
Carson, Max H.

1917
Kensey, Alexander

1918
Andrews, Clark F.
Bercaw, Corliss A.
Capra, Frank B.
Dowd, Munson J.
Hainsworth, Wm. R., M.S.
Heywood, Gene B.
Hoge, Edison R.

1920
Barnes, Hartwick M.
Black, James R.
Ehrenfeld, Day, M.S.
Hounsell, E. Victor
Hounsell, Theron C.
Sawyer, Mark A.
Smith, R. Carson
St. Clair, Harry P.
Woodbury, Roscoe E.

1921
Badger, R. M.
Boggs, Chester A.
Case, Henry R.
Champion, Edward L.
Craig, Robert W.
Forgy, Edward G.
Honsaker, Horton H.
Mintie, Ernest H.
Simpson, Charles F.
Stamm, Alfred J.
Stenzel, R. W.

1922
Ager, R. W.
Alles, G. A.
Ames, Paul R.
Bear, Ralston E.
Biddle, Charles J.
Darnell, Donald W.
Erb, Louis H.
Fleming, Thomas J.
Hall, Albert D.
Hathaway, Edward A.
Henny, George C., M.S.
Honsaker, John, Jr.
Hopper, Francis L.
Jasper, Walter
Keith, Clyde R.
Knight, Alfred W.
Kohtz, Russell H.
Marsh, Hallan N.
Ogden, Harold S.
Potter, William D.
Vesper, Howard G.

1923
Baier, Willard E.
Bangham, William L.
Barnett, Harold A.
Blakeley, Loren E.
Gilbert, Walton E.
Lewis, Howard B.
Loughridge, D. H.
Nies, Henry T.
Stromsoe, Douglas A.
Woods, Robert E.

1924
Anderson, Kenneth B.
Clark, Rex S.
Goodhue, Howard W.
Irwin, Emmett M.
Kalichevsky, Vladimir A.
Liddell, Orval E.
Losey, Theoodore C.
Maltby, Clifford W.
Miller, Roy
Parker, Cecil N.
Winegarden, H. M.

1925
Atherton, Tracy L.
Brunner, Michael C.
Burmister, Clarence A.
Clayton, Frank C. A.
Dalton, Robert H.
Ferkel, Albert J.
Freeman, Henry R.
Hart, Edward W.
Heilbron, Carl H., Jr.
Hertenstein, W.
Jones, Herbert J.
Jones, Walter B.
Maxstadt, F. W., M.S.
Miller, Leo M.
Pauling, Linus C., Ph.D.
Prentice, Leland B.
Salsbury, Markham E.
Sellers, W. D.
Simpson, Thomas P.
Smith, Neal D.
Stanton, Robert J.
Stewart, Earl D.

1926
Ball, Alpheus
Bowman, Robert B.
Dinsmore, Daniel G.
Edwards, Manley W.
Ericsson, Carl G.
Farly, George M.
Friauf, James B., Ph.D.
Graham, Glenn
Howell, John R.
Kiech, Clarence F.
Kirkeby, Eugene
Kossiakoff, Alexander
Moodie, R. W.
Schott, Hermann F.
Van den Akker, J. A.
Voelker, Joachim F.
Ward, Edward C.
Wise, W. H., Ph.D.
Wulf, Oliver R., Ph.D.

1927
Baldwin, Marshall A.
Baxter, Ellery R.
Bower, Maxwell M.
Capon, Alan E.
Farrar, Harry K.
Gardner, David Z. Jr.
Gottier, Thomas L.
Heilbron, Robert F.
Hoover, Vaino A.
Jaeger, Vernon P.
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Moore, George E.
Peterson, T. S.
Randolph, E. F.
Southwick, Thomas S.
Starke, Howard R.
Warner, A. H., Ph.D.

1928
Armstrong, Richard C.
Beckman, A. O., Ph.D.
Berman, Jack Y.
Brighton, Thomas H.
Coulter, Robert I.
D'Arcy, N. A., Jr.
Hodges, A. C., Ph.D.
Jacobs, W. Morton
Jacobson, Ray K.
Joujon-Roche, Jean E.
Kaneko, George S.
Kuhn, Jackson G.
Lash, Charles C.
Lindvall, F. C., Ph.D.
Lombard, A. E., Jr.
McFaddin, Don E.
McMillan, Edwin M.
Millikan, Clark B., Ph.D.
Sechler, Ernest E.
Shaffer, Carmun C.
Tuttle, Edward E.

1929
Berman, Isadore
Birge, Knowlton R.
Clark, Donald S.
Cline, Frederick R.
Dunham, James W.
Exley, Sidney T.
Findlay, W. A.
Fredendall, Beverly F.
Haeff, Andrew V., M.S.
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Rummelsburg, Alfred
Russell, Kenneth F.
Shields, Morton K.
Wheeler, Fred A.
Winger, R. E., Ph.D.

1930
Atkinson, R. B., Ph.D.
Ayers, Wilbur W.
Bechtold, Ira C.
Blohm, Clyde L.
Bode, Francis D.
Bungay, Robert H.
Butler, Albert
Carlson, Chester F.
Clark, John D.
Crawford, Franklin G.
Giebler, Clyde
Hillman, Ernest C., Jr.
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Murray, John S.
Pritchett, Jack D.
Ross, George A.
Sheffet, David
Stirton, Robert I.
Thayer, Eugene M.
Towler, J. W.
Zipser, Sidney

1931
Arndt, Wm. Frederick
Biddle, Russell L., Ph.D.
Boothe, Perry M.
Cogen, William M.
Detweiler, John S.
Green, E. F.
Hill, Earl S., M.S.
Hoch, Winton C.
Keeley, James H.
Kinney, Edwards S.
Kircher, Charles E. Jr.
Langsner, George
Liedholm, George E.
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Neher, H. Victor, Ph.D.
Peer, Edward S.
Peterson, Raymond A.
Pratt, Leland D.
Tarbet, Thomas
Terry, Paul M.
Wenner, R. R., Ph.D.
Wilmot, Charles A.

1932
Arnerich, Paul F.
Bleakney, Wm. M., Ph.D.
Bowden, Frederick W.
Bowler, Gordon E.
Bradburn, James R.
Chambers, John V.
Foss, Robert E.
Freeman, Robert B.
Graff, Donald B.
Harsh, Charles M.
Hodge, Mills S.
Jones, Charles W.
Keachie, Edward C.
Kent, William L.
Leermakers, J. A., Ph.D.
Oswald, W. Bailey, Ph.D.
Pruden, Worrell F.
Roach, Harold
Schuhart, Mervin A.
Sheffet, Joseph
Shockley, William
Shull, George O.
St. Clair, Robert W.
Thomas, William J.
Wilson, C. E.

1933
Berkley, G. Merrill
Czamanske, Milton, M.S.
Edwards, Everett, Ph.D.
Kemmer, Paul H., M.S.
Lewis, Wyatt H.
Mathewson, Arthur J.
Mendenhall, John D.
Meskell, John E.
Moore, William W.
Prater, Arthur N., M.S.
Root, L. Eugene, M.S.
Russell, Richard L.
Scholtz, Walter
Skaredoff, Nikolas
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Taylor, D. Dwight, Ph.D.
Wattendorf, F. L., Ph.D.
Wheeler, William T.
Widess, Moses B., M.S.
Wolf, Alexander, Ph.D.

1934
Babcock, Horace W.
Bollay, William, M.S.
Campbell, James R.
Charters, Alexander
Childers, Milford C.
Clauser, Milton U.
Cox, H. Orville
Craig, Carroll C.
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Sharp, Robert P.
Sherborne, John E.
Ugrin, Nick T.
Van Osdol, George W.
Wheeler, Edgar J.
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1935
Baker, Horace W.
Baldwin, Lawrence W.
Davenport, Horace W.
Davies, James A.
Dewees, Norman B.
Dunbar, Oliver C.
Estes, Harry
Etz, Arthur N.
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Pitzer, Kenneth S.
Rader, Louis T.
Ray, A. Allen
Reynolds, Edward H.
Scherb, Ivan V.

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1936

Bolster, Calvin M., M.S.
Boothe, Raymond H. F.
Bucknell, Wilson H.
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Dickinson, Holley B.
Dilworth, Robert P.
Douglass, Malcolm E.
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Stitt, Fred B., Ph.D.
Swanson, Walfred E.
Thompson, Tyler
Unholtz, Karl
Whipp, David M.
Wooldridge, D. E., Ph.D.

1937

Bailey, Jay R.
Brice, Richard T., Ph.D.
Edwards, John S., Jr.
Feuer, Stanley I.
Frost, Holloway H.
Levinton, Harold L., M.S.
Mann, George E.
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Miller, Nash H., M.S.
Miller, Wendell B.
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Van Dusen, Charles A. Jr.
Walley, Bernard
Webster, Martin H.
Wetmore, William O.
Wiley, Harold F., M.S.
Wyckoff, Peter H., M.S.

1938

Baker, John R.
Beavon, David K.
Bertram, Sidney
Cardwell, W. T., Jr.
Clarke, Charles W.
Davidson, Donald D.
Davis, Leverett, M.S.
Davis, Thomas V.
Dixon, Blaine A. Jr.
DuFresne, Armand F.
Evans, Henry K.
Farneman, John D.
Friend, Carl F.
Hopkins, Henry S.
Ives, Philip T., Ph.D.
Jack, Samuel S., M.S.
Jones, Ralph W., Jr.
Jurs, Albert E., Jr.
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Lilly, John C.
Llewellyn, Fred E.
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McLean, John G.
Milburn, William E.
Nagamatsu, H. T.
Nash, William F., Jr.
North, Harper Q.
Nunan, James K., M.S.
Olds, Robert H.
Osborn, Elburt F., Ph.D.
Twiss, William E.
Wilson, Gardner P.
Wood, Homer J.
Woolson, John R.

1939

Brown, Perry H,
Browne, John J.
Cabeen, William R., M.S.
Crozier, George O.
Devirian, Philip S.
Fischer, Richard A.
Flint, Delos E.
Goodell, Jack H.
Green, William M.
Hance, Harold V.
Morikawa, George K.
Pullen, Keats A.
Roudebush, Bert V.
Ruggiero, Ralph J.
Smith, Paul L.
Smith, Philip E.
Snyder, Willard M.
Stones, J. Eugene
Sullivan, Edwin F.
Wilson, John N., Ph.D.
Winchell, Robert W.

1940

Baird, Raymond C.
Barber, George C.
Blackinton, Roswell J.
Brewer, Alexander F.
Brewer, Alexander F.
Brewer, Leo
Brown, George R.
Burton, Clifford C.
Cox, Robert O.
Daams, Gerrit
Davies, Claude E.
Dessel, Frank W. Jr.
Dickerson, Edward O.
Doolittle, Russell, M.S.
Epstein, Ludwig I.
Faust, Paul H.
Foster, Gerald P.
Glassco, Robert B.
Grigg, Robert W.
Harper, John C.
Helfer, Robert, Ph.D.
Jongeneel, James W.
Krieger, Stuart A.
Lapin, Ellis
Larson, Walter R.
Loeffler, Donald E.
Longwell, Paul A.
Marquardt, Roy E.
Meyer, Robert B.
Moore, Robert S., M.S.
Morse, Francis, M.S.
Palmer, Charles S.
Quarles, Miller W., Jr.
Ray, Roberts S., Jr.
Reynolds, Howard W., Jr.
Richards, Raymond G.
Russell, Charles D., M.S.
Samuel, Hubert D., Jr.
Sandiford, P. L., Jr.
Sargent, Herbert
Scarborough, W. Bertram
Smith, Randlow
Steinmetz, D. H., III
Stone, Newton C.
Stone, William W., Jr.
Stoner, Willis A.
Stroud, Robert A.
Sumner, Herbert C., M.S.
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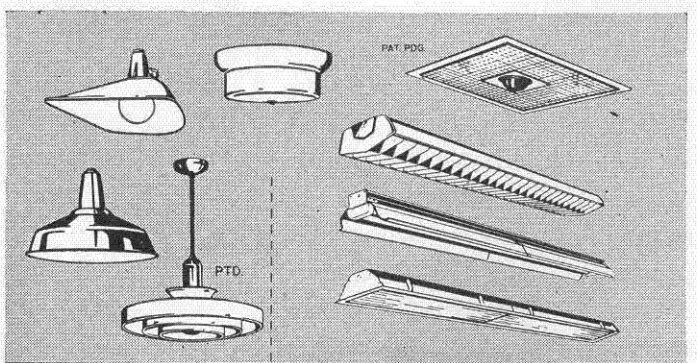

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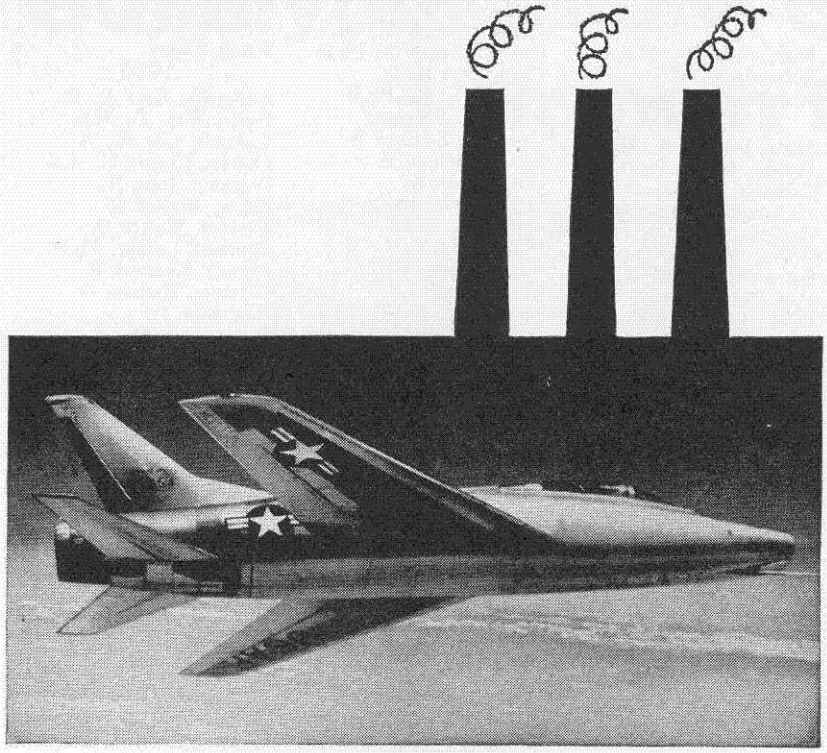

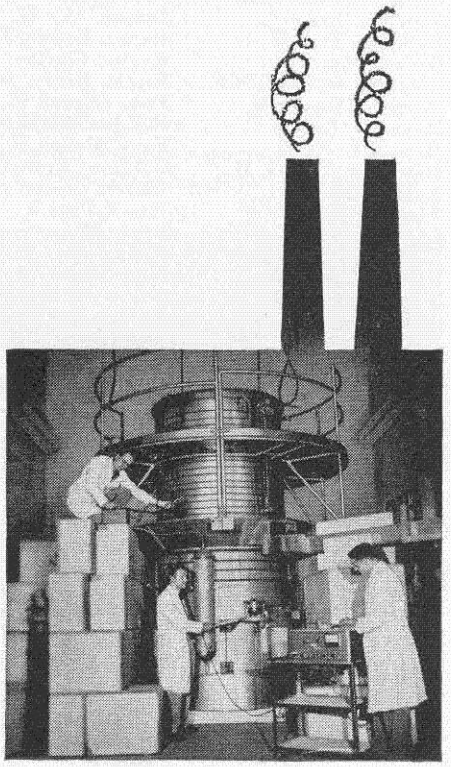

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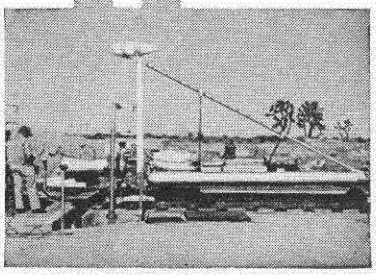

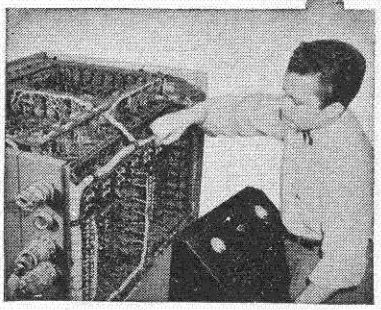

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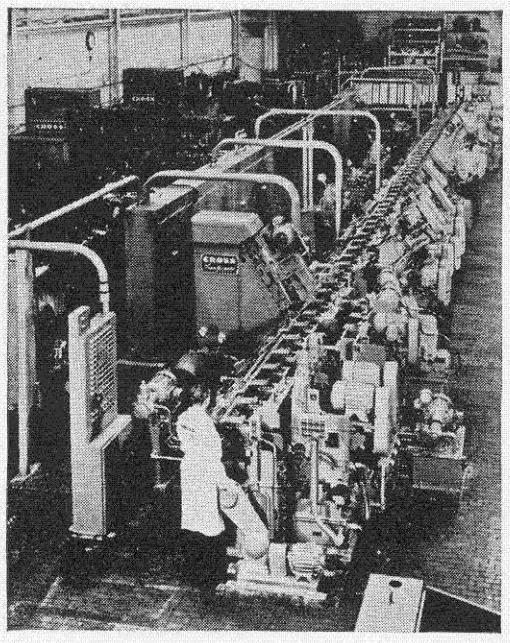
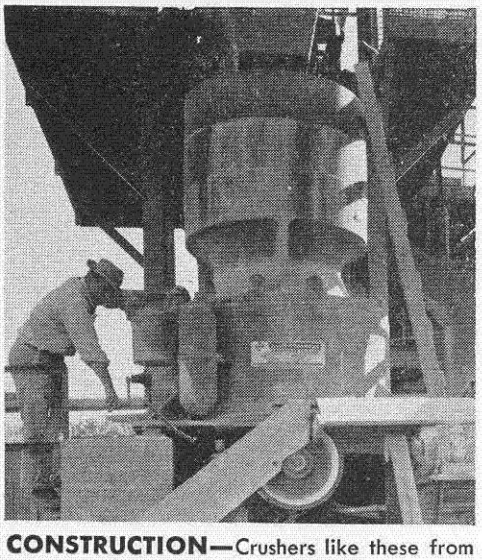


MANUFACTURING — There are 51 Allis-Chalmers motors in this lineup of machine tools designed for high automobile production.



CONSTRUCTION—Crushers like these from Allis-Chalmers process the enormous quantities of aggregate for the booming construction industry.

THERE IS much talk today about growth companies. Allis-Chalmers is one of them, supplying machinery for three basic industries—manufacturing, construction and power.

Therein lies an opportunity for you, since Allis-Chalmers builds many types of equipment.

. . . for a manufacturing industry that must increase output $3.5 billions by this time next year.

. . . for the construction industry that is destined to spend many billions of dollars on highways in the next ten years.

. . . for the electric power industry that will double its capacity by 1956.

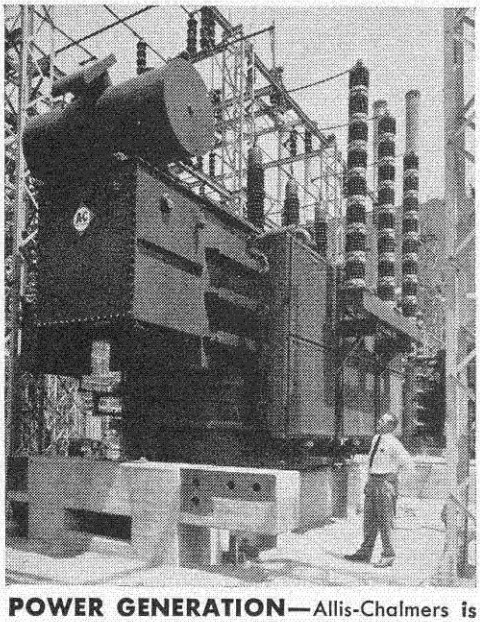
Here's what Allis-Chalmers offers to Young Engineers:

A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: Electric power, hydraulics, atomic energy, ore processing.

There are many *kinds* of work to try: Design engineering, application, research, manufacturing, sales. Over 90 training stations are available with expert guidance when you want it. Your future is as big as your ability can make it.

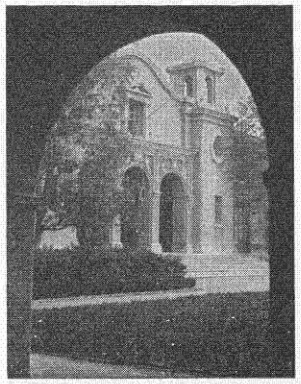
Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.



POWER GENERATION—Allis-Chalmers is helping meet growing power demand with equipment such as this 150,000 kva transformer.

A-4684 **ALLIS-CHALMERS** A-C ALLIS-CHALMERS Plants and Sales Offices all over the World



ALUMNI CALENDAR

October 27	Fall Dinner Meeting
November 12	Post Oxy Game Open House
January 12	Winter Dinner Meeting
February 4	Dinner Dance Oakmont Country Club
April 7	Annual Alumni Seminar Day
June 6	Annual Meeting
June 23	Annual Picnic

CALTECH ATHLETIC SCHEDULE

VARSITY FOOTBALL

Oct., 7, 8 p.m.
Cal Poly at Bonita High School in La Verne

Oct. 15, 2:15 p.m.
Pomona-Claremont at Claremont

Oct. 22, 2 p.m.
Long Beach at Long Beach

Oct. 28, 8 p.m.
Whittier at the Rose Bowl

FROSH FOOTBALL

Oct. 14, 3 p.m.
Pomona-Claremont at Claremont

Oct. 22, 2:15 p.m.
Occidental at Occidental

Oct. 29, 2 p.m.
Whittier at Caltech

ALUMNI ASSOCIATION
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

BALANCE SHEET
As of June 30, 1955

ASSETS

Cash in Bank		$ 448.13
Postage Deposit		158.41
Investments:		
Share in Consolidated Portfolio of C.I.T. 6-30-55, prior to current year capital gain	$35,998.01	
Share in Savings account	9,591.13	
Total Investments		$45,589.14
Furniture & Fixtures at nominal amount		1.00
TOTAL ASSETS		$46,196.68

LIABILITIES

Accounts Payable	228.24	
1955-56 Membership Dues paid in advance	5,913.50	
TOTAL LIABILITIES		6,141.74

RESERVES

Life Membership Reserve:		
Fully paid life memberships	34,625.00	
Payments on life memberships under the installment plan	25.00	
TOTAL RESERVE		34,650.00

SURPLUS

Balance June 30, 1955	4,459.52	
Provision for Directory	900.00	
Excess of income over expense for the year ended June 30, 1955	45.42	
TOTAL SURPLUS		5,404.94
TOTAL LIABILITIES, LIFE MEMBERSHIP, RESERVE, AND SURPLUS		$46,196.68

STATEMENT OF INCOME
For the year ended June 30, 1955

INCOME

DUES		$ 9,785.00
Less: Subscriptions to Engineering and Science Monthly for Association Members		7,568.75
Net Income from Dues		$ 2,216.25
INCOME FROM CONSOLIDATED PORTFOLIO OF C.I.T. Investment Income & Interest Income		2,044.09
PROGRAM AND SOCIAL FUNCTIONS:		
Income	3,306.35	
Expense	3,292.63	13.72
ANNUAL SEMINAR:		
Income	2,157.79	
Less Expense	2,020.02	137.77
SUNDRY INCOME:		19.92
NET RECEIPTS		$4,431.75

EXPENSES

ADMINISTRATION:		
Directors' expenses	252.20	
Postage	895.74	
Printing & supplies	913.14	
Total Administration	2,061.08	
Alumni Membership Solicitation	563.39	
Fund solicitation	861.86	
Total Expense		3,486.33
NET INCOME		945.42
Less: Directory Appropriation		900.00
NET INCOME TO SURPLUS		$ 45.42

AUDITOR'S REPORT

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, 1955, and the related statement of income 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 present fairly the financial position of the Alumni Association, California Institute of Technology at June 30, 1955, 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 13, 1955

DALE J. STEPHENS,
Public Accountant
South Pasadena

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Westbound Rio Grande freight in Ruby Canyon of Colorado River.

The freight rolls away an hour sooner

because photography cuts yard bookkeeping

The Denver and Rio Grande Western Railroad microfilms its waybills in minutes, cuts running schedules, saves costs in train idling time.

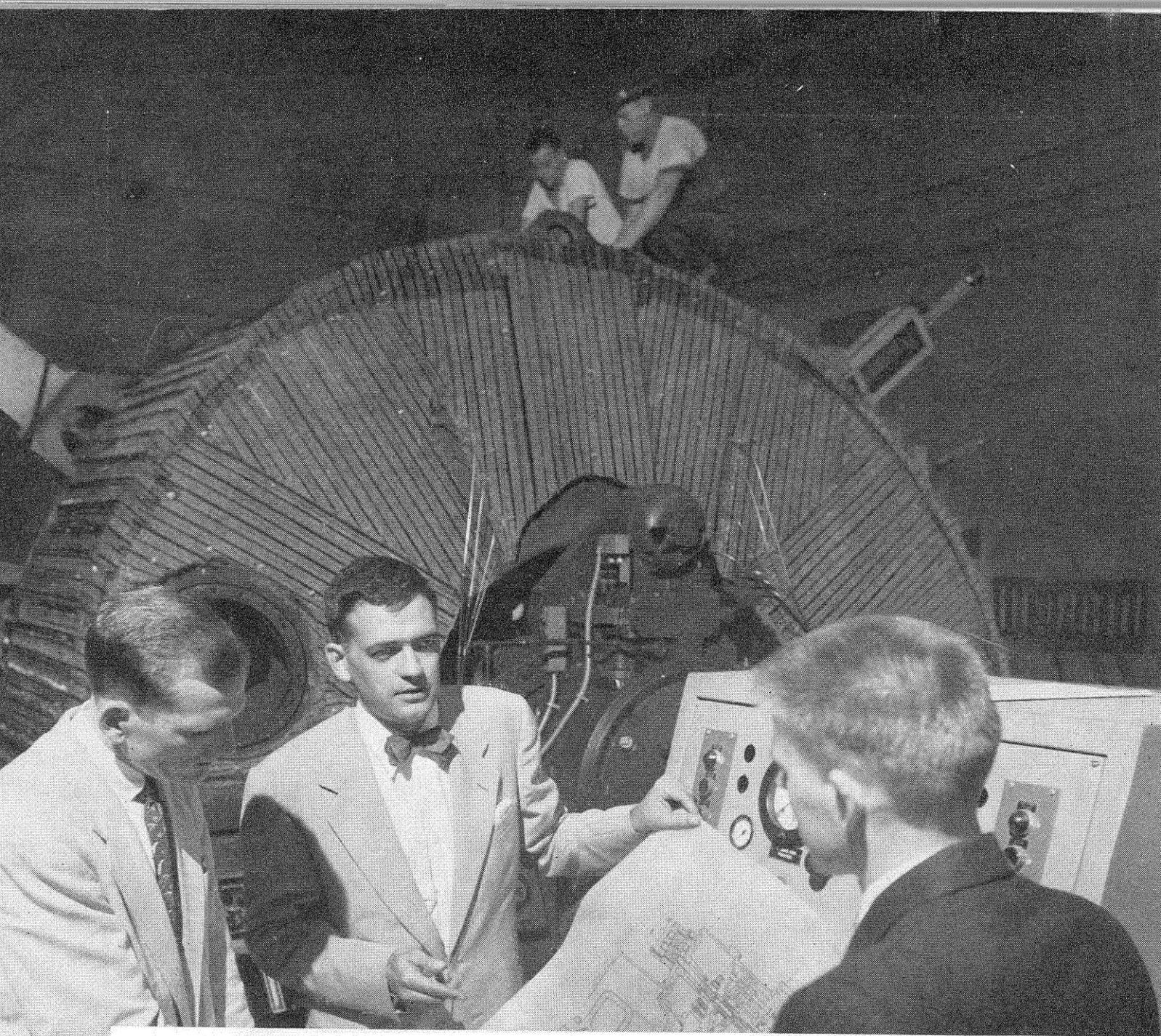
You don't find a Rio Grande freight idling at the terminal while waybills are copied by hand. Instead, Recordak Microfilming copies them. Then they're put aboard and the train is off in just about one-fifth the time it used to take, thus saving hours of valuable crew and train time. Then the wheel reports are made up from the films and teletyped ahead.

Railroading is but one of over a hundred types of businesses now saving money, time and space with microfilming. It is one of the fast growing and widely used ways photography works for industry.

Small businesses and large are finding that photography helps in simplifying routine procedures, in product design, in personnel relations. It improves production, saves time and cuts costs.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

Eastman Kodak Company, Rochester 4, N.Y.



G-E Development Engineering offers you careers with unlimited professional growth

In G.E.'s new Turbine Product Development Lab in Schenectady, Ed Freiburghouse, RPI '44, describes development engineering to students Bob Parker, Mississippi State '56, and Don Williams, Yale '55. Ed explains the extensive development of new bucket designs for steam turbines which lead the way to increased efficiency and operating economy.

Similar product development is being done in G.E.'s 132 plants in 101 cities and 24 states, offering you opportunity for professional development in many engineering channels, working with the more than 200,000 products G.E. makes for industry, the home, and defense.

The G-E Engineering and Science Programs train you in the field of engineering most suited to your interests and aptitudes, such as development, design, or the laboratory.

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NAME.....

COLLEGE..... DEGREE & YEAR.....

ADDRESS.....