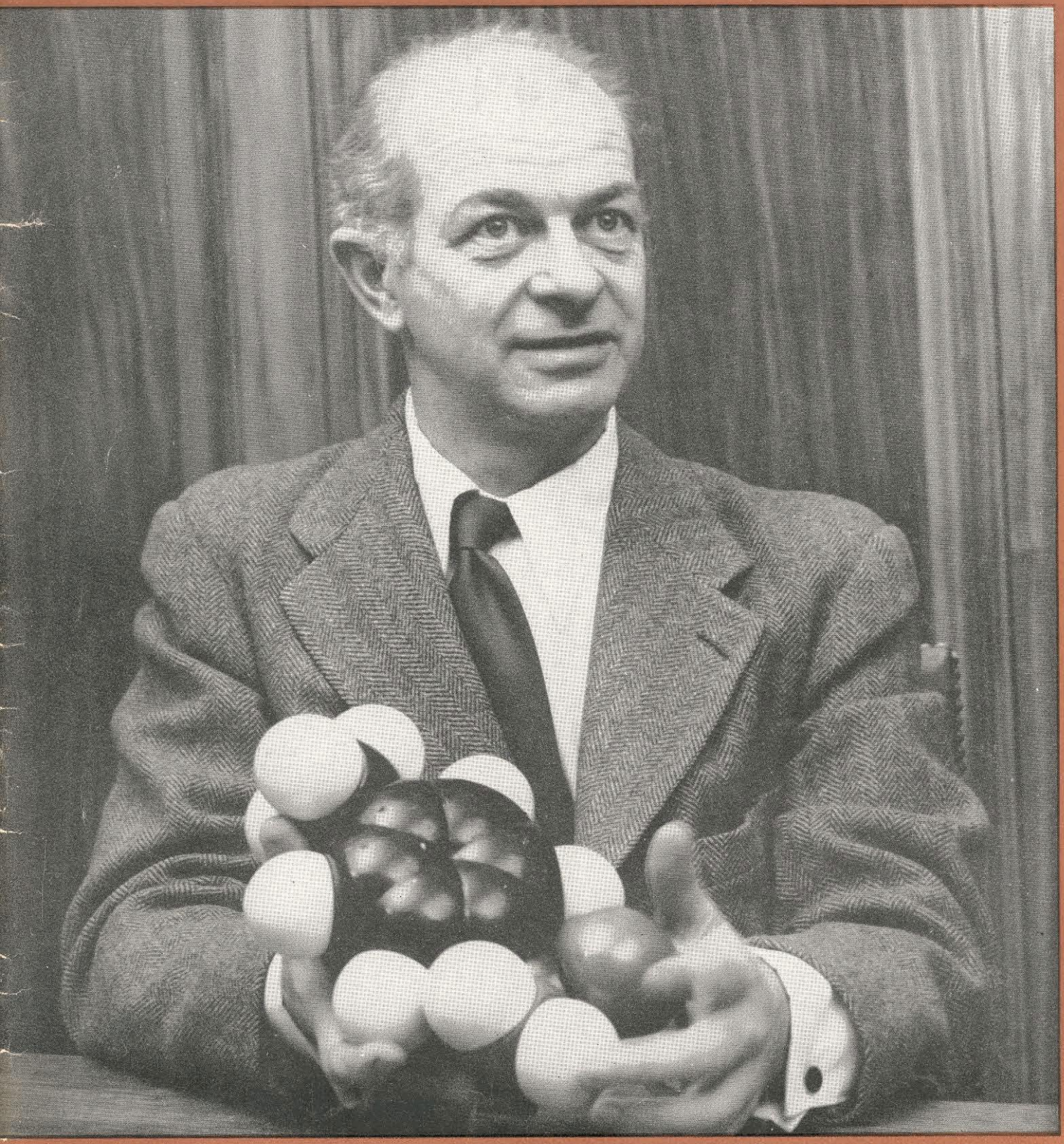
ENGINEERING | AND | SCIENCE

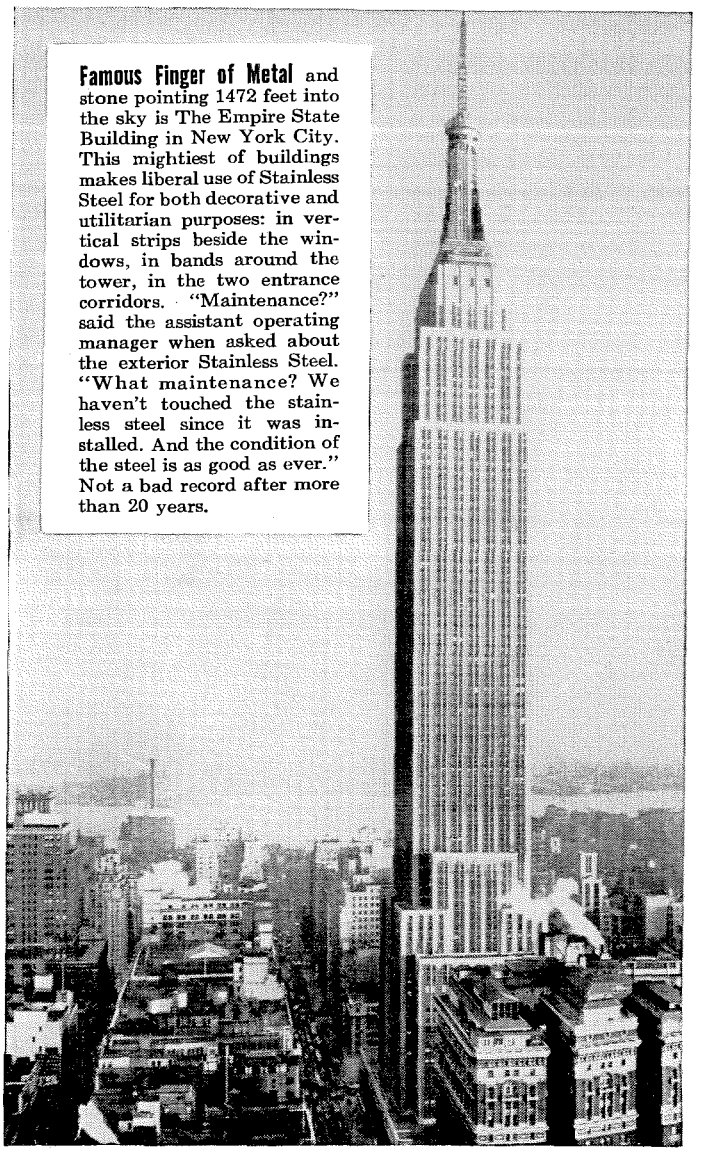
NOVEMBER/1954



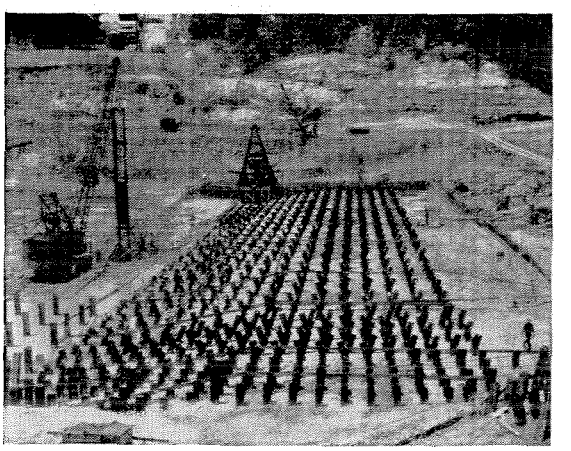
Nobel Prizewinner . . . page 11

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Only STEEL can do so many jobs so well



Famous Finger of Metal and stone pointing 1472 feet into the sky is The Empire State Building in New York City. This mightiest of buildings makes liberal use of Stainless Steel for both decorative and utilitarian purposes: in vertical strips beside the windows, in bands around the tower, in the two entrance corridors. "Maintenance?" said the assistant operating manager when asked about the exterior Stainless Steel. "What maintenance? We haven't touched the stainless steel since it was installed. And the condition of the steel is as good as ever." Not a bad record after more than 20 years.



Dragon's Teeth Sprouting? No, these are steel bearing piles in the foundation of a dam spillway. When the dam is finished, you'll never know the steel piles are there. But they'll be working just the same, for strength and safety, as enduring steel so often works unseen in buildings, highways, pipelines and power plants.

This Baby Sitter is Galvanized! In truth, a sturdy, good-looking Cyclone Fence is a dependable baby sitter. For it makes a safe home playground out of your yard. It keeps youngsters, absorbed in play, from stepping accidentally into the path of passing traffic. It prevents stray dogs from molesting your children or flowers. Cyclone Fence, made by U. S. Steel, is further evidence that only steel can do so many jobs so well.

MANUFACTURED FROM USS STEEL UNITED STATES STEEL

This trade-mark is your guide to quality steel

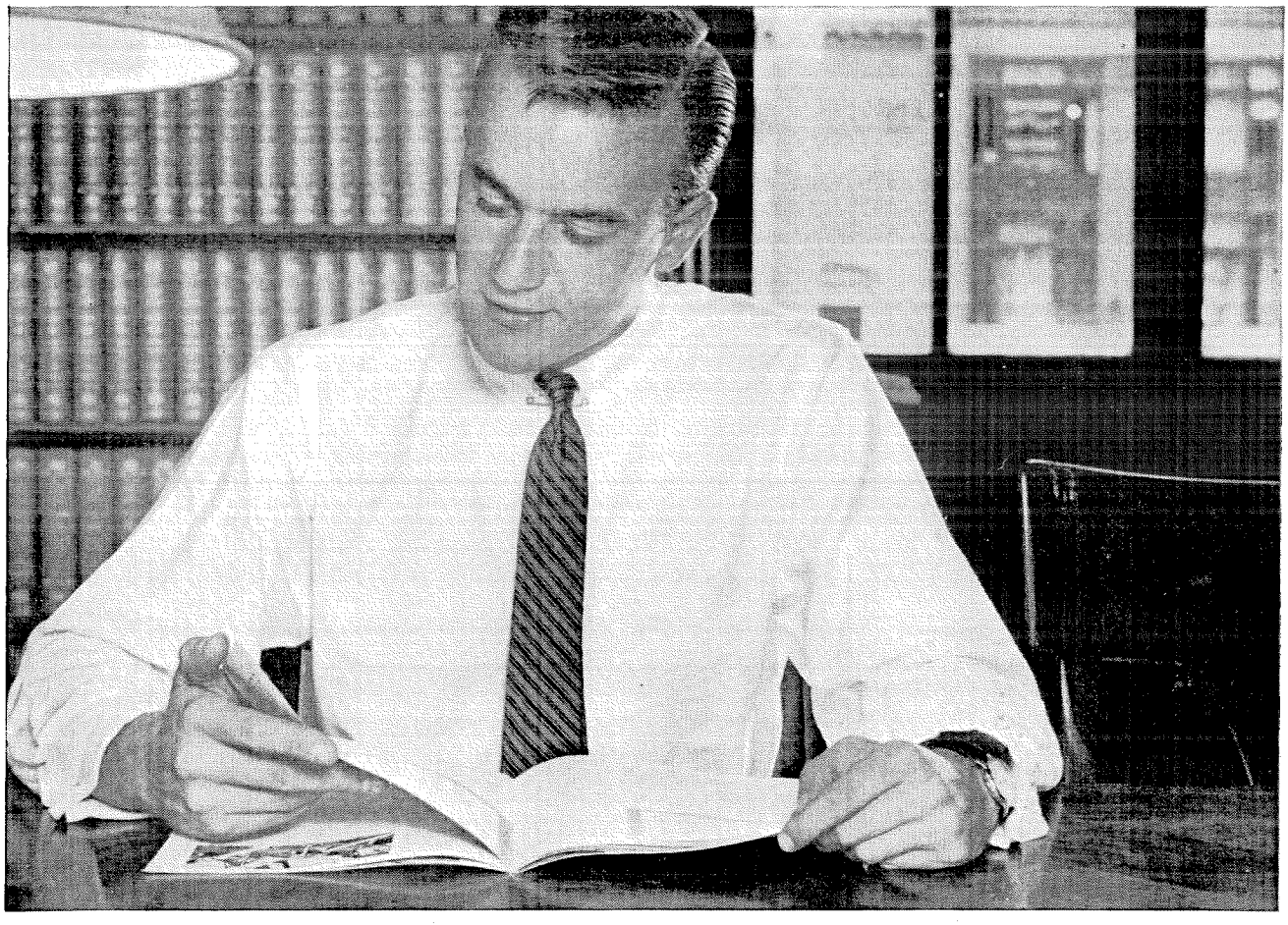
OPPORTUNITIES WITH U. S. STEEL

If you're thinking about what you're going to do after graduation . . . if you're interested in a challenging, rewarding position with a progressive company . . . then it will pay you to look into the opportunities with United States Steel. Your placement director can give you more details, or we'll be glad to send you the informative booklet, "Paths of Opportunity." United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

UNITED STATES STEEL

For further information on any product mentioned in this advertisement, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 4-1074



HE'S STUDYING A GM TEXTBOOK

YES, ever since our first issue—*June-July 1953*—the *General Motors Engineering Journal* has been welcomed by engineering faculties and students alike as an excellent contemporary source book.

And we suggest, if you are not familiar with this latest of GM publications, that you check your college library.

But—this is not a "circulation advertisement" for the *Journal*.

We mention it here — because we think a glance through any issue will give you a pretty clear picture of the high standards and advanced viewpoints of our GM engineers. And of the intellectual climate they find in which to think and to work at GM.

Certainly such standards, such viewpoints—and such a climate—must be weighed among the assets of a GM career.

So, again, may we suggest you glance at the *Journal* (copies are supplied free to all faculty members and school librarians who request them). We hope it will inspire you to write us for another important GM publication — "The College Graduate and General Motors." And to think seriously of making yours a GM career.

GM Positions Now Available In These Fields:

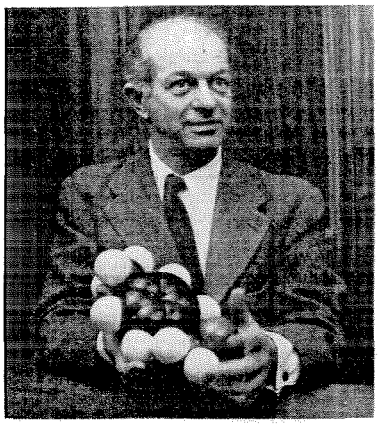
MECHANICAL ENGINEERING
METALLURGICAL ENGINEERING
ELECTRICAL ENGINEERING
INDUSTRIAL ENGINEERING
CHEMICAL ENGINEERING

GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan

ENGINEERING | AND | SCIENCE

IN THIS ISSUE



This month's cover picture is a new portrait of Dr. Linus Pauling, chairman of Caltech's Division of Chemistry and Chemical Engineering—and winner of the 1954 Nobel Prize in chemistry. In our cover picture Dr. Pauling is holding a model of a sulfanilimide molecule. For more about his work on molecular structure which earned him the Nobel Prize early this month—see page 11.

How good—or bad—is our present security system, as it has been set up to prevent scientific and other information of military value from falling into the hands of a potential enemy? Dr. George W. Beadle, chairman of Caltech's Division of the Biological Sciences, tackles this knotty question in "Science and Security" on page 15—and does it without gloves. Here's a vigorous and challenging article.

Caltech recently entered into a solemn agreement with nearly 100 other colleges to play down publicity on scholarship awards. Yet here we are, on page 22, playing *up* the awarding of the first Alumni Scholarship to a Caltech freshman named Timothy Harrington.

In this case, we plead special circumstances. Last year, after the Alumni Association's Alumni Fund reached its first goal—construction of a swimming pool on campus—it set, as its next objective, the establishment of a series of Alumni Scholarships. When the first of these went to Mr. Harrington this fall, it seemed only fair to let the many contributors to the Alumni Fund in on this fact. After all, to varying degrees, he's their boy. So meet Mr. Harrington on page 22.

PICTURE CREDITS

p. 13	Walter Girdner
p. 15	John Engstead
pps. 20, 22	Byron Johnson, Jr.

NOVEMBER, 1954 VOLUME XVIII NUMBER 2
PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

CONTENTS

In This Issue 3

Books 6

Letters 8

Linus Pauling—Nobel Prizewinner 11
The 1954 Nobel Prize in chemistry goes to the chairman of Caltech's Division of Chemistry and Chemical Engineering, for his research into the nature of the chemical bond and the structure of proteins.

Science and Security 15
What's wrong with our present security system—and what can we do about it?
by George W. Beadle

Caltech's First Alumni Scholarship 19

Student Life 20
What Every Techman Knows
by Martin Tangora, '57

A Botanist in the Sahara 22
Some notes from the travel diary of Frits Went

The Month at Caltech 30

Personals 34

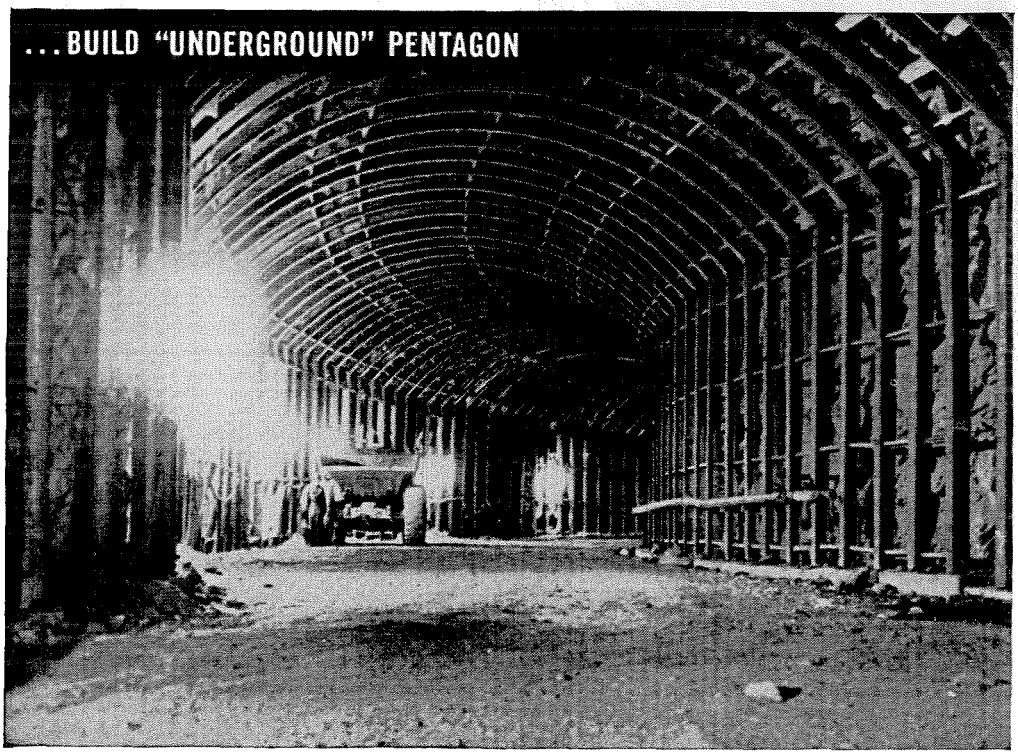
STAFF

Publisher.....Richard C. Armstrong '28
Editor and Business Manager.....Edward Hutchings, Jr.
Staff Photographers.....Byron Johnson, Jr. '56
Tom Bergeman '56
Editorial Consultant.....George R. MacMinn
Professor of English, Emeritus

Published monthly, October through June, at the California Institute of Technology, 1201 East California St., Pasadena 4, Calif., for the undergraduates, graduate students and alumni of the Institute. Annual subscription $3.50, single copies 50 cents. Entered as second class matter at the Post Office at Pasadena, California, on September 6, 1939, under act of March 3, 1879.

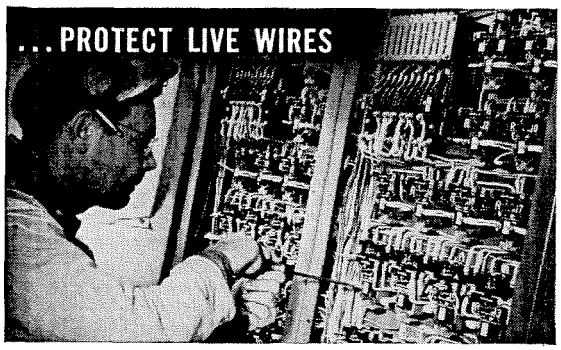
Manuscripts and all other editorial correspondence should be addressed to: The Editor, *Engineering and Science*, California Institute of Technology.

HOW HERCULES HELPS...



MUSCLE FOR MOUNTAIN MOVERS—
More than 1,000,000 lbs. of Hercules® dynamite were used by S. A. Healy Co., Chicago, to hollow out a mountain near Washington, D. C., in the construction of an alternate global communications center for use in case present Army, Navy, and Air Force facilities are knocked out by enemy attack. The task of carving this top-secret headquarters out of solid rock would have been impossible without industrial explosives and excavating know-how.

Most businesses are helped today by Hercules' business . . . the production of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products, and many other chemical processing materials—as well as explosives. Through close cooperative research with its customers, Hercules has helped improve the processing or performance of many industrial and consumer products.



SHORT CIRCUITS STYMIED—
Complicated electrical installations give longer, more dependable service when vinyl wire insulation is made with Hercules Hercoflex® 150. Hercoflex 150 is one of the Hercules family of vinyl plasticizers that are used in products ranging from toys to garden hose.

EASY TO HANDLE —
These kitchen utensils not only make a woman's job easier, but their brightly colored handles add a decorative touch as well. The handles are molded with Hercules Hercocel® cellulose acetate. In sales, design, and production, Hercules' services to the plastics industry keep products on the move.

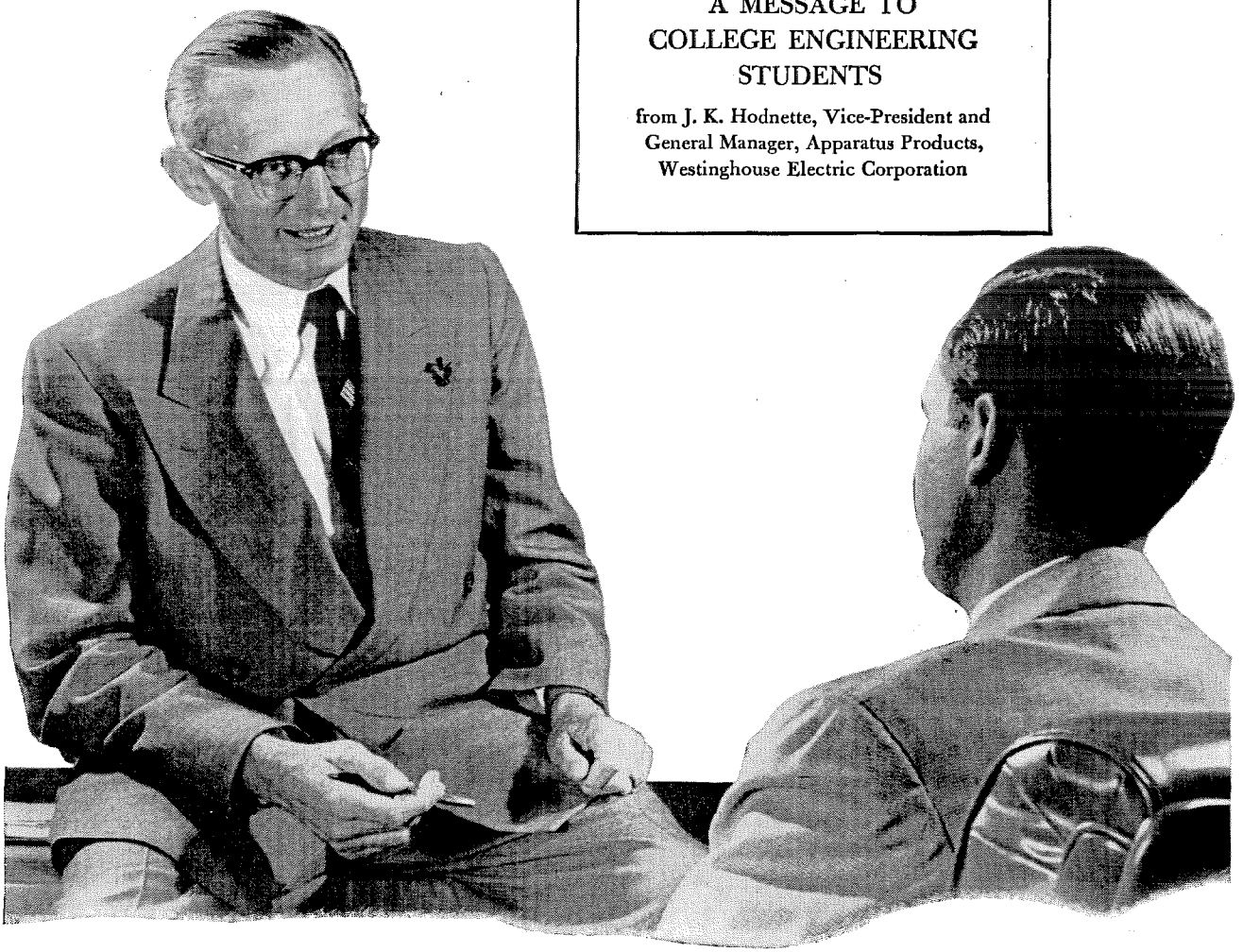
HERCULES POWDER COMPANY INCORPORATED *Wilmington 99, Del.*
Sales Offices in Principal Cities

G54-1

HERCULES

A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from J. K. Hodnette, Vice-President and
General Manager, Apparatus Products,
Westinghouse Electric Corporation



To the young man with a vision of success

Success means different things to different men. It can mean professional recognition, or great achievement, or exciting work, or many other things. Whatever its special meaning to you—keep its image in your mind, for you are already well on the way to achieving it!

If you are *determined* to become a research scientist, you *can* be. If you have a burning ambition to become a sales engineer, you can be. If you have your sights set on a top executive spot, you'll be there someday. One might think a large company like Westinghouse would have more pressing things to think of than the ambitions of its young engineers. On the contrary, nothing is more important . . . for our professional people are our biggest asset.

Here at Westinghouse, intensive efforts are made to help our professional men realize their individual goals —through extensive training programs, study programs leading to advanced degrees, leadership programs, and guidance in professional development. You are treated as an individual at Westinghouse.

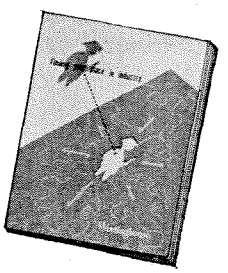
If you have the will, and are prepared, we can show you the way.

G-10271

YOU CAN BE SURE...IF IT'S
Westinghouse

For information on career opportunities with Westinghouse, consult Placement Officer of your University, or send for our 34-page book, *Finding Your Place in Industry.*

Write: Mr. S. H. Harrison, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 410 Bush Street, San Francisco, California.



BOOKS

MODERN PHYSICS FOR THE ENGINEER
Edited by Louis N. Ridenour
McGraw-Hill, 1954 $7.50

Reviewed by Gilbert D. McCann, Professor of Electrical Engineering

THIS BOOK presents a fundamental, technical, and yet easily readable treatment of the highlights of recent developments in modern theoretical and applied physics. It is recommended for all engineers and others with a general interest in modern physics, many fields of which are already influencing our engineering activities and society in general.

The book is made up of eighteen chapters, each by a different author, originally delivered as lectures in an extension course at the University of California at Los Angeles. Of the eighteen authors, four are on the Caltech faculty: H. P. Robertson, William A. Fowler, R. V. Langmuir, and Jesse Greenstein. Two others, Simon Ramo and Louis Ridenour, received their doctorates here.

The series has been divided into three main groups. The first of these is concerned with the fundamental laws of nature. It comprises the following nine lectures: "Relativity" by H. P. Robertson, "Atomic Structure" by L. L. Schiff, "Solid State Physics" by Frederick Seitz, "Magnetism" by Charles Kittel, "Microwave Spectroscopy" by W. D. Hershberger, "Nuclear Structure and Transmutation" by W. A. Fowler, "Electronuclear Machines" by R. V. Langmuir, "The Actinide Elements and Nuclear Power" by Glenn T. Seaborg, and "Elementary Particles" by W. K. H. Panofsky.

In the second group, Man's Physical Environment, Jesse Greenstein presents a summary of modern astrophysics, including stellar lifetimes and evolution, structure of the galaxy, and the fundamental physics of astronomical spectroscopy. David T. Griggs describes a new field of physics, high-pressure phenomena, and its applications to the geophysics of the earth's interior. Roger Revelle presents an interesting picture of geophysics under the ocean, and Leonard B. Loeb summarizes the present knowledge of atmospheric electricity, thunder storms and lightning. Modern knowledge of the fluid mechanics of supersonic flow is treated by Walker Bleakney in the last lecture of this series. This is the subject which has become so important to the design of high-speed missiles and aircraft.

The third general group presents topics in the important new field of applied physics and engineering which is having a profound influence on our modern way of life—communication and information processing. Simon Ramo discusses some of the modern concepts of physical electronics, from which have evolved such new devices as traveling wave tubes. John Bardeen discusses the fundamental solid state physics of semiconductors and their applications to diodes and transistors. In the last two lectures of the series, J. B. Wiesner presents modern concepts of communication and information theory, and Louis Ridenour discusses the basic principles of large scale digital computers.

ELECTRICAL ENGINEERS
MECHANICAL ENGINEERS
at all academic degree levels

for { electrical and mechanical engineering design and development, stress analysis, airborne structural design, electrical and electronic circuitry, systems studies, instrumentation, telemetering, electro-mechanical test, applied physics problems.

Sandia Corporation, a subsidiary of the Western Electric Company, offers outstanding opportunities to graduates with Bachelor's or advanced degrees, with or without applicable experience.

Sandia Corporation engineers and scientists work as a team at the basic task of applying to military uses certain of the fundamental processes developed by nuclear physicists. This task requires original research as well as straightforward development and production engineering.

A new engineer's place on the Sandia team is determined initially by his training, experience, and talents . . . and, in a field where ingenuity and resourcefulness are paramount, he is afforded every opportunity for professional growth and improvement.

Sandia engineers design and develop complex components and systems that must function properly under environmental conditions that are much more severe than those specified for industrial purposes. They design and develop electronic equipment to collect and analyze test data; they build instruments to measure weapons effects. As part of their work, they are engaged in liaison with the best production and design agencies in the country, and consult with many of the best minds in all fields of science.

Sandia Laboratory, operated by Sandia Corporation under contract with the Atomic Energy Commission, is located in Albuquerque — in the heart of the healthful Southwest A modern, mile-high city of 150,000, Albuquerque offers a unique combination of metropolitan facilities plus scenic, historic and recreational attractions — and a climate that is sunny, mild, and dry the year around. New residents have little difficulty in obtaining adequate housing.

Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. Working conditions are excellent, and salaries are commensurate with qualifications.

A limited number of positions for Aeronautical Engineers, Mathematicians, and Physicists are also available.

Make application to: **PROFESSIONAL EMPLOYMENT**

DIVISION A-1

Or contact through your Placement Office the Sandia Corporation representative with the Bell Telephone System College Recruiting Team for an interview on your campus.

SANDIA *Corporation*

SANDIA BASE ALBUQUERQUE, NEW MEXICO

LETTERS

A report on Caltech alumni now in the Jesuits

Sirs:

Recently I went through some back copies of *E&S* and found my name in a list of lost alumni. So I want to come out of the darkness and declare myself not at all missing.

Perhaps I can also give you a little news on my own doings, and those of two other Tech men who are with me in the Jesuits, studying for the priesthood.

Basic Training

I always enjoy seeing the various jobs that Tech men work into after graduation. Some seem to be in quite a different field from that in which they were trained at Tech. Maybe our work will seem so, too. *Pat Doherty*, '49, entered the Jesuits at Los Gatos, California, first, after a year of work in electrical engineering. I followed him the following year, after getting my MS at Notre Dame. *Tom Janssens*, '53, entered immediately after graduation. Tom is still at Los Gatos in the basic training period of our 15 years of study. Pat and I are here at St. Louis University, studying physics and philosophy.

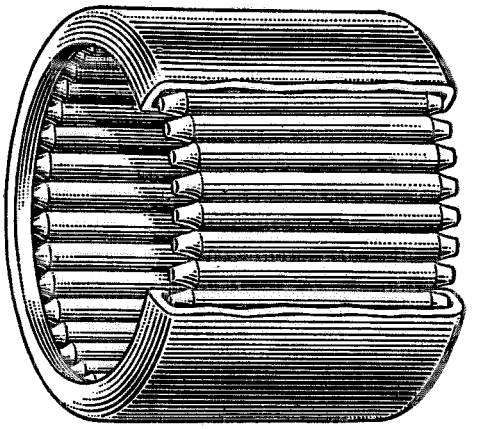
All three of us will probably be working in the field of physics after ordination; it will not be a sideline, but our main priestly work. Perhaps with a foothold in two such apparently diverse—almost opposed in some minds—fields of human experience, we will be able to make some little contribution to the unification of man.

The whole man

I certainly am proud to be an alumnus of Tech and thankful for the wonderful training it gave me. I especially appreciate the attempt that Tech has always made to train the whole man—"a broad man sharpened to a point," as Dr. DuBridge said at freshman camp long ago. I appreciate the articles in *E&S* that show that this spirit of trying to fit one's specialty in the whole of human endeavors continues strong at Caltech.

From time to time I hope to send you a little report on the doings of this little alumni cell inside the Jesuits. (There are other Jesuit alumni, no doubt, like Father Wertz

CONTINUED ON PAGE 46



This is a Torrington Needle Bearing

Designed for Today's Needs and Tomorrow's Trends—
Needle Bearings Offer A Unique Combination of Advantages

The Torrington Needle Bearing has two component parts—the full complement of relatively small diameter, thru-hardened, precision-ground rollers and a case hardened retaining shell by which they are held.

The bearing is a complete unit in itself, and is easily pressed into position in a bore machined to proper dimensions. The advantages of this unit construction in simplifying installation and speeding assembly are readily apparent.

High Radial Capacity

Of special importance is the high capacity of the Torrington Needle Bearing. This efficient anti-friction unit can carry a greater radial load than any other bearing of comparable outside diameter due to the large number of rollers. The small cross section of the bearing allows a large shaft which permits a rigid design with minimum shaft deflection.

Efficient Lubrication

The method of lubrication is another feature of the Torrington Needle Bearing. The retaining shell with its turned-in lips provides a natural reservoir for the lubricant. Thus the needle rollers turn in an oil or grease bath and continually bring up a fresh film of lubricant—insuring rotation of all moving members on a fluid film.

Low Cost

The size of the Torrington Needle Bearing, coupled with the simplicity of its construction, makes it a comparatively inexpensive anti-friction unit. Its compact size encourages simplified design which requires less material in surrounding components. This also contributes to further cost reductions.

The shaft serves as the inner race in the majority of Needle Bearing applications and therefore should be hardened and ground to proper dimensions. However, where it is desirable to use an unhardened shaft, an inner race can be supplied.

For Modern Design

Where the efficiency of anti-friction operation is desired, and where space, weight and cost are vitally important considerations, Needle Bearings provide a logical answer. That's why you will find them used in an ever-growing list of applications.

This is one of a series of advertisements designed to give you the latest engineering information on Needle Bearings. Should you have occasion to work with bearing design or wish more information, write our engineering department.

THE TORRINGTON COMPANY
Torrington, Conn. • South Bend 21, Ind.
District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON *NEEDLE* **BEARINGS**

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

Midget with the giant brain

The Problem

To design and build a computer for airborne automatic control systems—with severe restrictions imposed on size, weight and operation under extreme environmental conditions; in short, a computer that would be small, simple, reliable, rugged—and easy to build and maintain.

AT HUGHES RESEARCH and Development Laboratories this problem was examined exhaustively, and it was concluded that a digital computer offered the best means for satisfying the requirements because of its ability to solve complex problems accurately and quickly.

Because the requirements of this application could not be met by existing digital computers, owing to their large size, the following developments were undertaken:

1. Simplification of the logical structure of the computer through the use of a mathematical theory of computer design based on Boolean algebra—but with retention of the operational versatility of a general-purpose computer.

2. Development of ingenious circuitry to utilize the new logical designs.

3. Achievement of minimum size by the use of subminiature techniques, including germanium diodes, subminiature tubes, and etched circuits.

4. Employment of unitized construction: plug-in units of flip-flop circuits and diode networks.

Need for subminiaturization, then, was a governing factor. Consequently, entire new techniques for making things not only vastly smaller, but at the same time easier to build and service, were developed by Hughes. This is a continuing process and there is indication of even more significant advancement in miniaturization for the future.

A major effort at Hughes is also devoted to adapting electronic digital computer techniques to business data processing and related applications—destined for far-reaching peacetime uses.

One of the subminiature switching circuits from the Hughes airborne electronic digital computer is examined by Dr. Eugene M. Grabbe (right), Associate Head, Computer Systems Department, Advanced Electronics Laboratory, and Phil A. Adamson of the Technical Staff, Radar Laboratory.

ENGINEERS AND PHYSICISTS

Activities at Hughes in the computer field are creating some new positions in the Laboratories. Experience in the design and application of electronic digital computers is desirable, but not essential. Engineers and physicists with backgrounds of component development or system engineering are invited to apply.

ADDRESS: *Scientific and Engineering Staff*

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

LINUS PAULING

Nobel Prizewinner

The 1954 Nobel Prize in Chemistry goes to the chairman of Caltech's Division of Chemistry and Chemical Engineering for his research into the nature of the chemical bond and the structure of proteins.

DR. LINUS PAULING, Professor of Chemistry, chairman of the Division of Chemistry and Chemical Engineering, and director of the Gates and Crellin Laboratories at Caltech has been awarded the 1954 Nobel Prize in chemistry by the Swedish Royal Academy of Science.

The award is based on Dr. Pauling's "research into the nature of the chemical bond (the forces that hold molecules together) and its application to the elucidation of the structure of complex substances"—probably referring to his researches into the structure of silicate minerals, metals and alloys, other complex inorganic substances, complex organic compounds, and proteins.

The prize, established by the will of the late Alfred Nobel, Swedish inventor of dynamite, includes a diploma, the Nobel gold medal and a cash prize of approximately $35,000. Dr. Pauling has been invited to Stockholm to receive the award in person, from King Gustav Adolph of Sweden, on December 10.

Dr. Pauling is the fourth Caltech faculty member to receive a Nobel Prize. In 1923 the late Robert A. Millikan, Professor of Physics and chairman of the Caltech Executive Council from 1921 to 1945, received the Nobel Prize in physics for his work on the determination of the electronic charge. In 1933 the prize in medicine and physiology went to the late Thomas Hunt Morgan, Professor of Biology and chairman of the Division of Biology from 1928 to 1944, for his research on heredity. In 1936 Carl Anderson, a Caltech alumnus and Professor of Physics here since 1939, won the physics prize for his discovery of the positron.

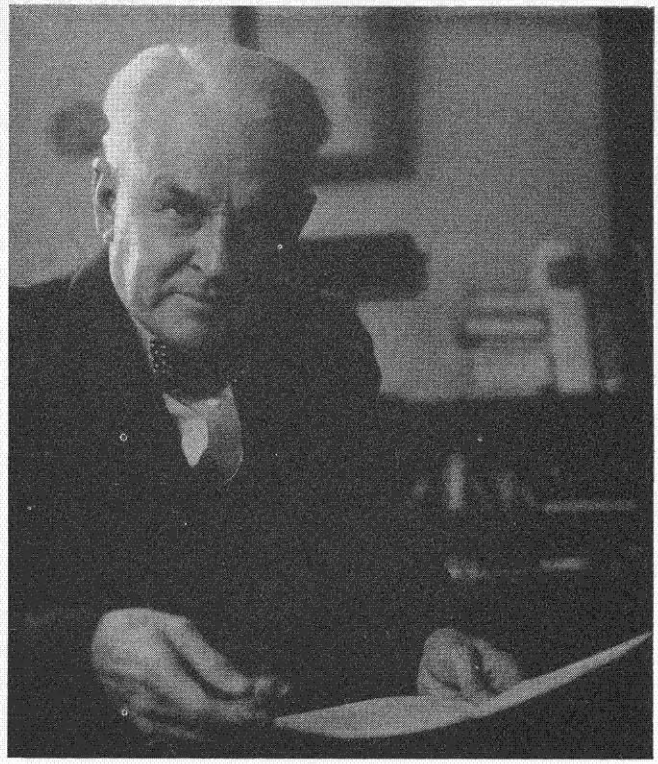
Edwin M. McMillan, another Caltech alumnus (BS '28, MS '29), now Professor of Physics at the University of California at Berkeley, shared the 1951 prize in chemistry with his colleague at UC, Glenn T. Seaborg, for their joint discoveries of six radioactive elements used in the development of atomic energy.

Linus Pauling was born in Portland, Oregon, on February 28, 1901. Both his father and his maternal grandfather were druggists—though this had little to do with his later interest in chemistry, for both men died when Linus was about 9 years old.

He was 11 when he first showed an interest in science, by starting an insect collection. A year later he was an avid collector of rocks and minerals, poring over

THREE FORMER NOBEL PRIZEWINNERS

On Caltech's Faculty



The late R. A. Millikan—1923 prize in physics

mineralogies borrowed from the public library, and copying down tables of the properties of minerals, blowpipe reactions, luster, streak, and hardness, so that he could identify the minerals he picked up around Portland.

He was first introduced to chemistry at the age of 13 when a school friend, Lloyd Jeffress (now Professor of Psychology at the University of Texas), showed him a couple of chemical experiments. Linus was fired with such enthusiasm that, with the aid of an old chemistry book of his father's, he set up a laboratory of his own in the basement at home, and used it constantly, until he went off to college.

He was 16 when he entered Oregon State College. After two years as a student, he spent one year at the college as a full-time assistant in quantitative analysis. He then returned for two more years of study, and got his BS in chemical engineering in 1922.

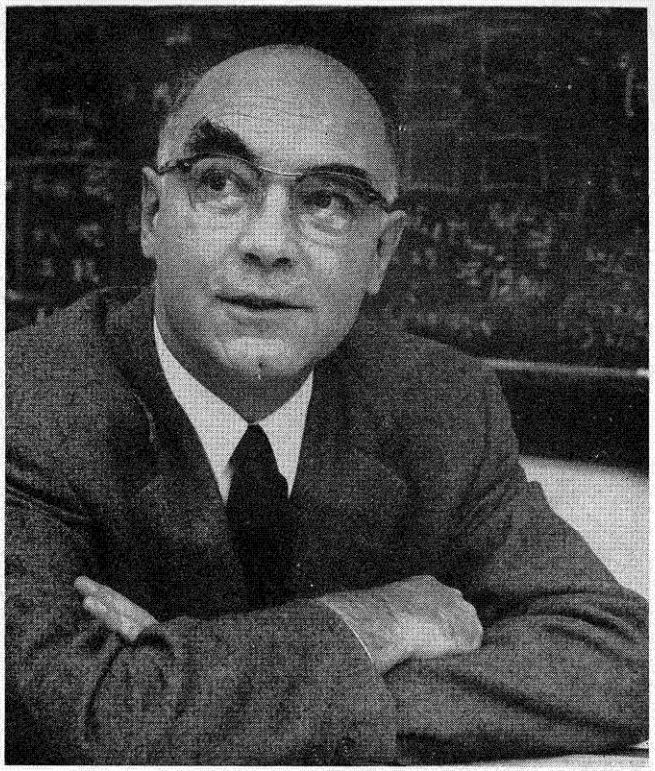
In the fall of 1922 Pauling came to Caltech, on a teaching fellowship, to do graduate work under Arthur Amos Noyes, the distinguished physical chemist who headed the Division of Chemistry here. By then he was interested in the field of atomic structure in relation to the chemical and physical properties of substances. At Noyes' suggestion he began research, with Professor Roscoe G. Dickinson, on the determination of the structure of crystals by X-ray diffraction, at the same time studying and carrying on several researches in theoretical chemistry.

After he got his PhD in 1925 Pauling was still so interested in the physical aspects of chemistry that he considered becoming an atomic physicist. He stayed on at Caltech for eight months as a National Research Fellow, then, on a Guggenheim Fellowship, spent a year and a half in Europe, doing post-graduate research with some of the great theoretical physicists—Arnold Sommerfeld in Munich, Niels Bohr in Copenhagen, and Erwin Schrödinger in Zurich—on the application of quantum mechanics to the problems of the structure of molecules and crystals.

But chemistry was still his chief interest and he came back to Caltech in 1927 as Assistant Professor of Chemistry. He was made a full professor in 1931, when he was only 30 years old. In that same year he was named the first winner of the American Chemical Society's Award in Pure Chemistry, given for the most distinguished research of the year by a young man not over 30.

In 1933 he was elected to the National Academy of Sciences—the youngest member of that distinguished organization at that time. In 1936 he was elected to membership in the American Philosophical Society, and in 1937, after the death of Arthur Noyes, Pauling suc-

The late Thomas Hunt Morgan—1933 prize in medicine



Carl Anderson—1936 prize in physics

ceeded him as chairman of Caltech's Division of Chemistry and Chemical Engineering and director of the Gates and Crellin Laboratories.

His broad fields of interest have covered all branches of chemistry—extending into experimental and theoretical physics in one direction, and into biology and medicine in the other. His work can be conveniently divided into two periods. Up to 1933 his experimental work comprised the determination of the structures of crystals and of gas molecules by the diffraction of X-rays and electrons, respectively, and his theoretical work included the discovery of basic principles concerning the nature of the chemical bond and the structure of molecules.

Throughout the second period, from 1933 to the present, he has devoted himself largely to applying these principles to the problem of the structure of proteins.

In 1934, after having worked for some time with fairly simple molecular structures, such as metals and inorganic compounds, he become interested in an organic substance whose molecule is large and complicated—hemoglobin, the protein that makes red blood cells red. The hemoglobin molecule has a molecular weight of 68,000 (as compared with 18 for water, for instance,) and it contains about 10,000 atoms of carbon, nitrogen, hydrogen, oxygen, sulfur, and other elements.

The hemoglobin molecule is involved in carrying oxygen from the lungs to the tissues. In studying the magnetic properties of hemoglobin, Pauling found that in venous blood the hemoglobin is attracted by a magnet, but in arterial blood it is repelled. This led to a study of the chemical bond between the hemoglobin and the oxygen which it picks up in the lungs, and to considerable new knowledge about the structure of the hemoglobin molecule.

This work on hemoglobin led Pauling to consider the chemical aspects of the field of immunology, and he began to try to understand, in terms of the chemical bond, how antibodies neutralize bacteria, viruses and other antigens to produce immunity. In 1940 he published a theory of the molecular structure of antibodies.

Pauling and his Caltech co-workers went on from the investigation of hemoglobin and antibodies to study other molecular giants that originate in the living system. By 1950 Pauling's applications of fundamental structural principles to the problems of protein structure, carried out in close collaboration with Professor Robert B. Corey, resulted in the prediction of specific configurations of the oxygen-hydrogen-nitrogen-carbon chains that form the backbone of protein molecules. In achieving the first accurate descriptions of the physical characteristics of protein molecules, Pauling and his coworkers opened a new chapter in the investigation of these substances.

Proteins comprise the principal substance of all living material. There are thousands of different kinds of proteins in the human body. Unlike the molecules of most

other chemical substances, which consist of a score or two of individual atoms, protein molecules are made up of thousands—sometimes millions—of individual atoms, each occupying a specific place in the architecture of the molecule.

The first great advance toward an understanding of protein structure was made in 1900 when the German chemist Emil Fischer found that proteins are composed of simpler substances known as amino acids. These were found to be linked together into larger groups known as polypeptides.

The problem of determining the structure of proteins then became one of finding the sequence of various amino acids in the polypeptide chain and the way in which the polypeptide chain is coiled.

Protein studies

Instead of trying to study the complicated proteins directly, Pauling and his co-workers, for more than 15 years, have been studying the structure of the amino acids of simple peptides, and of other simple substances related to proteins. By using the information obtained in this way they have been able to predict the essential atomic structure of several proteins, including those found in bone, muscle, and red blood cells.

During the past two years Dr. Pauling has been working on the structure of collagen, the protein that occurs in tendons, bone and skin. It is one of the most important proteins in the human body, for it gives strength and toughness to tissues. There is evidence now that many diseases, such as arthritis, involve some abnormality in the manufacture or structure of this protein.

Pauling and his associates have already found that sickle-cell anemia, a hereditary disease of the blood, arises from abnormalities in the structure of the hemoglobin molecule. Knowledge of the atomic structure of proteins, therefore, promises to be extremely valuable in medical research.

Professor Arne Tiselius, vice-president of the Nobel Foundation, and himself a former chemistry winner, has termed Pauling's achievements "a major contribution to protein chemistry, a field where the slightest theoretical advance can have important consequences in explaining the nature of diseases and bringing a cure for them."

Chemical honors

Dr. Pauling's work has brought him the highest honors that the field of chemistry has to offer. In addition to the Award in Pure Chemistry of the American Chemical Society, which he won in 1931, he has received:

1941—the William H. Nichols Gold Medal of the New York Section of the ACS.

1946—the Willard Gibbs Medal of the Chicago Section of the ACS.

1947—the Davy Medal of the Royal Society of London, and the Theodore William Richards Medal of the Northeastern Section of the ACS.

1948—the Presidential Medal for Merit for his outstanding services during the war to the Explosives Division, the Chemistry and Rocket Divisions, and the Committees on Medical Research and Internal Ballistics of the National Defense Research Committee.

1949—the presidency of the American Chemical Society.

1951—the Gilbert Newton Lewis Medal of the California Section of the ACS.

Academic honors

He has received honorary degrees from 11 universities: including Oregon State, Princeton, Chicago, Cambridge, London, Yale, Oxford, Paris, Toulouse, Tampa and New Brunswick.

He is the author, or co-author, of five textbooks and of close to 300 scientific papers in the fields of chemistry and physics. And, to top off all this professional activity, he is still enthusiastically teaching Caltech's course in freshman chemistry.

Dr. Pauling was married in 1923 to Ava Helen Miller, who was one of his chemistry students at Oregon State. The Paulings live in Pasadena, and have four children: Linus, Jr., 29, is now Resident in Psychiatry at Queens Hospital, Honolulu; Peter, 23, was graduated from Caltech in 1952 and is now doing graduate work at Cambridge University in England; Linda, 22, was graduated from Reed College in Portland, Oregon, last June, and is now also studying at Cambridge; Crellin, 17, is a freshman at Reed this year.

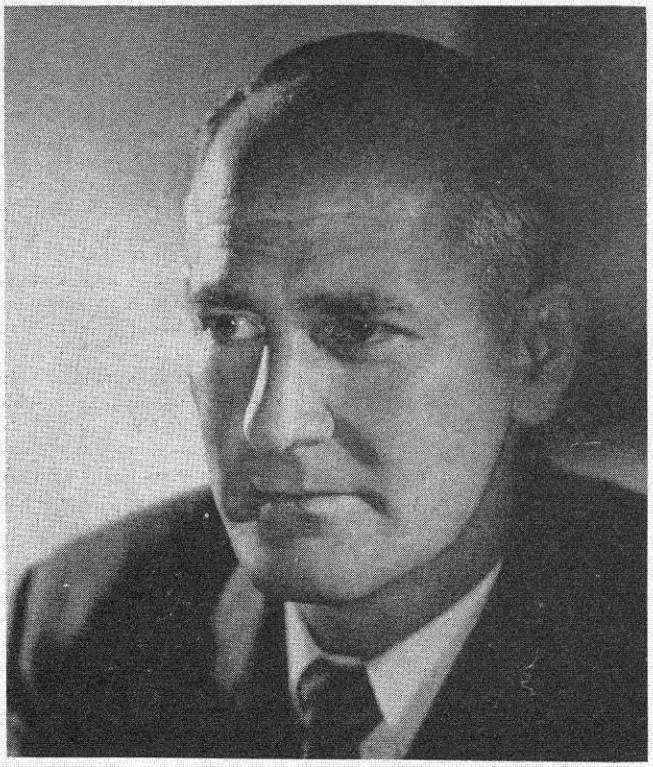
Pauling's statement

When he received notification this month that he had been given the Nobel Prize, Dr. Pauling said:

"The award of the Nobel Prize is a great honor, and I appreciate deeply the action of the Royal Swedish Academy of Science in selecting me to receive the 1954 Prize in chemistry. I am deeply appreciative also of the contributions made by my outstandingly able collaborators in the Gates and Crellin Laboratories of Chemistry of the California Institute of Technology to the work for which the Prize was awarded. I have been fortunate in having been for 32 years a member of the staff of this Institute, where there are unusually favorable conditions for carrying on scientific research.

"I have lived through the interesting period of initial development of the modern science of molecular structure, which might be called molecular architecture. Thirty-two years ago detailed structures were first determined for simple molecules, such as the water molecule. Now the structures of complex molecules, containing thousands of atoms, are being determined. I think that in the next few decades knowledge of the molecular structure of drugs and also of proteins and other constituents of the human body will lead to significant progress in biology and medicine."

George W. Beadle, Professor of Biology, Chairman of Caltech's Division of Biology and president-elect of the American Association for the Advancement of Science.



SECURITY AND SCIENCE

What's wrong with our present security system—and what can we do about it?

by GEORGE W. BEADLE

SECURITY IN THE BROADEST sense, of course, has many meanings—military security of a nation, financial security of the individual, and even evolutionary security of a species. Science is closely related to all of them. But I would like to talk about a very special kind of security; namely, the system that has been devised to prevent scientific and other information of military value from falling into the hands of a potential enemy.

Such a system requires that individuals be assigned varying degrees of security clearance, depending on the value of the information at their disposal. Thus we have clearance for top secret information, clearance for secret, Q clearance, etc. It is this system that I propose to discuss in terms of a few of the special problems it poses for science and scientists.

My knowledge of security in this sense is limited and I certainly do not claim to be an authority on it. I have been cleared, I have been a witness in an appeal from denial of clearance, and I suppose I've done an average amount of thinking and reading about the subject.

Like many others, I see in our present security system a machine so complex in its operation that, once having been set in motion, it is something almost impossible either to control or stop. And I sense a real danger that it may destroy our way of life if we do not find a means of controlling it.

The Oppenheimer case has brought into the open many of the difficult problems of security clearance. I shall not attempt to review the case here. This has already been done many times by persons much better qualified to do so than I. Some of you have read the transcript of the Atomic Energy Commission (and some say this transcript is itself a significant breach of security). An analysis of the case from a legal standpoint has been made by Professor Harry Kalven of the University of Chicago Law School in the September issue of the *Bulletin of the Atomic Scientists*. Arthur M. Schlesinger of Harvard discusses it in the October *Atlantic*. And many of you have read the account of it by the Alsops in the October *Harpers*. The case is included in Theodore White's article, "U. S. Science: The Troubled Quest," that appeared in the September 16 and 23 numbers of *The Reporter*. The September 25 issue of the British magazine *Nature* carries a long editorial attempting to explain the Oppenheimer case to its readers.

Some glaring inconsistencies

As these accounts point out, there are glaring inconsistencies in the AEC's position. On the one hand the Gray Board found Oppenheimer to have amply proved his loyalty, good judgment, and discretion in his twelve years of atomic energy work. In recommending denial of clearance it emphasized lack of enthusiasm for the H-bomb program. The Commission switched back to associations and behavior, of which it had full knowledge for many years, and charged grave defects in character. As you know, there were vigorous dissenting opinions by Evans of the Gray Board and by Smythe of the Commission—the only two scientists involved.

Aside from the question of great personal injustice to an outstanding physicist who has devoted twelve long years to government work, the Oppenheimer case has had many unpleasant repercussions.

It has split physicists and others into opposed camps and has consumed an incredible amount of time and effort on the part of able persons who might otherwise have used that effort in more constructive ways. The *Nature* editorial points out that only a nation as wealthy in talent as the United States could tolerate such conspicuous and extravagant diversion of its manpower resources.

Effect on government laboratories

The harm that has been done to government laboratories of science will probably never be fully known. How many scientists who might otherwise have joined the staffs of such laboratories will now choose some alternative?

To an outsider it would seem that the simple and direct solution would have been for AEC to allow Oppenheimer's appointment as consultant to expire, as I believe it would have done in a short time. I can see no reason why a government agency should seek or take the advice of an individual whose advice it doesn't want. It is a widely held belief that the alternative course was chosen in order to discredit Oppenheimer and strip him of influence in national and international policy matters. This is surely the result, for, as *Nature* points out, it would now be most embarrassing for Britain to even so much as seek his advice. If it is true that this was the primary motive, the case is a flagrant and inexcusable misuse of a security system that is designed to protect military secrets, not to discredit individuals.

The only good I can see that can possibly come of the Oppenheimer case is that it may lead to much needed revisions of the entire security system.

A negative system

The present system is largely a negative one. It says: In case of doubt, classify. In case of doubt, deny clearance. On first thought—and this, I'm afraid, is as far as many laymen go—it makes sense to classify everything and to clear only those about whom there is no derogatory information.

On further thought it becomes obvious that such a system has many serious disadvantages.

An airtight security system may slow down communications among scientists, between scientists and engineers, and between both groups and the military to such an extent that complete stagnation results. This is a serious problem. Allowing reasonable freedom of communication involves a risk of leaks and this risk must be balanced against the gain from more freedom. Many persons who have had experience with the present security system believe we have gone much too far in the negative direction.

Guilt by association

Too tight a security system may lead to too much dependence on that system— a false sense of security. Must of us felt pretty confident that the A-bomb secrets were effectively kept, but we learned to our dismay that this confidence was not justified. A tighter system might have prevented the leaks—one can never be sure of that. The price of a tighter system in reduced progress would have been a very high one.

Too tight a system reduces the number of competent scientists who can be used in classified work. Most laymen do not appreciate how large a factor this can be. Once the principle of guilt by association is admitted, we are all vulnerable. Those who defend Oppenheimer are potential security risks under an extreme system. Once the principle of lack of enthusiasm or faulty judgment is admitted as a basis of denial of clearance—and this the Gray Board did admit—the going gets even rougher. You and I disagree violently in our judgment as to the military value of a scientific development or a policy. I testify that your judgment is bad. You are equally certain that mine is no good. The result can easily be no clearance for either of us.

A basic difficulty with security clearance as now practiced is that it violates the basic principles of justice in a free society. It assumes that one is a poor security risk until every shred of doubt is removed—and there is usually no adequate opportunity to remove that doubt.

Such a system should be tolerated only in connection with military devices, policies, and plans of the most critical kind.

How can the system be improved?

There should be much more careful consideration of the question as to what kinds of information should be classified. The areas in which classification is practiced should be reduced to the barest minimum, particularly in times of peace. For example, AEC employs many biologists in its laboratories. Most of them do work that could perfectly well be unclassified. Yet, these laboratories in many cases are located "behind the fence"—in classified areas.

There is no doubt but that some very able scientists have refused to advise AEC, not because they believe they could not pass security clearance, but because they feel that the whole procedure is so unnecessary in the area in which their advice is sought. The system is so rigid that AEC cannot employ a scientist as a consultant without the full clearance process, even in areas like general genetics, where there is no need whatever for clearance. In many respects this is as unreasonable as requiring full security clearance for a man who digs a post hole for the AEC security fence. It is obvious that reduction in the amount of classified material to a level consistent with genuine military security would go a long way toward solving problems of this kind and would greatly reduce the number of persons requiring clearance.

Derogatory information

The clearance procedure for individuals should be modified drastically. The criteria by which information is evaluated should be clarified. As an example, I know of instances of denial of clearance where the following kinds of information were regarded as significantly derogatory:

1. Past membership in the AAAS. (The American Association for the Advancement of Science has 40,000 scientist members.)

2. The fact that a man's brother learned Russian 10 years earlier. (Most universities teach Russian to large numbers of individuals.)

3. Receipt of an information bulletin from the Soviet Embassy that was sent unsolicited to large numbers of persons—a publication much like the one our government now circulates in Russia, or did until recently.

No one with intellectual curiosity can be a good security risk under such a system carried to its limit.

Or let me cite another example of evidence taken in a hearing which I attended as a witness. I was asked, "Do you believe A (an associate and friend of long standing) is a Communist?"

My answer was, "No."

Evidence —and Conclusion

"Do you believe your friend A is a Communist?"

"No."

"Did you know B?"

"Yes."

"Did you know he was a Communist?"

"No."

"Then how do you know A is not?"

Conclusion: A is not a good security risk.

"Did you know B?"
"Yes."
"Did you know he was a Communist?"
"No."
"Then how do you know A is not?"

Of course I couldn't *know* with certainty.

Conclusion: A is not a good security risk.

I'm glad to say that after two years and the expenditure of much time and money on the part of A and his friends, he was cleared. But by that time he didn't want the job for which clearance was requested.

More emphasis needs to be given to positive evidence. In judging the Oppenheimer case many of us would have given more weight than did AEC to 12 years of faithful, loyal, and effective service to the nation—12 years with no slightest evidence of a disloyal act or of even a misplaced classified document.

There is another trend involving security clearance that in some respects gives even more cause for concern than those I've mentioned. This is the extension of security clearance to unclassified areas. Although it is a matter of public record that this has now been done by some government agencies, relatively little publicity has been given to the practice.

The facts are these. The U. S. Public Health Service now checks FBI files for derogatory information about

principal investigators who will direct unclassified research under USPHS grants to universities.

There is no disclosure of the details of the procedure. No open statement of criteria by which derogatory information is evaluated has been made, and there is no opportunity on the part of the individual to explain the circumstances or answer the charges. To indicate the absurd kinds of situations such a practice can lead to, I can cite the case of a well-known scientist who, while holding security clearance for secret information with one agency, had an unclassfied USPHS grant withdrawn because of derogatory information that was holding up a security clearance for top secret work with a third government agency.

A harmless policy?

If one does not think carefully about the implications of such a policy, it may seem harmless enough.

Those responsible for the expenditure of government funds should be persons of character, integrity, loyalty and discretion, shouldn't they?

Certainly. But is it necessary that a man be a good security risk in order to work on blood proteins, for example?

Let's say he has relatives behind the Iron Curtain. This fact might be a valid reason for denial of security clearance, but it is not a valid reason for denying him a grant to study blood proteins.

There are many valid grounds for denial of security clearance that transcend loyalty, good character, integrity, and discretion. Of course, the degree to which an individual has these qualities of character must be established. But is it a proper function of government to do this when classified work is not involved?

The institution and the individual

USPHS grants for work in colleges and universities are made to institutions, not to individual scientists. Therefore the responsibility for determining that the investigator is a person of good character should rest with the institution. The institution can do a better job of determining this fact than any government agency.

Unfortunately, persons outside the academic community do not know with what care the qualifications of prospective faculty members are examined. Characteristically, this procedure involves letters of recommendation from individuals in academic life who know the candidate personally and who are in turn known personally by those who evaluate the recommendations. Usually personal interviews are arranged. Unless the person being appointed is well established in his field and therefore well known professionally and personally, there is a trial appointment of one to five years during which a person is under close and careful scrutiny of his colleagues, not only in regard to professional competence, but also with respect to character, personality, decent behavior, and good judgment.

The danger of a mistake, of course, still exists but it is small. And if a mistake is made, the harm that can be done is usually not great. It is true, political views are not often directly investigated and conformity in opinion is not required. But this does not mean that disloyalty and subversion are tolerated or should be.

The universities' responsibility

Not only should universities be conscientious about determining the qualifications of staff members, but they should insist on assuming this responsibility in all areas of non-classified work.

The assumption of this task by government agencies is an invasion of the rights of university faculties, administrations, and boards of trustees. It should be resisted with vigor. Universities must insist that they can, and DO, do the job adequately.

Now that I have alleged that the entire security system needs overhauling—a need widely recognized among scientists in government laboratories as well as outside—what do we do about it? And what do we do about the problem created by the extension of security clearance techniques to unclassified work in universities?

On the latter point, there is almost unanimous agreement among scientists, including a high proportion of the professional and administrative staffs of USPHS itself.

Attempts have been and are being made to solve this problem quietly behind the scenes in Washington. The offending policy apparently comes directly from the Secretary of Health, Education, and Welfare, Oveta Culp Hobby—at least she has publicly acknowledged responsibility for it. But she seems resistant to all appeals to reason.

I hope Secretary Hobby will eventually undergo a change of heart. But even though this would solve the immediate USPHS problem, it would not be a final solution.

It's everybody's problem

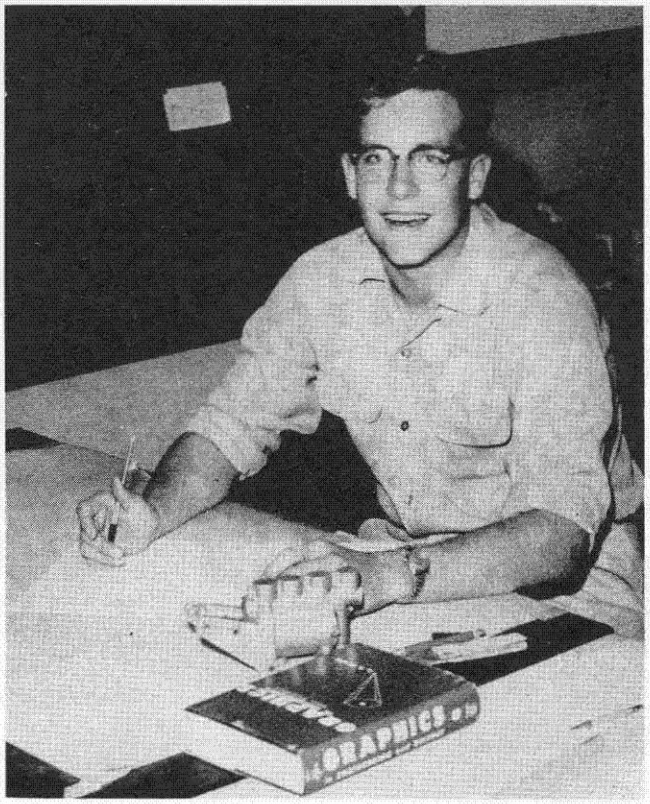
I believe what is necessary for intelligent handling of all security problems of the kind I am talking about is clear thinking on the part of all parties concerned.

In the universities, this process should start with individuals. It is our responsibility as faculty members to understand the problem in all its implications. The same is true for administrators and trustees.

We must all realize that denying the existence of the problem or otherwise evading responsibility will not solve it—and might even delay its solution.

If, after study and reflection, we still believe that our present security system needs revision, our next logical step is to make the public and members of Congress understand the reasons for our opinion. In short, we must do everything possible—individually and collectively—to create wider areas of understanding on this fundamental problem.

ALUMNI SCHOLAR



Timothy Harrington '58

Caltech recently entered into a solemn agreement with nearly 100 other colleges to play down publicity on scholarship awards. Yet here we are playing UP the awarding of the first Alumni Scholarship to a Caltech freshman.

In this case, we plead special circumstances. Last year, the Alumni Association's Alumni Fund set as its new objective the establishment of a series of Alumni Scholarships. Now that the first of these scholarships has been awarded to Timothy Harrington '58, it seems only fair to let the many contributors to the Alumni Fund in on this fact—since he's their boy. So meet Mr. Harrington.

THE CALTECH ALUMNI FUND reached its initial goal last year when it raised $167,000 for the construction of a swimming pool and locker rooms, now nearing completion on the campus. As its next objective the Alumni Association set the establishment of an endowment to provide for undergraduate scholarships—four-year, full-tuition grants to be known as Alumni Scholarships.

Contributions were great enough in 1953-54 to provide for the granting of the first of these scholarships this fall to a member of the entering freshman class. Timothy Harrington of Santa Rosa, California, was selected by the Caltech Committee on Undergraduate Scholarships and Honors to receive the award.

Timothy is 17, and a graduate of Santa Rosa High School, where his scholastic rating put him among the first 10 students out of a class of about 200. (After two months at Tech he notes, a little wistfully, that it was easier to stay on top there than it is here.)

He worked during his high school years to save up for college. When he was a young sprout he had a paper route. Later he became a delivery boy and stock boy for a drug store, working from 6:30 to 9 every evening, with longer hours on weekends.

As a result, he didn't have much time to go out for sports, though he did serve as track manager in high school. At Tech, now, with his time his own again, he's been out for freshman football, playing second-string left tackle ("Second string," he explains modestly, "because there are only two of us playing that position.")

In high school he was an avid stamp collector, a hi-fi fan, and a devotee of science fiction. Tech hasn't changed these hobbies much, though there's not much time for stamps anymore.

Timothy's father is Deputy County Surveyor and Road Commissioner for Sonoma County. He has two sisters, 14 and 10. He's always been interested in science in general and, since junior high school, physics in particular. As of now, he wants to do research in nuclear physics at Tech.

In junior high school he won an honor award—as the student of the year who had demonstrated the highest degree of citizenship and rendered the most service to his school—the highest award bestowed by the faculty. He doesn't seem to have changed much since then.

In spite of his first attack of midterms he's still enthusiastic about Tech. "One of the best parts," he says gratefully, "is, like one of my friends says—you can use words of more than three syllables around here and be sure everybody will understand you."

WHAT EVERY TECHMAN KNOWS

NOW EVERYONE KNEW what it was like to be a Techman.

The freshmen knew what it meant to be so far behind in their work that it seemed impossible to catch up—and, for most of them, this was a new sensation.

Even a few upperclassmen were feeling the pain worse than ever before. Heavier academic loads, stiffer competition, more outside activities—everything seemed to place a premium on time; but nobody seemed to have any.

Rotation

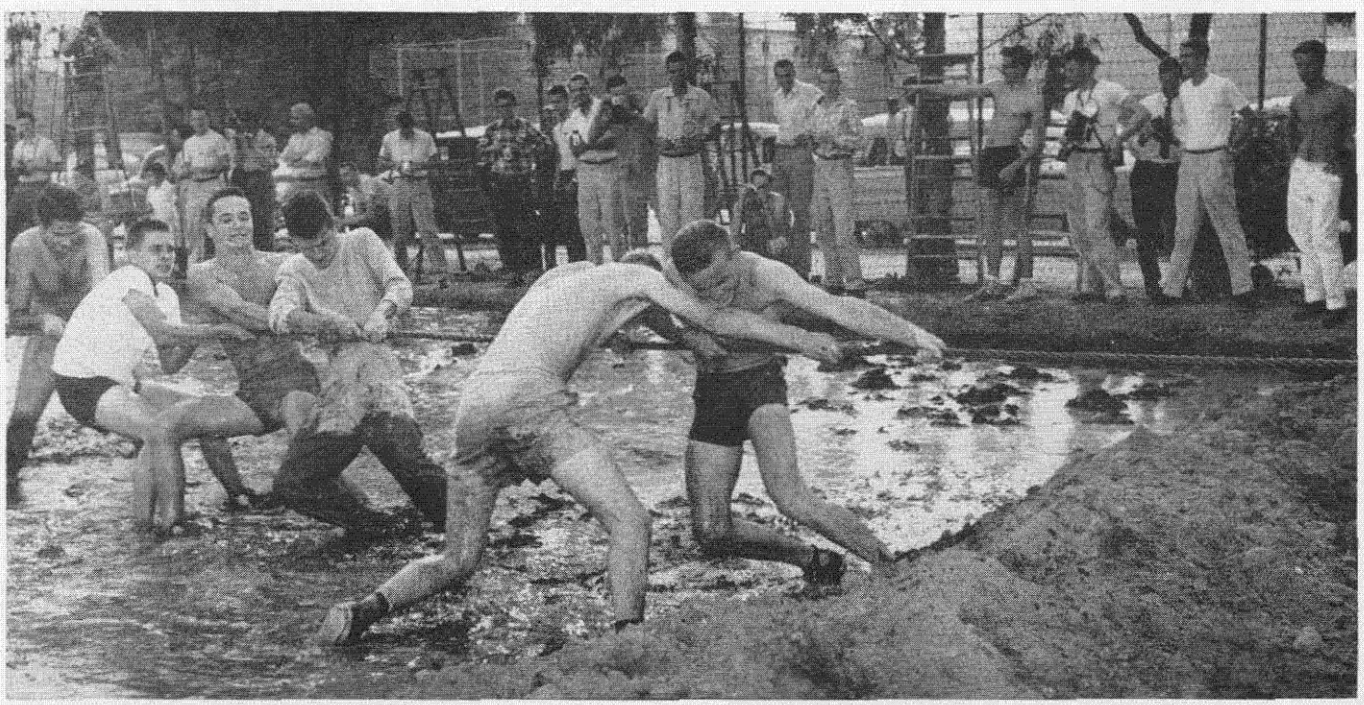
Rotation whirled to a friendly close (although certainly the close is the least friendly part of rotation) and each of the houses boasted proudly that it had again skimmed the cream for its list of entering freshmen. Every frosh had learned more names in a week than he had ever expected to learn in a year, and every upperclassman had crammed into his head dozens of freshmen's names which he expected to forget immediately.

So initiation began. The dust that was gathering on the bone-dry courtyard floors suddenly was washed away, as 1301 East California Street was bathed in its annual October rainy season. A couple of guys got hurt, the waterfights were clamped down on, but nothing could stem the tide of initiations in general. Mudfights and raw eggs were forced upon hapless pledges until they rebelled. Toilet seats, shower heads and fuses disappeared mysteriously into the night (the only mystery being which house's frosh had taken them.) Cold showers enjoyed a new vogue, and enterprising capitalists were making huge profits on the sale of balloons.

Heavy snow

Then, suddenly, initiation was over, the frosh were in the houses, and quiet reigned in many quarters as the wiser students snaked furiously in order to make up for two weeks of mischief-making.

The freshmen in particular were hiding behind locked doors. A few foolhardy ones had been trapped by the lounge rats and the card players, and had been sucked into the maelstrom of babes, bridge, and benzedrine. But most took their studies at least as seriously as they knew how. They knew now what MRW was, and the legend of Rastus Pasmoquoddy. They had seen Pauling get six decimal places from a six-inch slide rule, and



Highlight of all non-varsity athletics at Caltech this fall—as it has been every fall—was the Mudeo.

they knew how to solve pulley problems with Conservation of Rope. Most of all, they knew what upperclassmen meant when they said that "it snows here all year around."

Sports

The football team was, as it should be, the center of athletic interest. In the season opener against Pomona's returning champions, the eleven stood up well; the next week, against a superior L. A. State aggregation, the Beavers took a 12-0 first half lead on a very strong showing, but collapsed in the fourth quarter from sheer exhaustion to go down 20-12.

The soccer team promised another good year, even if it did have to draw mostly on American talent—and the water polo and cross country teams showed early that they knew how to win. The frosh footballers clearly outplayed the Oxy frosh but had two bad breaks beat them, 12-0.

Blacker was out to steal the Interhouse Trophy and, on the basis of the first two sports, softball and cross country, had piled up a commanding lead, with firsts in both events. Nobody could be counted out, though, and the three next teams in the Interhouse race were separated by only two points.

Highlight of all non-varsity athletics, it must be admitted, was again the Mudeo. The sophomores, class of '57, enjoyed the usual advantages: experience, and fewer losses through ineligibility (three dozen frosh were ineligible through football alone.) The frosh put up the usual good fight but received the usual licking, 4-3, which was, as usual, in doubt up to the last event, the tire spree. Several television stations covered the Mudeo this year and played their movies back later in the day, while a few dripping contestants even got their pictures in the paper.

The Ricketts frosh, at least, had their revenge, for they won the brake drum in the very first riot.

Social life

Social life started on its merry whirl. "More exchanges and better ones!" was the mating cry of any social chairman, whether of ASCIT or one of the houses. Girls were brought in from every place imaginable, treated like queens, and their names, addresses and phone numbers recorded.

ASCIT even brought a hundred Scripps women to the L. A. State football game, and to a dance afterwards, in order to do its share. A couple of weeks later the annual Scripps Bike Race and Barbecue was a big success. (It had to be, for the Scripps kitchens did not serve that night.) Blacker won the bike race, but everybody won a Schmippsie who really tried.

Steady fever

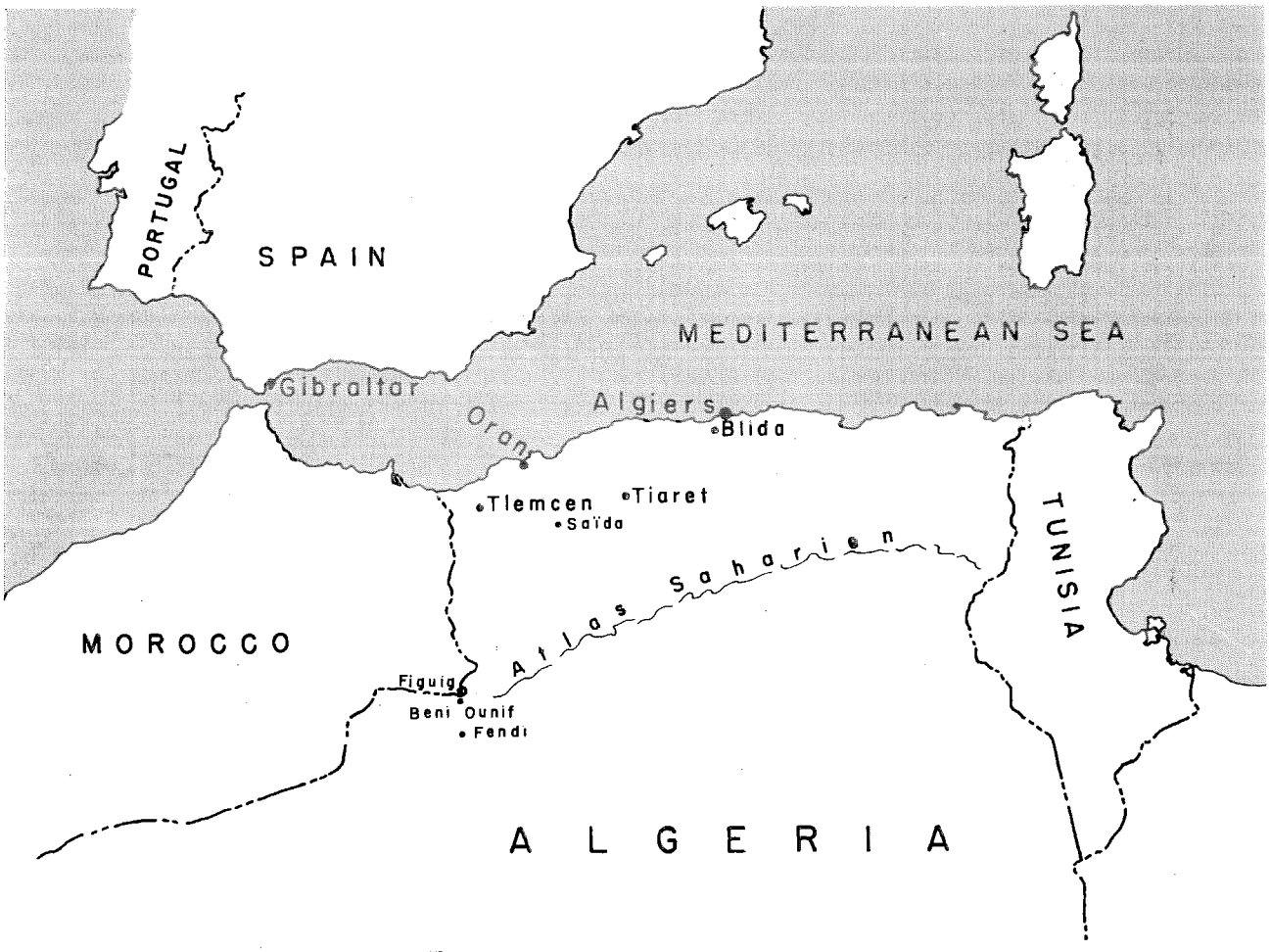
November is upon us now, and there is a new fever in the alleys and lounges. It's time for Midterms, and the Interhouse Dance—and every Techman will go down on his knees to the man who invents the thirty-six hour day.

But until that inventor makes himself known, every Techman will drag himself out of bed mornings long before he has had as much sleep as he wanted.

It is his way of life.

—Martin Tangora, '57

The experienced sophomores won the Mudeo—and stuck the freshmen with the bill for this year's Frosh-Soph Dance



A BOTANIST IN THE SAHARA

Some pages from the travel dairy of FRITS W. WENT

Last summer I signed up for an excursion to Algeria, to be held before the International Botanical Congress in Paris. One of the main reasons I took this trip was to visit the Sahara, if only for a few days, to compare it with the other deserts I had seen.

Algiers, June 14

The excursion is not going into the desert as originally planned, because it is already too late in the season and blazing hot. But since that is what I came for, I arranged to go only for the first week with the excursion and then take the train to Beni Ounif on the edge of the Sahara near the Moroccan plateau, and stay there five days. Everywhere it seems to be politically quiet and safe, and I was warned only against scorpions and snakes.

This afternoon I took a long walk through Algiers. I was told that the Casbah was safe to walk in during the day, and this proved to be the case.

Along the Rue de La Casbah there were open air restaurants, with the tables and chairs leaving just enough

space for the donkeys and pedestrians. Not a car penetrates this Arab quarter, and I did not see a single non-Arab. I hope to see it in sunlight, too; I couldn't take any pictures today in the gloomy, overcast light.

It probably seemed more gloomy than it really is, for the number of blind and deformed people is appalling, and almost every other disease, even leprosy, is common. Nor have I ever seen a more complete collection of whiskers of all sizes and descriptions.

The women still go largely veiled, though the nose and mouth seem to be the only parts of the face which should be hidden now—behind almost transparent nylon handkerchiefs.

The stench was terrible—as bad as in Jaffa—largely rotting urine, but also rancid fat from frying, mixed with spices. Streets either go up and down as stairways, or are almost level. Whereas there seems to be a minimal street width at walking level, every house tries to steal as much space above the street as possible. The second floors jut out into the street so that, higher up, the houses are less than a yard apart, and sometimes are even built together.

The living quarters were worse than anything I saw elsewhere, even the smallest holes had mattresses with people lying on them. Whereas all the houses in the Casbah were many stories high, just outside it there were packing-crate hovels, covered with corrugated iron, which would have made the Okies of the thirties blush. They were piled three deep along some of the streets, and served as living quarters and stores at the same time. Instead of doors they would have a curtain of blouses or garments which were being sold.

Boghari, June 15

This morning the excursion started exactly on time, with 15 of the 17 excursionists present. A big bus was waiting for us in front of the botany building of the university.

We first drove through the rich quarters of Algiers, with enormous villas surrounded by gardens. Here there were bougainvillea, jacaranda, and other trees flowering, but on the whole not much is done for the beautification of the city with trees.

All country we crossed today was calcareous, and in many places it made me think of Israel or southern Spain, and later also somewhat of southern California. We first crossed the hills of Sahel, immediately behind Algiers, with no natural vegetation left, and then came into the Mitidja Valley, which was—before the arrival of the French 125 years ago—a big swamp. Now it is drained and very fertile and looks like the Esdraelon Valley in Galilee.

After passing through Blida, we arrived at the Atlas de Blida, which is hardly 2000m. high, but which we crossed through a deep, impressive canyon. Along the stream lots of wild oleanders made a pink ribbon, and on the slopes wild figs and wild olives grew. We stopped at a small side canyon, the Ruisseau des Singes, where there is still a whole colony of wild monkeys.

Emerging from the canyon we came onto a landscape of rolling hills with a lot of erosion, planted largely to grapes. At the price of wine (20-25c a bottle) they must grow grapes for pleasure rather than profit.

In the Ouarsensis, June 16

After a short night in a rather primitive hotel in Boghari we left at five this morning. The country was much drier, and completely deforested with even no macchi (chapparal) left and very poor cereals cultivated by the Arabs.

Late in the morning we arrived at Teniet-el-Haad, where a National Park has been created to protect one of the few stands of Cedrus atlantica (Mediterranean cedar) left in Algeria. Although deforestation can account for a part of the paucity of Cedrus stands, even before man came they must have been very scattered too, like Sequoia. Many of the trees which are left are magnificent, perhaps 500 years old; the oldest tree counted had 800 rings. The largest I saw had a circumference of 7½m. It is remarkable how successful Conifers really are as trees, at least in cool climates. This is perhaps another example indicating that there is no such thing as evolutionary pressure and that once an organism is adapted it cannot become "better" adapted than other organisms living under the same conditions. That is to say, adap-

Frits Went, Caltech Professor of Plant Physiology, is in charge of the Institute's Earhart Plant Research Laboratory, where plants are grown under every possible climatic condition.

tion is to the physical environment, and not in relation to the other existing plants.

June 18

We are now on the road from Saida southward to drier regions. If we could follow it for 2,000 miles we would arrive in Tombouctou. The country is a high plateau, gently rolling, treeless, and largely planted with barley—hundreds of acres at a stretch. Some of it looks excellent, some beautiful—all red with poppies. Everywhere you see Berbers' tents, which look just as decrepit as the Bedouin tents in Israel. There are usually some donkeys around, and in a few places the camels are close to the tents.

The donkeys are the main means of transport, and the methods for riding them are numerous. One either sits astride, in the middle or further back, closer over the props if the donkey is small or the rider large. One can also sit sideways, with both legs on one side—but in either position one kicks the belly of the donkey once per second with both heels. The more important Arabs ride horses, and have saddles with backrests.

As for other animals—there are no mosquitoes, few flies, lots of really vicious Arab dogs, many scorpions (they said one under every two stones, but we found only one under every *four* overturned), some snakes—among which adders are the most poisonous — many singing birds near water, and lots of storks with nests on roofs, chimneys, dead trees or even palms. On the flower heads of thistles there are lots of butterflies and brilliantly colored beetles. There were Scarab beetles rolling manure balls. But I did not see—or feel—bedbugs, fleas, or cockroaches.

June 19

After leaving Saida we drove all day through more or less mountainous country. There was very little forest left, and the undergrowth became opener. This made the development of annuals good, and more and more appeared. I had a good day collecting seeds.

At noon we stopped at Sidi bel Abbes, headquarters of the Foreign Legion, and saw their museum, which is not particularly inspiring. We stopped for the night in Tlemcen, which lies at about 800m. altitude and is nice and cool, even in summer, so that many people come here to escape the humidity of Oran or the coast in general.

In the the town there are three mosques and an old Arab fortress, now of course held by the French. Outside the town there are rather remarkable ruins of the walls and towers of a second city, built there by the Sultan of Morocco, who once laid siege to the Sultan in Tlemcen. When this siege stretched over many years, the Sultan of Morocco built a separate city for his army just outside the city of Tlemcen, and the ramparts and the Tour du Juif still exist.

June 20

This morning we walked to a canyon just outside Tlemcen, where a river comes down from the rather high mesa-like mountain, making fine waterfalls. It was perfect Sunday-morning weather, sunny with just enough wind to make it cool.

We passed Arab houses and saw a lot of washing being done in an irrigation ditch, which followed the contour lines of the rather steep mountain.

While washing, most women do not have to be veiled, fortunately, for in inland Algeria all Arab women look like nightmares, with a white sheet wrapped around them, from which only a single eye peeks out. Why there are not more traffic accidents I do not understand, for these women cannot possibly judge distance.

In a pine forest planted against the higher slopes of the mountain dozens of families were camping. These were largely Arabs—quite emancipated, for the women were not veiled and the younger boys and girls were doing some sort of folk dances.

En route to Beni Ounif, June 22

Before going on with our daily progress, a few observations on smog. Everywhere over Algeria hangs a more or less dense blue haze. In the mornings a whitish haze forms near the surface of the soil in the valleys, which rises as a bluish haze and soon decreases visibility of the surrounding mountains. The previous day's smog seems to lie as a definite layer at perhaps 1000m. height.

Near Oran the smog is denser, and clear pictures of the city from a distance seem to be impossible at this time of the year. I was told that this haziness is most pronounced in May and decreases in August, when the vegetation becomes very dry.

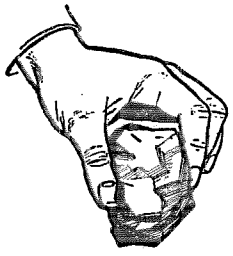
Beni Ounif, June 24

Today we had an exciting day. At 6 a.m. we left Beni Ounif on foot, taking with us food and water for the day. We walked the 8 km. to Figuig, one of the largest oases in existence, on Moroccan territory. We first crossed a very flat and almost vegetationless plain, with here and there in the lower places a green shrub of Zyziphus Lotus. When we came to the mountains we found a bright green shrub I had already seen from a distance, which proved to be Capparis spinosa, perhaps the most amazing plant I know. It was anchored in the crack of a rock, with no apparent roots reaching the soil below. This would not have done it much good anyway, since there were practically no other plants growing in the neighborhood, and so there must have been very little water around. Yet the plant had lush green leaves and beautiful white flowers.

Later we saw about a dozen other plants growing in rocks, some of them having obviously split the rock. This plant must be able to grow without any water from its substrate, and must develop enormous suction forces. But why, if the plant is so obviously adapted to extreme desert conditions, does it not grow all over these mountains? It is not grazed off either—partly because it

QUARTZ CRYSTALS

How a 1¼ hour "gem-cutting" operation became an 8-minute mechanized job



PROBLEM: Preparing quartz crystals for use as electronic frequency controls calls for the highest degree of precision. So much so, in fact, that prior to World War II skilled gem-cutters were employed to do the job.

But during the war, there were not enough gem-cutters to keep up with the demand for crystals in radar, military communications and other applications.

Western Electric tackled the job of building into machines the skill and precision that had previously called for the most highly skilled operators.

SOLUTION: Here is how quartz crystals are made now—by semi-skilled labor in a fraction of the time formerly required:

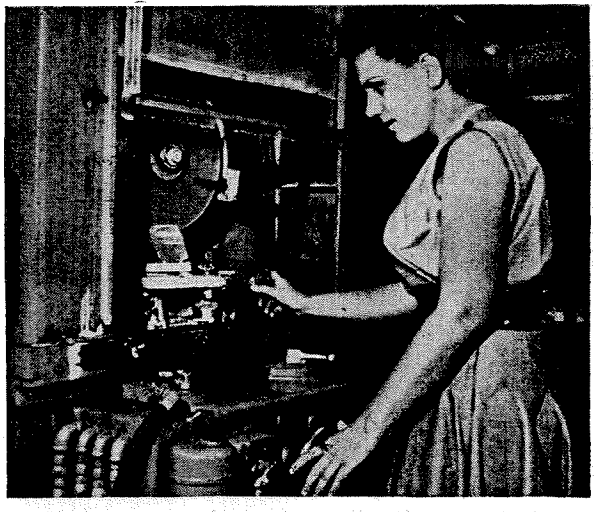
A quartz stone is sliced into wafers on a reciprocating diamond-edged saw, after determination of optical and electrical axes by means of an oil bath and an X-ray machine. Hairline accuracy is assured by an orienting fixture.

The wafers are cut into rectangles on machines equipped with diamond saws. The human element is practically eliminated by means of adjustable stops and other semi-automatic features.

The quartz rectangles are lapped automatically to a thickness tolerance of plus or minus .0001". A timer prevents overlapping. Finally, edges are ground to specific length and width dimensions on machines with fully automatic microfeed systems.

Most of these machines were either completely or largely designed and developed by Western Electric engineers.

RESULTS: With skill built into the machines —with costly hand operations eliminated— this Western Electric mechanization program raised production of quartz crystals from a few thousand a year to nearly a million a month during the war years. This is just one of the many unusual jobs undertaken and solved by Western Electric engineers.



Quartz stones are cut into wafers on this diamond-edged saw, with orientation to optical axis controlled by fixture. This is just one of several types of machines designed and developed by Western Electric engineers to mechanize quartz cutting.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; Haverhill and Lawrence, Mass.; Lincoln, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City.

grows in very inaccessible places, and partly because of the extreme bitterness of the leaves.

At the pass between two mountains we came upon the road to Figuig, and the overflow of the oasis water passed through there and supplied a fair number of date palms, surrounded by little gardens. In the distance Figuig lay on a high mesa, one mass of date palms, with a few mosque towers sticking out.

The whole town of Figuig, with 10,000 inhabitants, is surrounded by walls, and each individual date garden is also walled with stone or adobe walls, 2-3m. high. Each family owns such a walled garden, and other crops are grown in between. The wheat had just been harvested, and in some places vegetables were planted, although most gardens were left dry over the summer, when there is not enough water to irrigate the whole surface of the oasis.

We went first to see the captain of the garrison. He gave us a guide, who showed us the whole oasis, which is a composite of about seven villages. At the head of it is a Pasha, who rules as a mayor with Shirs, a sort of councilmen, one elected by each village. Each village also has its Cadi, a Justice of the Peace. On our walk a very dignified Arab came up to us, ceremoniously gave us a hand, said a few polite things, and went on his way. He was a Cadi.

We first went to the springs, where all the water for the oasis comes from. They are very large, and must be artesian, for they are located at the highest point on the mesa. They are probably cemented-over, and we heard a lot of noise from small boys emerging from one of the springs. Our guide chased them out of the spring, where they had been swimming. From the endless number of naked copper-brown boys emerging from the staircase I imagined that the spring was larger than it actually was. Inside it was suffocatingly hot and humid. Another spring was beautifully clear and blue. From these springs, about 5m. below the surface of the village, an amazing network of underground ducts distributes the water through the oasis; everywhere there are manholes through which these ducts can be reached.

Then we walked through the living quarters of one of the villages, with a maze of little streets just wide enough for a donkey with his burden. In some places the streets were completely covered with houses and formed cool places where men congregated. The sanitary system seemed very good, for the whole village smelled sweet. We saw dozens of apparently public privies just off the street. In the older parts of the villages there are watchtowers, still left from the time when villages fought bitterly among themselves.

Finally we saw the Public Garden, with a slight attempt at a formal garden and a nice public swimming pool. After having eaten our lunch near one of the springs, to the accompaniment of the joyous cries arising from any swimming pool frequented by boys, we tried to find our way back. We did not want to take the same road we had come on, and soon found that the village was one of the most cleverly designed mazes we had ever seen. We knew in which direction we had to go, but innumerable times crossed our path, trying to emerge from the endless walls which always again loomed up around us. It took us exactly one hour to get out again. At 2 p.m. we reached Beni Ounif again, more dehydrated than any of us had ever been before. We stood under the shower with a bottle to drink from, trying to let water re-enter our system from all directions.

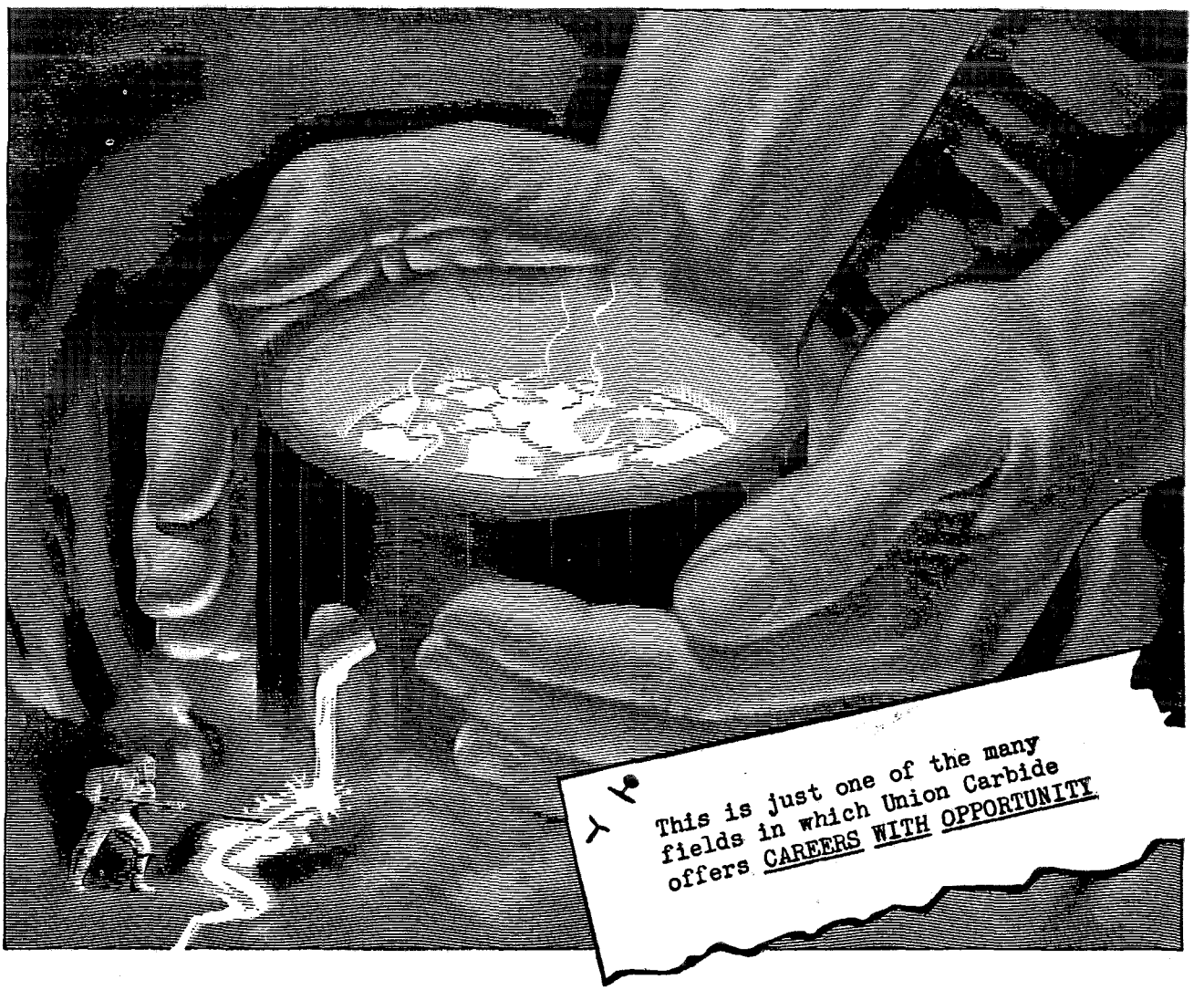
At 4:30 the military doctor came to get us. He had to make a visit to an outlying village, Fendi, and went there with his Arab assistant in a jeep. The road was fair—just a scraped surface, going through an endless desert plain, with low mountains to the NW. Here and there a smaller or larger group of palms indicated water, and in each of the larger clumps there was a well for watering sheep and camels, which were grazing all around on the sparse vegetation. It had been a very wet winter, and lots of dried-up annuals covered the ground. But there were very few perennial plants to be seen.

Beni Ounif, June 25

Fendi itself was a very small village of perhaps 100 inhabitants. It is of course, an oasis covered with date palms, which looked good. We were very ceremoniously received by the village notables, the doctor being an important official. A big colorful carpet was rolled out under the palms, very nice pillows, all home-made, were placed on it, and the doctor presided over the assembly in a friendly but dignified manner. He spoke some Arab, but most of what he said was officially translated. I spoke some with the Arabs, who had a slight knowledge of French.

When they asked where I came from, they knew the United States, but California or Los Angeles did not register. Then I thought I had a bright idea, and told them I was from Hollywood, but that drew a similar blank. I realized later that these people have never seen or heard of movies.

As I was invited to sit down on the carpet, I realized just in time that one takes off his shoes in Arab countries as one is invited in. Then the tea ritual started. The president of the village ordered his underlings to bring everything. A water kettle with a 5mm. thick layer of soot was placed on a fire nearby, and then a big brass tray with a silver teapot and five glasses and a lot of other paraphernalia was placed in the center of the carpet. Out of a teacan of the old-fashioned type I remembered from Holland about a half cup of tea was poured into the teapot, which was first rinsed with water, and this wash water was thrown away. Then the pot was three-quarters filled with water, and little packages of mint were stuffed into the pot. Then a big sugar-loaf was produced and a brass hammer, looking like a geological hammer.



The hotter...the better

Carbon has a peculiar quality—it's at its best when "the heat is on"

IN THE ROARING HEAT of steelmakers' furnaces, molten metals boil and bubble like water in a teakettle.

STANDING FIRM in the intense heat of many of these furnaces are inner walls made of blocks of carbon.

Because pure carbon laughs at heat—actually grows stronger as it gets hotter—it has become vitally important in making iron, steel, and many of the other things all of us use every day.

IN CHEMISTRY, carbon and its refined cousin, graphite, handle hot and violent chemicals that would quickly destroy metal or other materials. Today there are pumps, pipes, tank linings, even entire chemical-processing structures—all made of carbon or graphite.

UCC... AND CARBON—*For over 60 years the people* of Union Carbide have pioneered in the discovery, development, and production of many carbon and graphite products for both industry and the home. This is one more way in which UCC transforms the elements of nature for the benefit of all.

STUDENTS AND STUDENT ADVISERS: *Learn more about career opportunities with Union Carbide in* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Write for booklet H-2.*

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.
In Canada: UNION CARBIDE CANADA LIMITED

UCC's Trade-marked Products include

NATIONAL Carbons ELECTROMET Alloys and Metals HAYNES STELLITE Alloys PRESTONE Anti-Freeze LINDE Oxygen
ACHESON Electrodes PREST-O-LITE Acetylene PYROFAX Gas EVEREADY Flashlights and Batteries Dynel Textile Fibers
KARBATE Corrosion-Resistant Equipment BAKELITE, VINYLITE, and KRENE Plastics SYNTHETIC ORGANIC CHEMICALS

The sugar-loaf was skillfully reduced to large pieces which could be stuffed into the pot. After a proper waiting period the brew was officially tasted, and poured from great height into the glasses. It was very sweet, but delightfully refreshing. Then the spent mint was removed from the pot, some more tea added, new mint, water and sugar, and then a second cup was poured.

As a guest you have to drink three glasses like this in succession, but I stopped at two. And I did not have any bad effects from it. The tea, however, was green tea.

In the village I made a list of the plants which they cultivated. In the middle of the oasis they had a dam which kept a small lake as a water source. The level, however, was low, and consequently they did not have enough water for irrigation in some places and their cultures had started to wilt. The water is all pulled up in very primitive buckets made of old automobile inner tubes fastened to a lever with a counter-weight.

One of the interesting things about their cultures is the complete absence of our common garden pests and diseases: no aphids or viruses. Tomato plants looked excellent; they were just starting to get into production. All is used for local consumption; not only are there no local markets, but transport over long distances over the desert would be impossible.

Of fruit trees, in addition to dates, there were fig, peach, apricot, lemon, grape, and pomegranate (only the latter in abundance). Vegetables grown were tomato, cabbage, eggplant, squash or pumpkin, onion, broad bean, watermelon, pepper (paprika), perhaps a little corn.

Beni Ounif, June 26

The first day we arrived I was surprised at the low intensity of the sunlight here. At 0900 or 1000 you could look almost directly into the sun, which had a whitish haze around it. Everyone had told me that the radiation of the sun was so strong here that you *had* to wear a hat or something. This proved to be nonsense, and in Dr. Maire's publication *Études sur la Flore et la Vegetation du Sahara Central*, I find that he says that in the Sahara the photochemical light intensity is much weaker than one would think at first, because of the frequency of dust in the air. Dust content of the air is so great that sometimes "dry fogs" occur (veritables brumes seches). But because of the low vapor content of the air, the heat radiation is high, and this causes high temperatures.

Wind is very common in the Sahara. This causes a curious surface-pitting of stones, which we hardly have in California deserts. The typical desert sheen I have not seen here. Since we came here there has been much wind, which comes up very suddenly, and then as suddenly stops. This is largely a question of local heating, for the barometer did not change abruptly during these wind-storms, and during night and early morning the air was very quiet. The enormous expanses of flat terrain without intervening high mountain ranges certainly must help in building up strong winds. I wonder whether it is this wind that keeps vegetation here so poor.

En route to Algiers, June 27

The excursion has been so concentrated thus far that there has not been time to consider in a more detached way what I have seen thus far in Algeria. I cannot say that I feel at home here, although many aspects of the country remind me of other Mediterranean countries or of California. I do not know whether that is because there are hardly any forests where one might find refuge, or no higher mountains where unspoiled vegetation beckons the biologist, or whether it is the humidity of the coast zones, the dirtiness of the Arabs or the cyclopic women—looking like Ku Klux Klanners—or the monotony of the landscape without trees.

The wheat fields are enormous but it seems that they produce just enough for local consumption. The Arab wheat fields are poor, with lots of weeds, and are on odd lots around their villages. They are harvested by hand, but the big European cultures are just now being harvested by big combines. Nowhere is the monotony of these wheat fields broken by a farm surrounded by old trees.

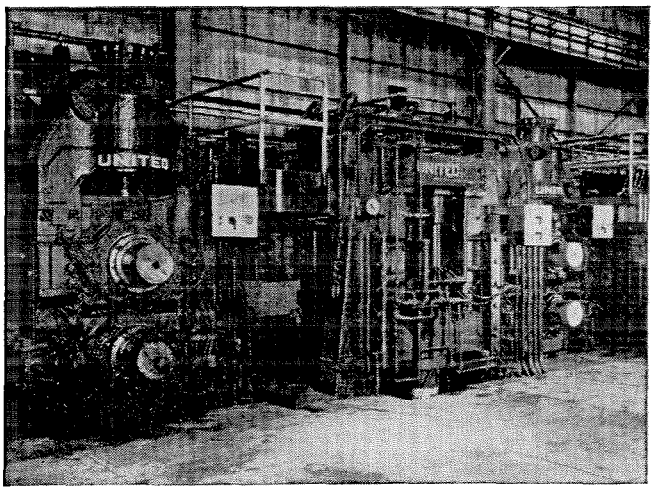
Vineyards look much nicer, with their soft green; they are more closely planted than in California, probably because there is more rain. There are also large olive orchards, but these are still relatively young and look like our San Joaquin Valley fruit orchards—that is to say, too neat—and they have not taken on the patina of old age, so attractive in the other Mediterranean countries.

Really full of charm was Figuig; that is a place I will always long to see again. It was a real oasis, a restful shady place in the harshness of the desert. It is to some extent comparable to Palm Springs, but for the rest, there is nothing in California comparable to it.

After returning to Pasadena I looked up what had been written by other botanists about the Sahara. I found that visitors who had only seen the Sahara had a somewhat warped idea of deserts in general. In the clear deserts of California or Israel plant growth is relatively more abundant than in the Sahara, when places with equal rainfall are compared. This means that rainfall is relatively more efficient in deserts with less wind and less dust.

It is very likely that dew is of importance in this better development. According to observations of Foureau and Fitting practically no dew occurs in the Sahara, which is understandable, because its dust would prevent radiation toward the sky. In our deserts and in Israel, dew is a common phenomenon and the differences in vegetation noted above are apparently related to this dew difference.

Another page for **YOUR BEARING NOTEBOOK**

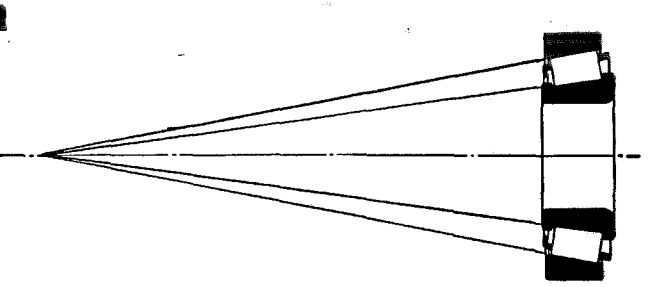


How billet mill gets extra bearing capacity in same space

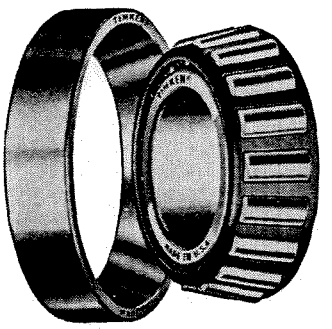
Engineers who designed this 10-stand billet mill specified that the roll necks be mounted on Timken® Balanced Proportion bearings. That's because Timken Balanced Proportion bearings have load ratings up to 40% higher than same-size bearings of older designs. And they make possible a 50 to 60% increase in roll neck strength which means greater rigidity and higher rolling precision.

True rolling motion, high precision practically eliminate friction

All lines drawn coincident with the working surfaces of the rollers and races of Timken bearings meet at a common point on the bearing axis. This means Timken bearings are designed to give true rolling motion. And they are precision manufactured to live up to their design. Result: Timken bearings practically eliminate friction, save power.

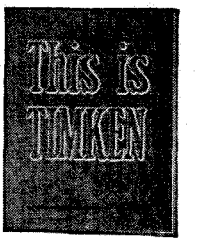


TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



Want to learn more about bearings or job opportunities?

Many 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, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◎ AND THRUST ⊣◎⊢ LOADS OR ANY COMBINATION ✳

THE MONTH AT CALTECH

Albert B. Ruddock, Chairman of the Board of Trustees

Chairman of the Board

ALBERT BILLINGS RUDDOCK was elected chairman of the Board of Trustees of the Institute at the annual meeting of the board on November 1.

Mr. Ruddock succeeds James R. Page, chairman since 1943, who will continue to serve on the board as chairman of the finance committee and in other important capacities.

At the same meeting John E. Barber, who became a trustee in February of this year, was elected vice president and treasurer of the board. As treasurer, he succeeds Dr. William B. Munro. Dr. Munro has been associated with Caltech since 1926. As Professor of History and Government for nearly twenty years, he was a leading figure in the establishment of the Institute's Humanities program, and was elected a trustee in 1945. He is also a trustee of the Huntington Library and the Huntington Memorial Hospital.

Mr. Ruddock, a Caltech trustee since 1938, has been prominent for many years as a diplomat and as a civic leader in southern California.

A native of Chicago, Mr. Ruddock was educated at Yale (BA 1907), Columbia (MA 1909), and the Ecole des Sciences Politiques in Paris, 1911. From 1912 to 1916 he was Secretary of the American Embassy in Berlin and the following year held the same post in Brussels. From 1917 to 1920 he served in the State Department in Washington and from 1920 to 1923 in the American Embassy in Peking.

Mr. Ruddock resigned from the foreign service in 1924 to enter private business. Since then he has been associated as trustee or director with many institutions, including the Security First National Bank of Los Angeles, Occidental College, the Los Angeles County Museum, the Town Hall of Los Angeles and the Pasadena Civic Music Association. He has been chairman of the advisory committee of the Los Angeles County General Hospital and chairman of the management committee of the Huntington Memorial Hospital. In 1943 he received the Arthur Noble Award for outstanding service to Pasadena, where he lived from 1923 until 1952.

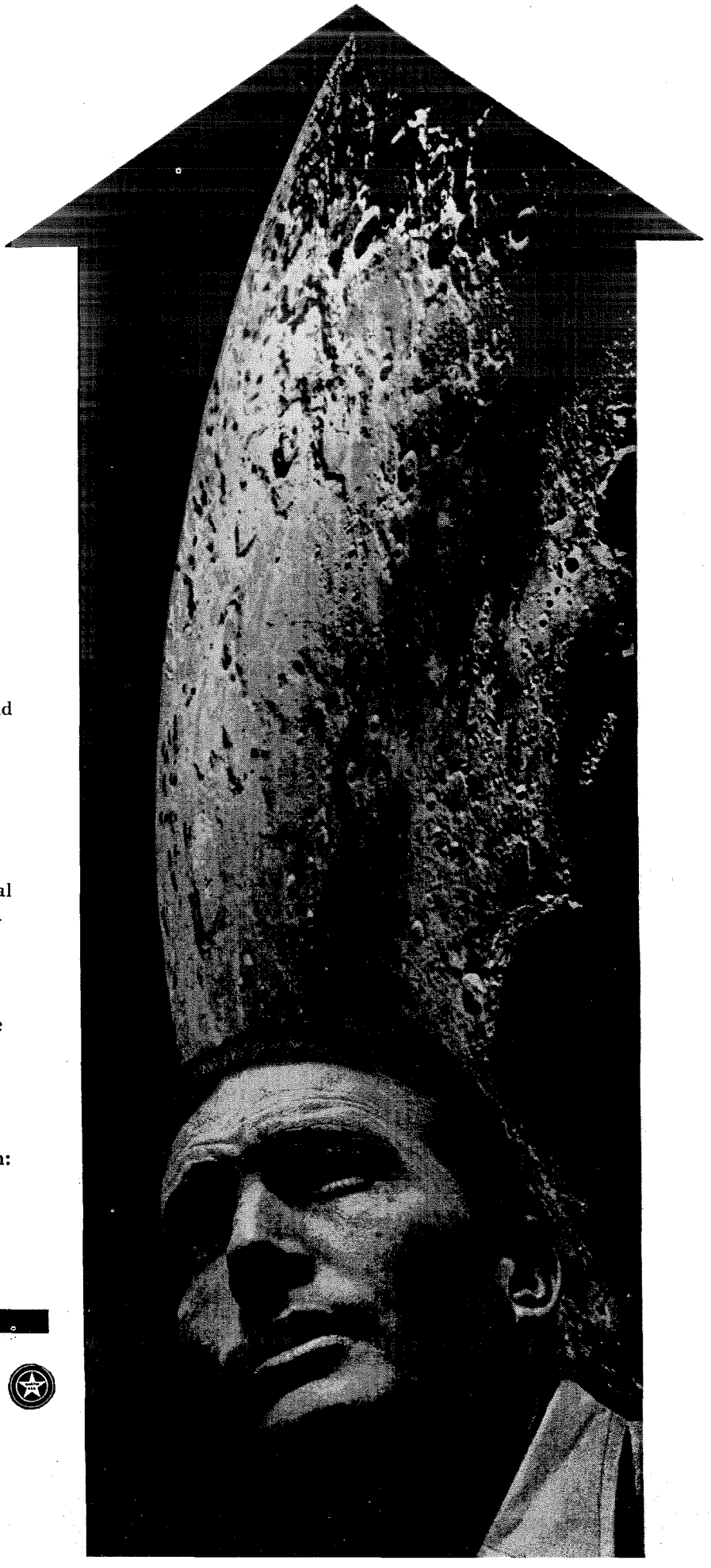
Mr. Ruddock is currently president of the Southwestern Development Company of Los Angeles and a director of the Universal Consolidated Company. He is also a director of the Santa Barbara Foundation and the Santa Barbara Museum of Art.

Montgomery of Alamein

FIELD MARSHAL Viscount Montgomery of Alamein, the British World War II hero who is now Deputy Supreme Allied Commander of the NATO forces in Europe, will be the guest of the Institute for three days this month, November 28-30.

Last spring President DuBridge attended a conference in Paris, of which Marshal Montgomery was chairman. When he learned the Marshal's plans for a visit to the United States this fall he invited him to come to Pasadena.

Marshal Montgomery will be honored at an invitational dinner given by the Trustees of the Institute for the California Institute Associates on November 29. On November 30 he will attend a public luncheon, given by the Institute and the Los Angeles World Affairs Council, where he will speak on "The Whole Question of NATO and the Defense of the Free World."



tonight

This man could almost reach the moon tonight... for he stands at the brink of a new age in the conquest of space, and he knows this:

If we had to, we could get him there. Given time and urgent need, we could design, build and deliver the total solution to that problem.

An entirely new development in the aircraft industry now makes this possible. It is a science and a method of developing aircraft, guided missiles and electronic systems not as traditional flying vehicles but as fully coordinated solutions to operations problems.

Today, The Glenn L. Martin Company's creative engineering resources and production facilities are among the finest in the new world of weapons systems development.

And one of the reasons for Martin's dynamic future in this new world is basic to leadership in any organization:

There is always an opening for outstanding ability.

MARTIN

BALTIMORE · MARYLAND

NSF Grants

THE NATIONAL SCIENCE FOUNDATION this month awarded grants totalling $58,500 to Caltech researchers.

A three-year grant of $34,500 went to John R. Pellam, Professor of Physics, for experimental work at extremely low temperatures.

A two-year grant of $15,000 went to Max Delbrück, Professor of Biology, for work on light and dark adaptation in a mold.

And a two-year grant of $9,000 went to Henry Borsook, Professor of Biochemistry, and Richard S. Schweet, Senior Research Fellow in Biology, for a continuation of Dr. Borsook's studies in protein synthesis.

Achievement Award

HOMER J. STEWART, Caltech Professor of Aeronautics, has received the University of Minnesota Outstanding Achievement Award, an honor given to former students of the University. The award was presented to Dr. Stewart at a dinner in Minneapolis on October 15, commemorating the 25th anniversary of the University's Department of Aeronautical Engineering.

Homer Stewart received his BS in Aeronautical Engineering at the University of Minnesota in 1936. He did his graduate work at Caltech, and got his PhD here in 1940. He has been at Caltech ever since, teaching and doing research in the field of theoretical and applied aerodynamics. He became Professor of Aeronautics in 1949.

In addition, he serves as Chief of the Research Analysis Section of the Jet Propulsion Laboratory, where he has made important contributions to the development of guided missiles. He is a member of the Scientific Advisory Board of the U. S. Air Force and was consultant to the former Guided Missiles Committee of the Department of Defense, Research and Development Board. He is also a consultant to the Aerojet-General Corporation.

Harry Earhart

HARRY B. EARHART, founder of the Earhart Foundation, died on October 21 at his home in Ann Arbor, Michigan. He was 84 years old.

A gift of $407,000 from the Earhart Foundation made it possible for Caltech to build its Earhart Plant Research Laboratory in 1949.

Mr. Earhart was, successively, an owner of Great Lakes shipping vessels, a machinery manufacturer, and president and director of several oil companies. He also served as a director of the American Petroleum Institute and the National Safety Council. He was a close friend of the late Dr. Robert Millikan, chairman of the Executive Council of Caltech from 1921 to 1945, and from 1933 to his death he was a member of the California Institute Associates.

Embryologist

LORD ROTHSCHILD, Director of Research of the Department of Zoology at Cambridge University and Chairman of the Agricultural Research Council of Great Britain, will be at Caltech during the month of November working with Dr. Albert Tyler, Professor of Embryology, on some problems of the early phases of both plant and animal reproduction. Rothschild and Tyler worked together at Caltech in 1951 and during the summer of 1953 at Cambridge.

Appointed a research associate in biology at Caltech, Lord Rothschild is confining his studies in embryology here to what takes place in the first 45 minutes after the fertilization of the egg. ("After that," he says," some other scientist will have to take over.")

In the first 45 minutes something happens that changes the nature of the egg. "It is the same in the embryo of a bit of seaweed, a bumble bee, or a human being," says Rothschild.

With the help of Dr. Tyler, Rothschild is trying to find out what *does* happen. And they would like to find answers for such questions as: "What happens if two sperms enter an egg instead of just one;" and "Do eggs breathe faster before or after fertilization?"

Lord Rothschild is also at work on a book on this subject. His research project is being sponsored jointly by Caltech, Cambridge University, the U. S. Public Health Service, and Britain's Agricultural Research Council.

A member of the famous Rothschild banking family, he tried working in the family business for three short months once—then gave it up permanently to do research in embryology.

Top Performers

DR. GEORGE W. BEADLE, Chairman of the Division of Biology, and Dr. Richard P. Feynman, Professor of Theoretical Physics, are included among the "Top Performers of the Year" in the annual selection of distinguished Californians which *Fortnight Magazine* published in its November 3 issue.

Dr. Beadle received one of America's highest scientific honors in January of this year when he was made president-elect of the American Association for the Advancement of Science. He will serve as president during 1955.

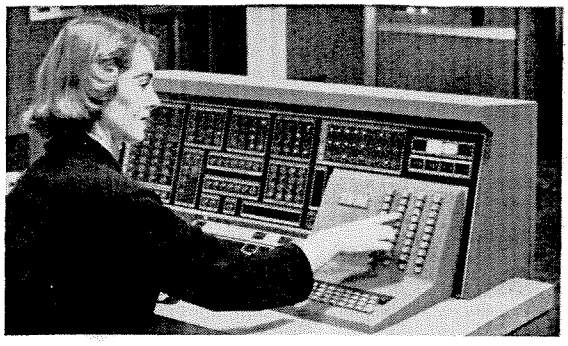
Dr. Feynman has been honored twice this year for his scientific achievements. In April, he was elected to the National Academy of Science, and in January, he was selected as winner of the Albert Einstein Award, consisting of a $15,000 cash prize and a gold medal. This award is made every three years for an outstanding contribution to knowledge in the mathematical and physical sciences.

MR. MORSE PUTS HIS INVENTION TO PRACTICAL USE

Actually, Morse's first message over his electric telegraph was, "What hath God wrought?" Ever since, it's helped solve the problem of getting money from home . . . and a good many other problems as well.

Inventor Morse wouldn't recognize some of the latest developments in his field. Automatic coding and decoding machines. Radar. Electronic computers. Such devices depend on **ball** bearings to maintain moving parts in accurate alignment, cut friction to the minimum and reduce wear.

In every field . . . designers and engineers call on New Departure for the finest in **ball** bearings. For New Departure manufacturing is known to employ advanced methods of automation, integration and quality control.



IBM's latest brainchild, the 702 Electronic Data Processing Machine, is an outstanding example of New Departure **ball** bearing application. New Departures also assure accurate support of moving parts in IBM's now famous 701 Electronic Computer.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

PERSONALS

1918

H. Darwin Kirschman, MS '19, on a four-month vacation down the east coast of South America, located Tech alumnus *Bradley H. Young,* '35, in Sao Jose Dos Campos, Brazil, where he is Dean of the School of Airways at the Centro Tecnico de Aeronautica. After lunch together, Brad took him on a tour of the school, and mentioned that, among other things, he is giving 15 hours of lectures each week in Portugese.

William R. Hainsworth, MS, has been appointed Vice President in charge of Research for the Fluor Corporation of Los Angeles. Another Tech grad, *C. L. Blohm,* '30 is Manager of Research.

1922

Bryant Essick, President of the Essick Manufacturing Company in Los Angeles, has been serving as Chairman of the Board of the Los Angeles Branch of the Federal Reserve Bank of San Francisco, having been elected to the Board last year. He was also recently made Chairman of the Board of the T. L. Smith Company of Milwaukee.

1923

Walton E. Gilbert has a spot of advice for anyone fed up with the daily grind: "For a refreshing slant on life, I suggest a golf playing tour of Western Europe. Without being vice-president of anything I have, in the last 20 months, enjoyed the odd game of golf in Holland, Denmark, Germany, France, British North Borneo, Indonesia, the Argentine, Trinidad, Venezuela, Colombia, and the good old U.S.A. Anyone wishing to experience such a continual round of pleasure need only join Shell as Senior Production Engineer in Overseas Operations—and see the world." The line forms to the right.

1929

L. Reed Brantley, PhD '30, was elected vice president of Alpha Chi Sigma, National Professional Chemical Fraternity, at their convention last June.

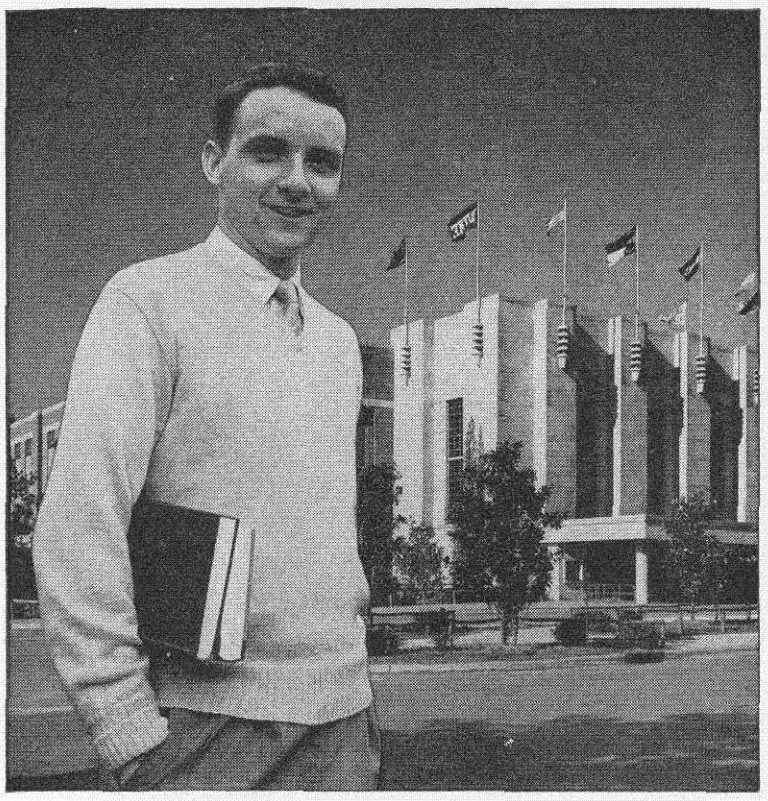
1930

Karl Effman died suddenly on August 23, 1954. The following details were obtained from a management newsletter of the Perfect Circle Corporation, Hagerstown, Indiana: "It is with deep regret that we report the death of Karl Effman, Manager of the Engineering Division. Karl, along with his wife and three children, was returning from a vacation and stopped for the night in a motel at Colorado Springs, Colorado. As the maid was making her rounds the next morning, she received no response to her repeated knocks on their door. Shortly after noon, she let herself in with a passkey and found the whole family unconscious. Apparently a gas refrigerator was the cause. Although a resuscitator was obtained promptly, Karl did not respond. His wife, daughter, and older son are out of danger, but a 6-year-old son was in critical dondition." Karl joined the Perfect Circle Corporation in 1933, and was 45 years old.

Ralph Atkinson, PhD '30, owner of the Atkinson Laboratory in Los Angeles, has recently started a new plant in Beverly Hills to manufacture magnetic recording materials. Their "Hollywood Recorda-Tape" should be on the market shortly.

1932

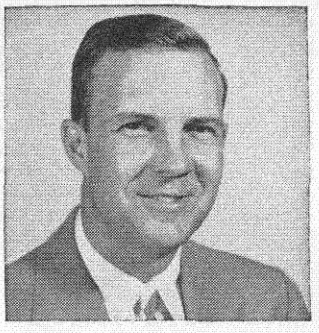
Maurice Biot, PhD, private consultant in physics and applied mathematics, New York City, visited the Caltech campus early in October, when you could barely distinguish Kerckhoff from Dabney because of the smog. Originally, Maurice had intended staying here some time, but he soon changed his plans and hurried back



James B. Walker received his B.S. in mechanical engineering from North Carolina State College in June 1954, and he's presently working for his M.S. at the same college. By asking pertinent questions, Jim is making sure that the position he finally accepts will be the right one for a fellow with his training.

Jim Walker asks:

Can a mechanical engineer make real progress in a chemical firm?



H. M. Pickering, Jr., received a B.S. in M.E. and E.E. from the Univ. of Minn. in 1940. He gained valuable technical experience at Hanford Works, in Richland, Washington, and in Du Pont's Fabrics and Finishes Plant at Parlin, N. J. Today he is Works Engineer for Du Pont's Seaford, Del., plant, where nylon comes from.

"Pick" Pickering answers:

Well, Jim, that's what the lawyers call a leading question, and the answer leads right into my bailiwick. I came to Du Pont in 1940, after taking a combined mechanical and electrical engineering course. So I had what you might call a double reason for wondering about my future with a chemical firm.

I soon learned that the success of a large-scale chemical process is vitally dependent upon mechanical equipment. And the success of this mechanical equipment—especially for a new process—depends on (1) Research, (2) Development, (3) Plant Engineering, and (4) close Supervision. The net result is that a mechanical engineer at Du Pont can progress along any one of these four broad highways to a top-level position.

My own Du Pont experience includes mechanical engineering work in fields as varied as atomic energy, fabrics and finishes, and nylon manufacture. Every one of these brought with it a new set of challenging problems in construction, instrumentation, and power supply; and every one provided the sort of opportunities a man gets in a pioneering industry.

So, to answer your question, Jim, a mechanical engineer certainly has plenty of chances to get somewhere with a chemical company like Du Pont!

Want to know more about working with Du Pont? Send for a free copy of "Mechanical Engineers at Du Pont." This 24-page booklet describes in detail the four broad categories of jobs mentioned by "Pick" Pickering. Typical pioneering problems in each of these four categories are outlined. This booklet briefs a young mechanical engineer on how some of the newest and most challenging problems in his field were solved. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Bldg., Wilmington, Del.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

WATCH "CAVALCADE OF AMERICA" ON TELEVISION

to New York. On the smog problem, he commented wryly: "It's been solved. Only the politics remains."

1933

Col. Clarence R. Laubenfels, MS, got back into uniform for a three-year tour of duty in 1951, and was stationed at Wright Field, where he was Assistant for Flight Safety Engineering for the Wright Development Center. After his retirement from the Air Force last April he returned to Los Angeles City College, where he is teaching engineering.

Russell N. Doescher, PhD '40, died on July 17, 1954. The alumni office has no further information as to the cause of his death. Russell worked for North American Aviation in Chatsworth, California.

1934

John Cortelyou is still Building Maintenance Engineer for the Southern California Gas Company in Los Angeles. John has two children; his son Bob will enter college next year.

1935

Adrain H. Gordon, MS '36, Chief of the Training School of the British Weather Service, has just returned from a two-year period of secondment (the official term for loan of personnel to other departments) with the Secretariat of the World Meteorological Organization. This is a specialized agency of the United Nations with headquarters in Geneva, Switzerland. During this tour of duty Adrian attended international conferences in Washington, D. C., but couldn't manage a trip to California, much as he longed for one.

Howard P. Gluckman received an MS in electrical engineering last June from USC, is now working in specification research and with a special study group at the Los Angeles Department of Water and Power. Howard realizes now just how long it has been since he graduated from Caltech—because his daughter is dating Tech freshmen! Howard also has a son.

John B. Higley has a new job and a new son. The new job: with the Raytheon Manufacturing Company of Boston, Massachusetts, in Radar and Communications Engineering—the new son: Robert Hawley Higley, born last December.

Jackson Edwards, who operates his own business in Hollywood, has moved to larger quarters at 7708 Woodrow Wilson Drive, and added a field engineer to his staff. The firm, Jackson Edwards & Co., represents a group of eastern manufacturers of technical electronic equipment.

1936

Edwin M. Getzman of Temple, New Hampshire, died suddenly on July 4, 1954, after a prolonged illness.

Eugene M. Rector is now a member of the technical staff of the Advanced Electronics Laboratory, Hughes Research and Development, at Culver City, California. Another Tech man *Lawrence W. Baldwin,* '35, MS '37, is also at Hughes now, working in the Radar Division. Both men were formerly with the International Telemeter Corporation.

1937

Robert M. Mahoney has become assistant to the manager of the Industrial Relations Department at the Union Carbide and Carbon Corporation in New York. Bob started with the United States Vanadium Company right after graduation.

David Pressman, PhD '40, has joined the staff of the Rosewell Park Memorial Institute in Buffalo, New York, as Director of Research in biochemistry.

Christopher Dykes, MS '38, is working as an Advising Aeronautical Engineer, retained by manufacturers in the United States, Canada, and the United Kingdom. Chris makes his home in London, but in the course of his work is a frequent traveller to the U.S.A., including the West Coast, and on his occasional stops in Pasadena stays at the Athenaeum. In addition to consulting, he is Director of Giannini Ltd., (a subsidiary of G. M. Giannini & Co., Pasadena) and as Technical Manager of Mercast Ltd. of Great Britain. Chris was married in 1945, and the Dykes' have two children—a daughter age 5, and a son born last June.

Martin H. Webster, an attorney with his office in Los Angeles, participated in a Tax Institute at the John Marshall Law School in Chicago this summer. While on his trip East, Martin also gave a report on the 1954 revenue code to the Taxation Section at the annual American Bar Convention. As you may have gathered, Martin specializes in tax practice.

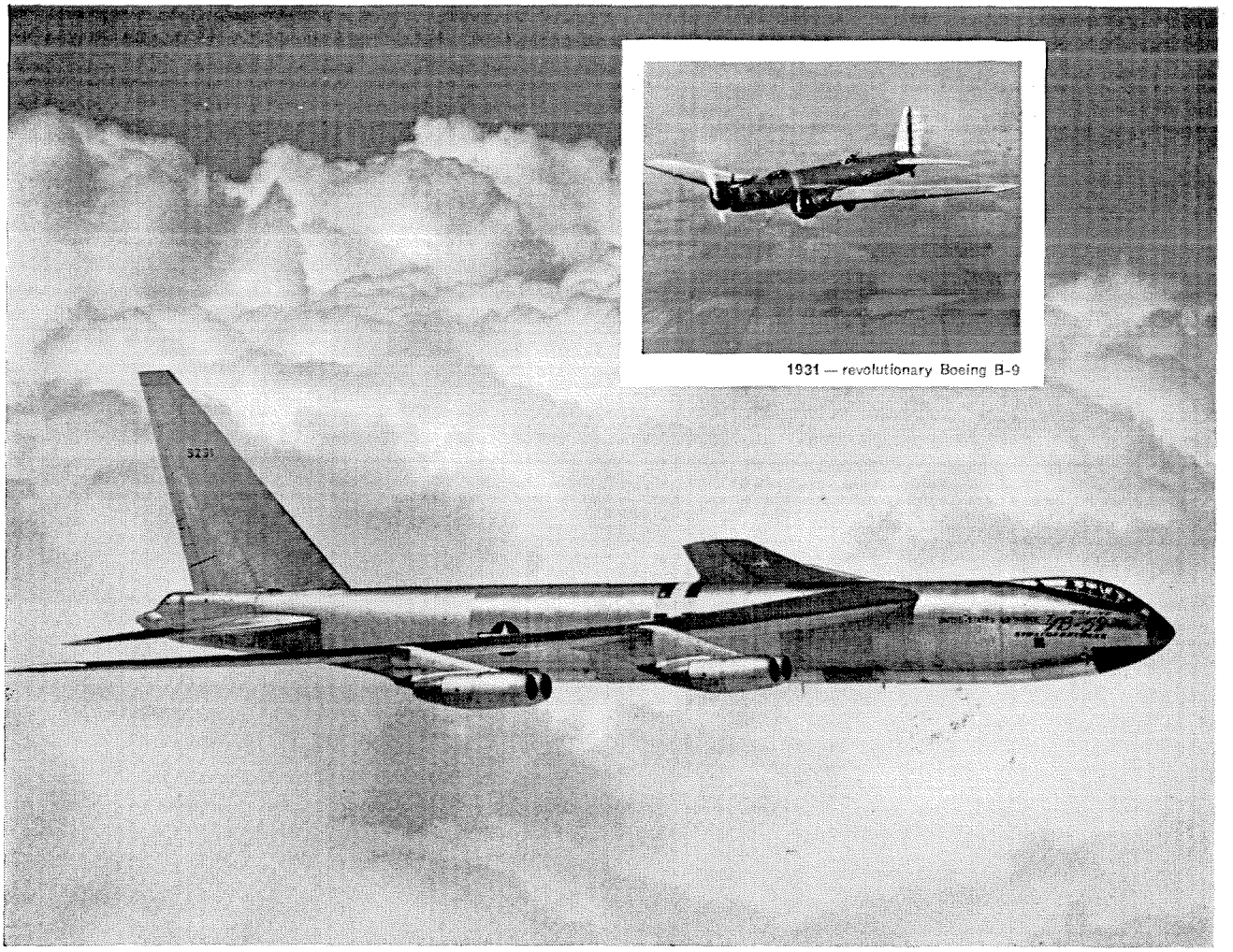
1938

Lt. Col. Roy S. Kelley is now in Japan with the Army's Far East Engineering Section. After graduation from Caltech Roy went on to West Point, graduating in 1941. Before being sent to Japan he was stationed in Korea with the 44th Engineering Construction Group.

1939

José Pulido Ortiz, MS, was recently appointed Technical Director of Atlas S. A., contracting company with main offices in Mexico City. The firm is engaged in special projects in water supply and sewerage, maritime works, paving, etc. José has two

CONTINUED ON PAGE 40



1931 — revolutionary Boeing B-9

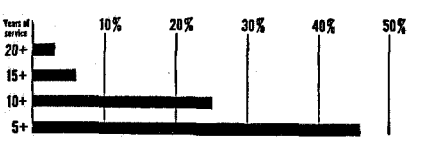
1954 — Boeing 8-jet B-52, America's outstanding heavy jet bomber

Leadership is a long-time tradition at Boeing

In 1931, Boeing engineers designed the B-9, a revolutionary low-wing bomber that could outdistance any contemporary pursuit plane.

Today, they've produced the free world's outstanding heavy jet bomber, the B-52, and America's first jet transport. Boeing also builds the record-breaking B-47 medium jet bomber, conducts a major guided missile program, and research in nuclear power for aircraft.

These growing programs mean expanding opportunities at Boeing for engineers of virtually EVERY type, including mechanical, civil, electrical and aeronautical. It also means plenty of room for advancement. Boeing, which now employs more engineers than even at the peak of World War II, promotes from within, and holds regular merit reviews to give you individual recognition.



As the chart shows, 46% of Boeing's engineers have been here for five years or more; 25% for 10 years; and 6% for 15 years, and many have been with the company 25 years or longer.

Boeing offers engineers an unusual variety of experience, from applied research to production design, from work with new materials and techniques to co-ordination of a vast subcontracting program which provides contacts with a cross-section of U. S. industry.

Boeing also helps engineers continue their graduate studies, and reimburses them for tuition expenses.

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

JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Company, Seattle 14, Wash.

BOEING

SEATTLE, WASHINGTON WICHITA, KANSAS

"I chose Worthington for opportunities in international trade"

• "Worthington was my choice," Mr. Berger says, "because of the excellent training and the unusual experiences that are possible with a manufacturer having a worldwide reputation, and worldwide distribution. Then, when a company has seventeen divisions, including air conditioning, refrigeration, turbines, Diesel engines, compressors and pumps of all kinds, construction machinery, and power transmission equipment, a graduate engineer's chances for getting into his chosen field are even better.

"Supporting these divisions are research, engineering, production, purchasing, and sales, domestic and export. The real opportunity, however, is in Worthington itself. This is a company that is growing, just as it has for more than a century. It is always looking for new, related products and good men to engineer, produce, and sell them—at home and abroad.

"I began my career with Worthington's training program in the Research and Development Laboratory, where full-scale equipment is designed, tested and improved. This experience gave me an understanding of the tremendous part the company plays in the everyday life of millions of people. Within fourteen months I was sent to Mexico to inspect the facilities of our distributors there.

"The opportunities for first-hand laboratory experience, sales training and contact, travel and field trips, among many others, make Worthington a first-rate company for the young engineer with a desire to learn and progress in his work."

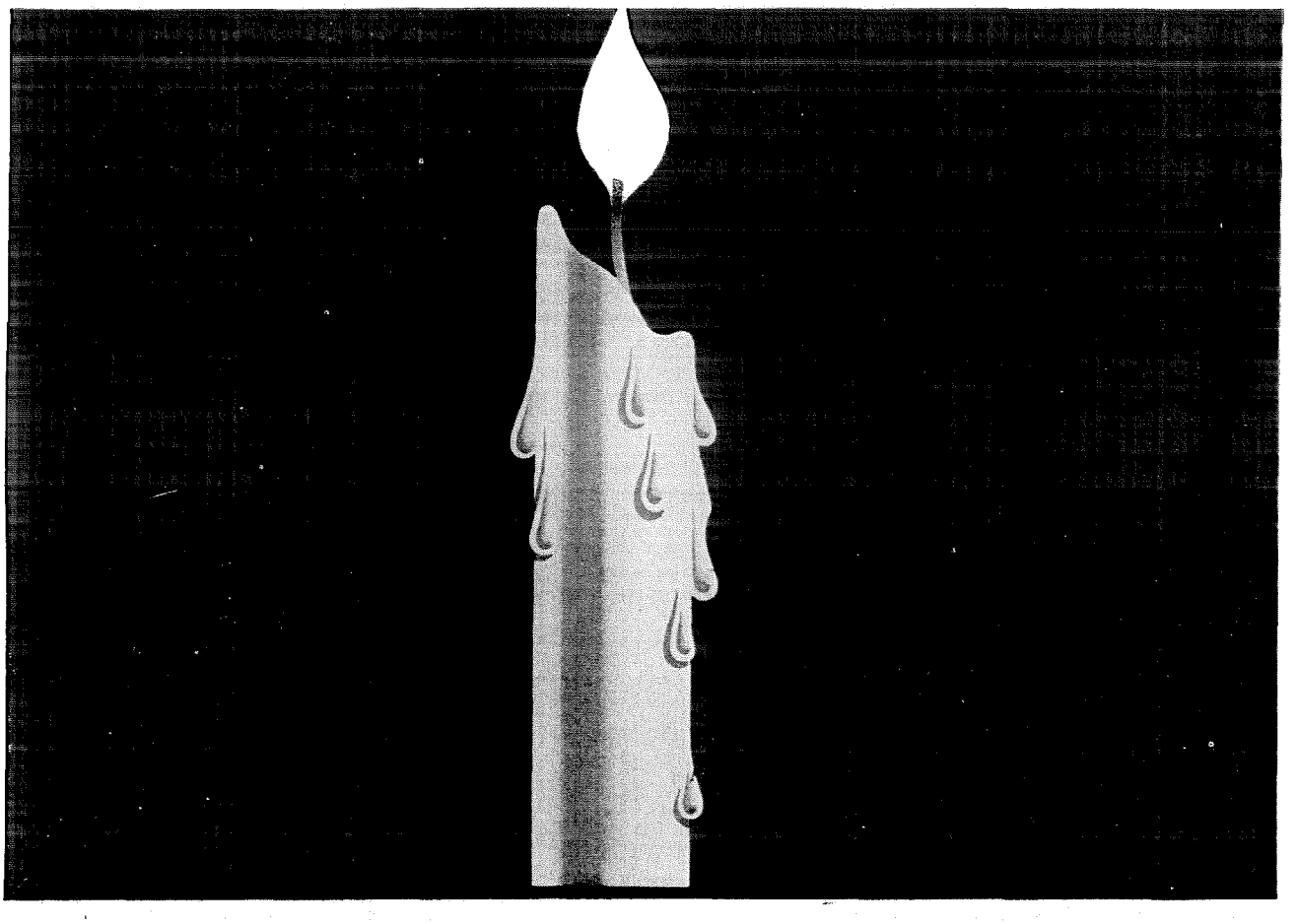
When you're thinking of a good job, think *high*—think *Worthington.*

8.26

FOR ADDITIONAL INFORMATION, see your College Placement Bureau, or write to the Personnel and Training Department, Worthington Corporation, Harrison, N. J.

WORTHINGTON

THE SIGN OF VALUE AROUND THE WORLD



WAX WORKS . . .

Until a few decades ago, the principal users of wax were the candlestick makers. Today's diversified demands for wax put it in the class of modern industrial miracles.

Go into a super-market . . . see how wax works in the packaging and protection of milk and dairy products, cereals, bake goods, frozen foods. Think of its use in drug and cosmetic products . . . cups, crayons and carbon paper . . . polishes, preservatives and paper matches . . . And the number of industrial applications defies accurate calculation.

TOO BIG FOR BEES . . .

The ancients knew the physical properties of wax . . . and bees supplied the raw material. What then spurred this century's growth in production to more than a half-million tons a year?

The answer lies partly in the petroleum industry's desire to find more profitable applications for one of its products . . . partly in the desire of other industries to improve their processes and products.

AMERICA WORKS LIKE THAT . . .

Here, industry is paradoxical. It is independent, yet dependent . . . cooperative, yet competitive. It strives to make more money, yet is always seeking ways to keep costs and prices down.

And, to further these aims, management relies on the constant flow of information available through America's all-seeing, all-hearing and reporting Inter-Communications System.

THE AMERICAN INTER-COM SYSTEM . . .

Complete communication is the function, the unique contribution of the American business press . . . a great group of specially edited magazines devoted to the specialized work areas of men who want to manage better, research better, sell better, buy better.

COMMUNICATION IS OUR BUSINESS . . .

Many of the textbooks in which you are now studying the fundamentals of your specialty bear the McGraw-Hill imprint. For McGraw-Hill is the world's largest publisher of scientific and technical works.

After you leave school, you will want to keep abreast of developments in your chosen profession. Then one of McGraw-Hill's many business magazines will provide current information that will help you in your job.

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET, NEW YORK 36, N. Y.

HEADQUARTERS FOR TECHNICAL AND BUSINESS INFORMATION

McGRAW-HILL FOR BUSINESS

boys, Raphael and Joe Louis, who are both attending the Randolph Macon Academy in Front Royal, Virginia.

Carrol M. Beeson, PhD, has been appointed head of the Petroleum Engineering Department at the University of Southern California, where he is also Professor of Petroleum Engineering.

Warren E. Wilson, MS, is directing a new engineering program at Penn State. He has been named Westinghouse Professor of Engineering Education, a position sponsored by the Westinghouse Foundation, and will study information available on engineering education and develop means by which improvements can be made. Previously (from 1948 to 1953) Warren was President of the South Dakota School of Mines and Technology.

1940

W. Bertram Scarborough, MS '41, has been so busy working for Standard Oil of California that he hasn't had time to inform the Alumni Association of his whereabouts—so he ended up on their "missing" list. Bert's wife, Bea, now writes that he has just finished working on a new catalyst cracker for El Segundo, and is currently on another construction job in Salt Lake City. The Scarboroughs have sold their home in California, and are now living in Utah with their three children, David, 8, Nancy, 5, and Marjorie, 1.

Raymond C. Baird, MS, is now engaged in private consulting in the engineering field in Los Angeles. He's working mainly with noise, vibration, fluid flow and electronics.

1941

Ernest G. Chilton, MS, Development Supervisor in the Mechanical and Electrical Engineering Department at Shell Development in Emeryville, California, has been appointed 1954-55 Chairman of the professional Division's Committee in the San Francisco section of the American Society of Mechanical Engineers.

Joseph W. Trindle, MS '49, is now in Algiers doing faith work with the North African Mission.

1942

Gordon K. Woods and wife Greta announce the birth of their third son, Eric, on September 4th. Gordon is Works Manager of the Kaiser Electronics Division of Willys Motors in Arlington, Virginia. His responsibilities also cover the company's Nashua, New Hampshire plant.

Robert E. Anderson reports that he is still "geologizing" for the Signal Oil and Gas Company in (and out of) Los Angeles.

1943

Theodore Buettell reports the arrival of Heidi Ann last April. She's a 27-pound dynamo now, holding her own with the Buettells' two other children—Mike, 8, and Christina, 5. Ted received his MBA business administration degree from UCLA last June and is now working in Douglas at Santa Monica as a coordinator in the Estimating Department.

Peter Dehlinger, MS, resigned his position at Continental Oil Company to accept an Associate Professorship of Geophysics in the Texas A & M Geology Department. Peter had thought a long time about making the switch to teaching, and so far he's finding it just as much fun as he hoped it would be.

Edward P. Fleischer and his wife Sally proudly announce the adoption of Cynthia Gayle, born on August 17th.

1944

Richard J. Soike, MS '48, has been named section head for the refrigeration section, Engineering Division, at Procter and Gamble in Cincinnati. Dick started with Procter and Gamble in 1948 as a mechanical engineer. He and his wife Margaret have two children, Mark, 3 and David, 2.

1945

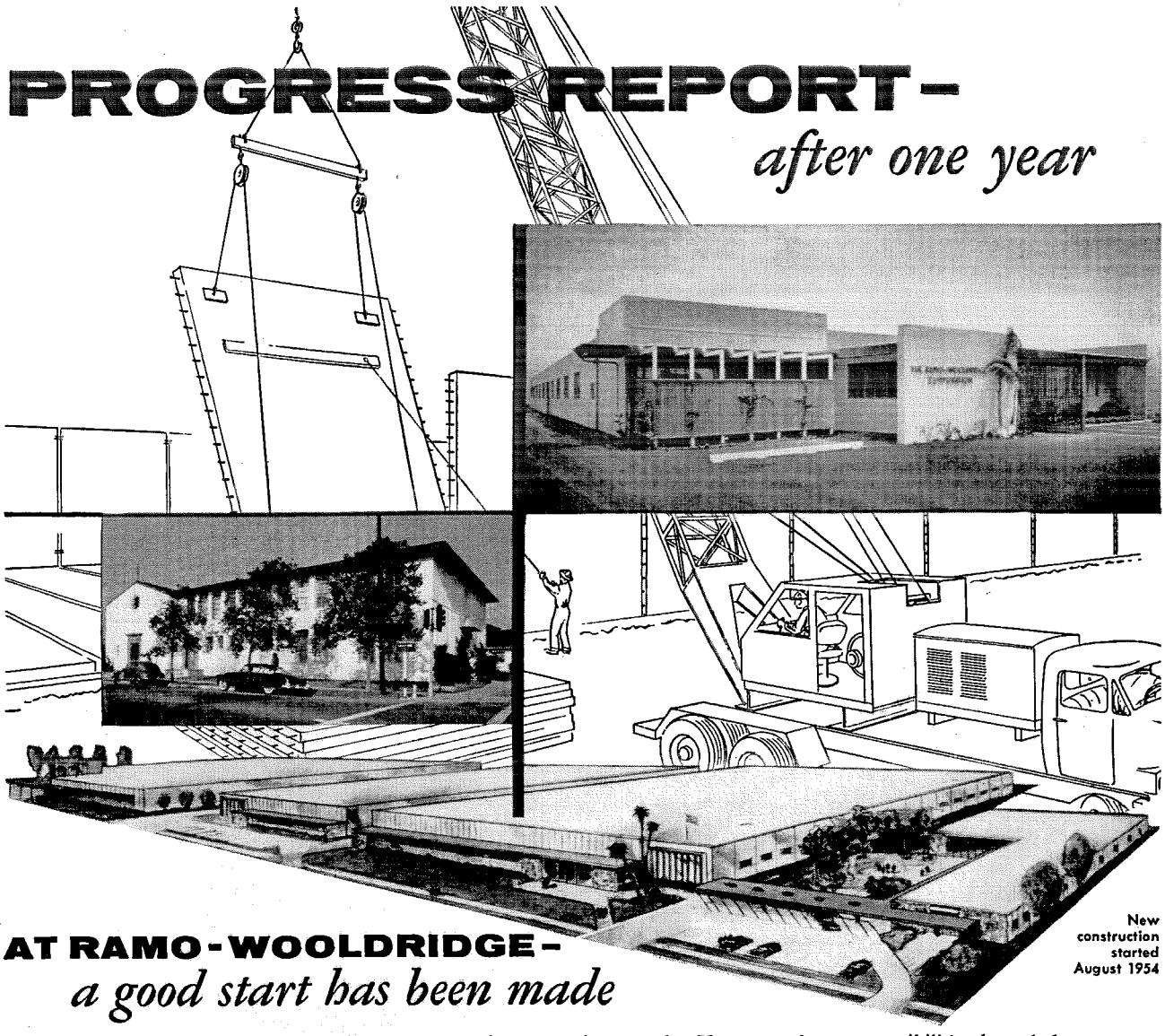
Lee Auslender has formed his own company, Auslender Productions, in Beverly Hills. The firm packages and produces television programs and commercials, both "live" and on film. He has also been teaching a course for the UCLA Extension Division on Television Advertising. Before starting in business on his own, Lee was a film director and program manager for KDYL-TV, Salt Lake City, and KSBW-TV, Salinas, Calif.

Clifford O. Harvey, Jr., is Staff Assistant to the Chief Industrial Engineer at North American Aviation in Los Angeles. (Cliff claims this is just a fancy title for staff work.)

Raymond Fredette, MS, Aeronautical Engineer with the Cook Research Laboratories in Skokie, Illinois, has been awarded a meterious civilian service award for his "scientific accomplishments in ballistics and aerodynamics for the Research Division of the Bureau of Ordnance," according to an announcement by the Bureau of Naval Ordnance. Ray is currently assigned to programs on guided missiles, rockets, and special aerodynamics studies for Cook.

Henry Roese, Sales Engineer for the Southern Pipe & Casing Company in Glendora was stricken with polio on August 2nd. It was diagnosed as a light case, and Henry probably won't have any after-

PROGRESS REPORT—
after one year



New construction started August 1954

AT RAMO-WOOLDRIDGE—
a good start has been made

Progress during a new company's first year can be measured in terms of plant and equipment, contract back-log, or quality and quantity of personnel.

By any of these standards the first year's experience of THE RAMO-WOOLDRIDGE CORPORATION has confirmed the soundness of the basic theses on which the company was established:

1. Competence in systems analysis, engineering and development, a relatively scarce commodity, is one of the most salable articles in America today.

2. Scientists and engineers find unusual satisfaction in participating in the development of a company in which, from the outset, all features of the organization and of the operational procedures are designed to be as appropriate as possible to their special needs.

Today, research and development activities are being conducted by an organization of approximately two hundred people, which will more than double within twelve months. Urgent project responsibilities have led to the temporary use of such quarters as the former school and church shown in the photograph, but construction is complete on 20,000 and well along on an additional 80,000 square feet of the 200,000 square foot permanent laboratory building program. Orders have been placed for $1,500,000 worth of digital and analogue computers that will be installed the end of this year to facilitate the extensive analyses required by current projects.

In the light of the first year's progress THE RAMO-WOOLDRIDGE CORPORATION anticipates expanding opportunities to perform major research, development and—a little later—manufacture in the fields of commercial and military electronic systems, and in guided missiles.

The Ramo-Wooldridge Corporation

8820 BELLANCA AVE., LOS ANGELES 45, CALIF. • DEPT. RW3

POSITIONS ARE AVAILABLE FOR SCIENTISTS AND ENGINEERS IN THESE FIELDS OF CURRENT ACTIVITY

Guided Missile Research and Development

Digital Computer Research and Development

Business Data Systems Development

Radar and Control Systems Development

Communication Systems Development

effects, but he'll be taking treatments for about a year. Henry's daughter contracted polio at the same time he did, but she has completely recovered by now.

Burton L. Henke, MS, PhD '53, is developing a soft X-ray camera at Pomona College, which may bring a greater understanding of viruses, protein molecules, and other particles in the 50- to 500-A range. This technique offers several advantages, most important of which is that it permits the use of wet samples, which is of particular interest to biochemists. To date, little work has been done in the soft X-ray range, which lies between ultra-violet light and conventional X-rays. In contrast to conventional X-rays, they are strongly absorbed or scattered by matter. Because of this property, this heretofore unused radiation may form the basis for a new and valuable research technique for the biologist, chemist, and physicist.

1946

José D. Cortes, MS, has a new home in Mexico City for his family: wife Gilda, a daughter aged 4, and (in his own words) three "devils" stair-stepped at the ages of 3, 2, and 1. José is a contractor for the Mexican Government's Building and Irrigation Project at the San Pedro River in the state of Nayarit.

1947

Milton D. Van Dyke, Ms, PhD '49, is in England taking advanced studies in fluid mechanics and basic aerodynamic theory on a Fulbright Award and a Guggenheim Grant. He has been granted a year's leave of absence from the Ames Aeronautical Laboratory at Moffett Field, California, where he is a staff scientist for the National Advisory Committee for Aeronautics, an independent agency of the U. S. Government.

Hussein M. A. El-Sum, MS, is now at the University of Redlands, where he is in the Department of Physics. Before returning to the states, Hussein was at the University of Fouad, Cairo, Egypt.

1948

Griffith C. Barlow, M.D., and wife Mary Jane (also a Doctor) have opened an office for the practice of medicine in Glendale—both general practice and pediatrics.

Donald W. Otto, who was employed as a special agent by the Great American Insurance Company of Los Angeles, died in September. This information was sent by a classmate, *H. B. Lewis, Jr.*, who wrote: "This is to inform you of the death of Donald Otto. The cause was cancer, first discovered two years ago; apparently cured but appearing again last December. Efforts to halt the development of the disease failed, and death came on September 17th or 18th after a week in the hospital at Berkeley, near his family's home. He was a very fine person and will be sorely missed."

Rupert M. Bayley, Transmission Design Engineer Associate for the City of Los Angeles, received his Engineer's degree in Electrical Engineering from USC last June. He got his MS in EE from USC in 1951.

James E. Whitney, MS, reorts some recent additions: a daughter, Joanne Lynn, born September 25th, 1953, and a PhD in inorganic chemistry from the University of Maryland in 1954. Jim is now employed in the Water Resources Division of the U. S. Geological Survey in Washington, D. C.

Robert Zacharias, MS '49, is a member of the technical staff at the Radar Division of Hughes Research and Development, Culver City, California. Previously, Bob worked at Northrop Aircraft.

1949

David S. Hogness, PhD '53, left the Laboratories of Dr. Jacques Monod in the Institut Pasteur, Paris, in August, and is now doing research with Dr. Bernard Davis' group in the Pharmacology Department of New York University, at the NYU College of Medicine.

1950

Kenneth J. Hammond is now working for the Wianco Engineering Company in Pasadena; he and his wife are expecting their first child next March.

Melvin Sprecher, who entered the Army in September, 1953, is now in Korea with the 7th Infantry Division.

David B. MacKenzie was married last January to Mary Dunn of Pittsburgh, and, ten days later, left for Libya, where his wife joined him in February. Dave was doing exploratory work for American Overseas Petroleum, Ltd., an affiliate of Caltex. In April he was transferred to Turkey. Nothing permanent, though. In fact, by now they may even have been transferred again—possibly to France this time.

George H. Cleland, PhD, is an Assistant Professor of Chemistry at Occidental. Before this appointment, George was a research chemist at the U. S. Naval Ordnance Test Station, China Lake, California.

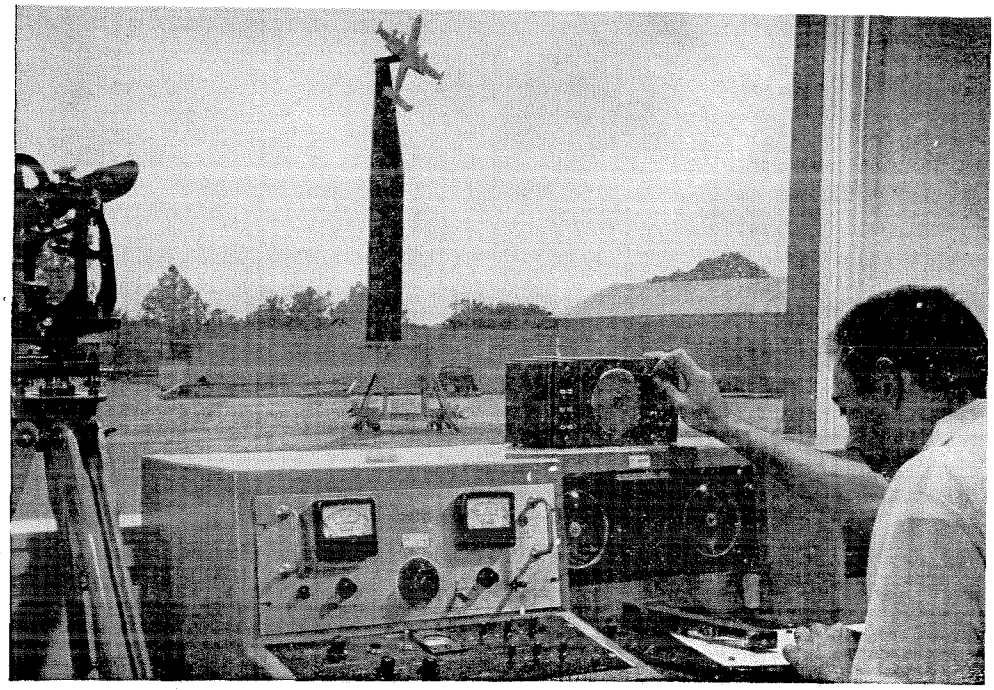
Donald T. Oswald, MS '51, and his wife announced the birth of Lawrence James Oswald on the 14th of August. This is their first child. Don is a Research and Development Engineer for the Concrete Conduit Company in Colton, California.

Joseph R. Moran, MS, and his wife Frances welcomed Robert Michael Moran on the 6th of August at Mather Air Force Base, California, where Joe is a Captain. This makes it two sons for the Morans.

1951

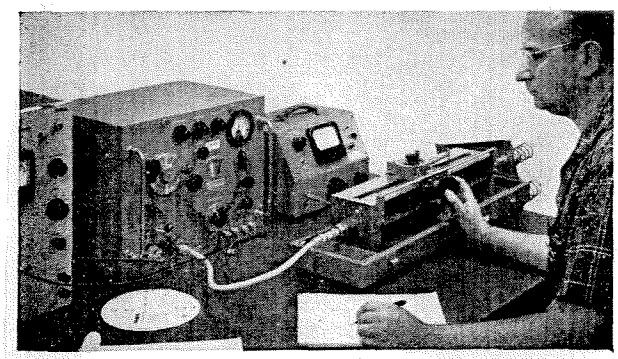
Frank W. Wood was transferred from General Petroleum to Sovosco, another Socony subsidiary) in February of this year. As Assistant European Purchasing Advisor, Frank makes his home in Paris, but gets to travel all though Europe in the course of his work.

Peter F. Orchard, MS, is a Combustion Engineer for the Bristol Aeroplane Company Ltd., Bristol, England. Right now



Electronics Research Engineer Irving Alne records radiation antenna patterns. Twenty-two foot plastic tower in background eliminates ground reflections, approximates free space. Tower is of Lockheed design, as are pattern integrator, high gain amplifier, square root amplifier, logarithmic amplifier.

Antenna development program at Lockheed expands



Electronics Research Engineer F. R. Zboril measures input impedance of a scale model helical antenna array used for ground tracking of missiles. Most of Lockheed's other antenna work involves advanced research studies on flush mounted antennas.

Lockheed's diversified development program presents Electronics Engineers qualified for airborne antenna design with a wide range of assignments in communication, navigation and microwaves. Antenna design is one of the fastest growing research and development areas at Lockheed.

Studies embrace virtually all types of aircraft, including the Super Constellation radar search plane—a type of aircraft developed and produced exclusively by Lockheed.

Career Positions at Lockheed

Lockheed's expanding development program has created a number of positions for Electronics Engineers and Physicists to perform advanced work in antenna design.

In addition Lockheed has a number of positions open for engineers in aerodynamics, thermodynamics, flight test analysis, structures and design to perform advanced studies on such diverse projects as: Applications of nuclear energy to aircraft, turbo-prop and jet transports, bombers, trainers, supersonic aircraft with speeds surpassing Mach 2, and a wide range of classified activities.

Program for Advanced Study—To encourage members of its engineering staff in study leading to advanced degrees, Lockheed reimburses 50% of the tuition fee upon successful completion of each course relating to the engineer's field at the University of Southern California and University of California at Los Angeles. Both universities offer a wide night school curriculum in science and engineering.

E. O. Richter, Electronics Research department manager (seated), W. R. Martin, antenna laboratory group engineer (standing), and J. L. Rodgers, electronics research engineer, discuss design of corrugated surface antenna.

LOCKHEED

AIRCRAFT CORPORATION

BURBANK **CALIFORNIA**

Peter and his wife are in the process of building a new house.

James A. Ibers is doing research work in Australia this year, operating out of Brunswick, Victoria.

1952

Dale C. Krause, who had been with the Cerro de Pasco Corporation in La Oroya, Peru, South America as an Assistant Geologist is now in the Army, stationed at Ft. Winfield Scott.

Richard E. Kennon was married right after graduation, and the Kennons now have an 18-month-old son. Dick started with Westinghouse in the Sales Engineering Division in 1952, and is still stationed in the Los Angeles office.

Edward F. Davis, MS. '53, was awarded a Radio Corporation of America Fellowship for the 1954-55 academic year. The purpose of the Fellowship is to encourage study and research in electronics. Ed will continue his graduate studies at Caltech.

1953

Arthur E. Britt joined the Hughes Aircraft Field Engineering Department upon graduation, and completed the factory training school, working on a fire control radar built by Hughes for the Air Force. Since then, Art has been a Technical Advisor to the Air Force at Oxnard Air Force Base and the Davis-Monthan Base in Tucson. Right now he is at the Manston R.A.F. Station in England. While in England Art has had a chance to do a bit of traveling—has seen Germany and France and is looking forward to covering the rest of Europe.

John C. Behnke, Jr. will be married to Miss Rachel Morgan in December. She is a graduate of Vassar, formerly worked with Dr. Frits Went here at Caltech, and is now studying for her PhD in botany at UCLA. John is in medical school at UCLA.

Leon Vickman is now a member of the technical staff of the Radar Division, Hughes Research and Development, Culver City, California.

Pierre Marien, MS, is doing an 18-month stint with the Belgian Army, and is stationed as an officer with the General Services of Military Constructions in Ghent, Belgium. After his stretch with the military, Pierre hopes to work in the U.S. (California or Florida if possible) as a civil engineer, to gain experience in hydraulic design and dam construction.

Bruce Holloway, PhD, brings us up to date on his activities since receiving his degree: "After leaving Caltech I visited England, where I was married, then France, Switzerland, and Italy. Returning to Australia, I was appointed Research Fellow in Microbial Genetics at the John Curtin School of Medical Research, Australian National University, Canberra. Peter Gray Holloway arrived on November 21st, 1953, this being the only non-experimental progeny to date. Apart from that, nothing important has happened, except a continued desire to return someday to Caltech."

1954

Richard M. Mark, PhD, and Lillian Gee of Pasadena were married last August, and are making their home in Pasadena. Lillian is a graduate of the University of California.

Richard E. Hyde is taking graduate work in mechanical engineering at Caltech.

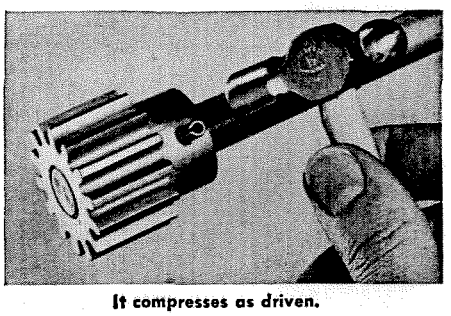
Samuel Autrey, *Jerry Van Hoven*, and *Ed Bryan* are working together at the Bell Telephone Laboratories and sharing an apartment in Summit, New Jersey. All their time, money and energy went into decorating of same apartment recently, with the end result that, after the last chair was moved into place, the boys suddenly discovered they had no silverware—and no money to buy any, until pay day. At last report they were eating with beer-can openers—and admitting it was hell eating peas that way.

Howard Everett Shanks and Patricia Ann Murphy of Pasadena were married August 5 and are living in Los Angeles while Howard attends UCLA grad school.

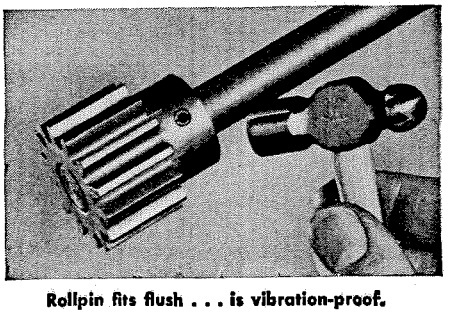
Where will you use this simple fastener?

Rollpin is driven into holes drilled to normal production-line tolerances.

No threading, peening or precision drilling with ROLLPIN



It compresses as driven.



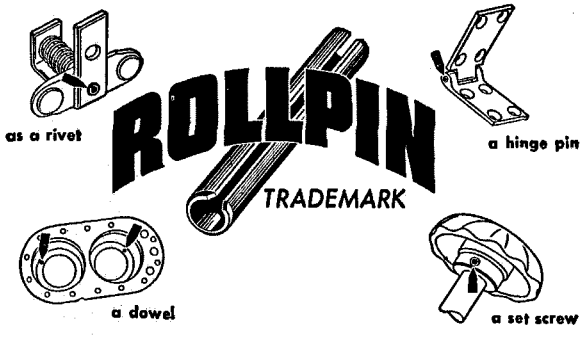
Rollpin fits flush . . . is vibration-proof.

Rollpin is the slotted tubular steel pin with chamfered ends that is cutting production and maintenance costs in every class of industry.

This modern fastener drives easily into standard holes, compressing as driven. Its spring action locks it in place—regardless of impact loading, stress reversals or severe vibration. Rollpin is readily removable and can be re-used in the same hole.

* * *

If you use locating dowels, hinge pins, rivets, set screws—or straight, knurled, tapered or cotter type pins—Rollpin can cut your costs. Mail our coupon for design information.



Elastic Stop Nut Corporation of America
Dept. R16-CM, 2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

☐ Rollpin bulletin

☐ Elastic Stop Nut bulletin

☐ Here is a drawing of our product. What fastener would you suggest?

*Name*_____ *Title*_____

*Firm*_____

*Street*_____

*City*_____ *Zone*_____ *State*_____

LETTERS . . . CONTINUED

of Loyola University, besides secular priests and those of other orders.) And we'll be keeping up with the rest of you through *E&S*.

Donald Merrifield, '50
St. Louis, Missouri

Nonsense Note

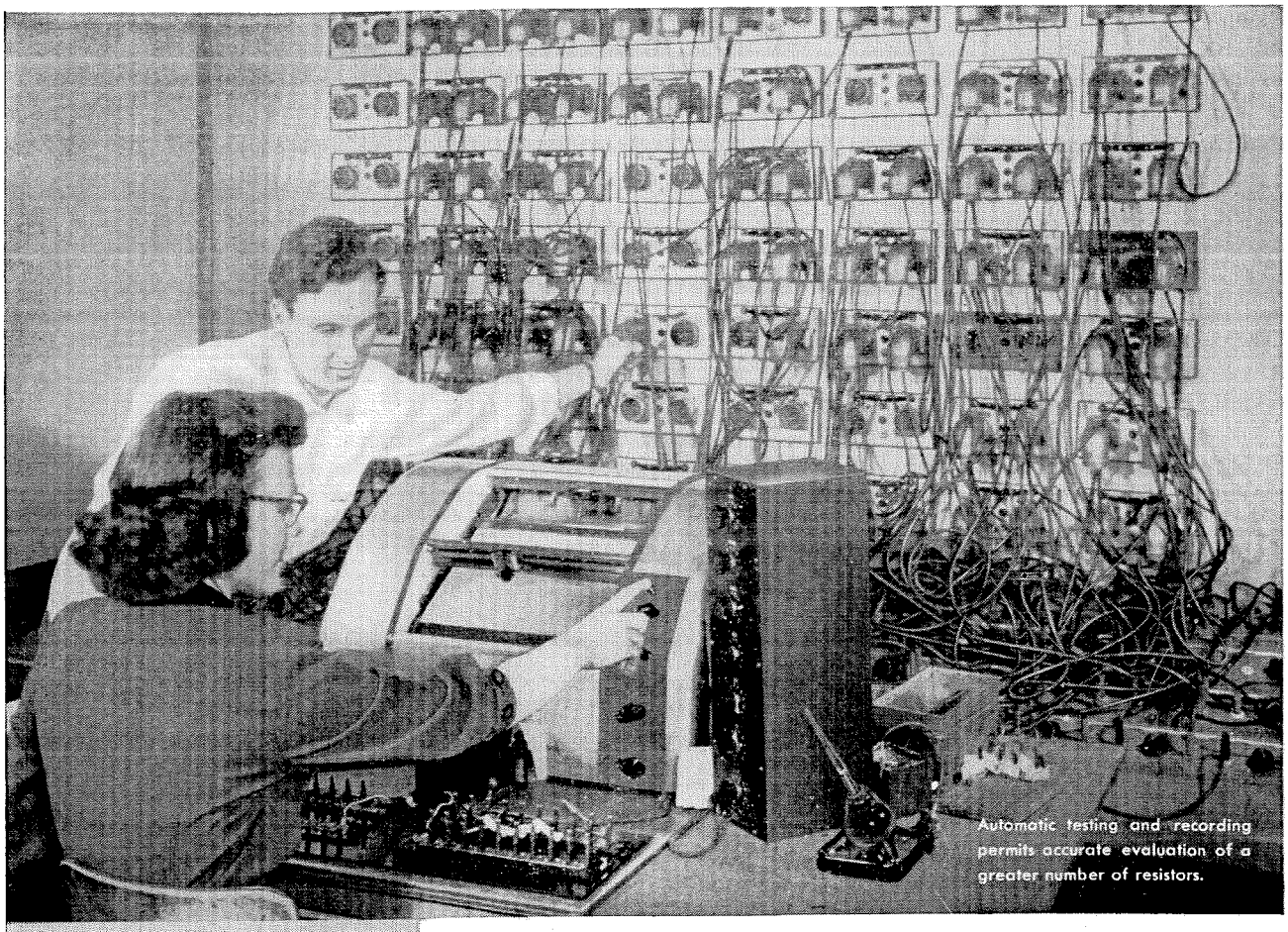
Sirs:

The following words of wisdom on the subject of alumni funds have probably been kicking around for so long that their original author could not possibly be identified. At any rate, I picked this up in the *Engineering and Mining Journal* the other day and thought some of the other donors to the Caltech Alumni Fund might get a laugh out of it:

Almost everyone is asked from time to time to contribute a shekel or two to the old alma mater and practically any reply but hard cash is unsatisfactory to the fund collectors. The following letter received by one such group is an exception:

"As I am an aluminum of two other colleges besides Yarvard, and cannot, with my bismuth in its present state, pay antimony to all three, I hope you will not think me a cadmium if I do not caesium this opportunity of making a donation. So far this year I have metal current expenses, but in these troubled times when the future holds in store we know not phosphorous, I could not make a contribution without boron from the bank. It would nickel out of my savings. A manganese spend his dollars these days; a tin spot is gone in no time. One is lead to believe he is pouring them down the zinc. Much better to sodium up in a stocking. So don't be silicon not make any contribution this year unless a bromine helps me out."

John Erickson, '34
Glendale, Calif.



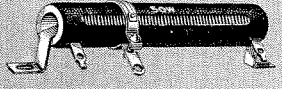
Automatic testing and recording permits accurate evaluation of a greater number of resistors.

BASIC REQUIREMENTS

JAN and MIL Specifications are basic guideposts for electronic advancement, whether used as engineering reference points or as procurement standards. IRC's dual emphasis on mass production and exacting testing assures highest performance standards at lowest possible cost.

SPECIFIC EXAMPLES

Type BT Insulated Composition Resistors
MIL-R-11A Specification



IRC Power Wire Wound Resistors
MIL-R-26B Specification

Type BW Low Wattage Wire Wounds
JAN-R-184 Specification

Sealed Precision Voltmeter Multipliers
JAN-R-29 Specification

ONLY IRC MAKES SO MANY JAN AND MIL TYPE RESISTORS

. . . another reason why engineers prefer IRC Resistors

56 different IRC resistors is today's figure—all equivalent to JAN or MIL specifications. Manufacturers of military equipment who must meet these specifications depend on IRC for all their resistor requirements. Offering the widest line of resistors in the industry—138 different types in all—IRC is the logical source of JAN and MIL type units.

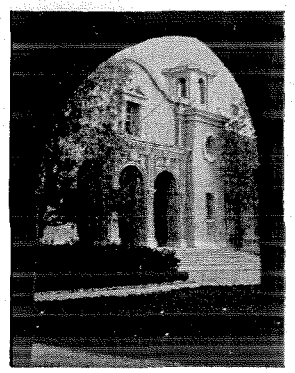
IRC

Wherever the Circuit Says ~~~

INTERNATIONAL RESISTANCE CO.

401 N. Broad St., Phila. 8, Pa.

In Canada: International Resistance Co., Toronto, Licensee



CALTECH CALENDAR

November, 1954

ALUMNI CALENDAR

January 12	Dinner Meeting
February 5	Dinner Dance Oakmont Country Club
April 16	Alumni Seminar Day
June 8	Annual Meeting

FRIDAY DEMONSTRATION LECTURES

Lecture Hall, 201 Bridge, 7:30 p.m.

Nov. 19—
Can We Get Rid of Smog?
Dr. A. J. Haagen-Smit

Dec. 3—
The Earth's Atmosphere
Dr. Oliver R. Wulf

Dec. 10—
Electrons, Electronics and Microwaves—D. L. Field

Dec. 17—
Effects of Environment on Plant Growth—Dr. F. Went

YMCA LUNCHEON FORUMS

Athenaeum, 12 Noon

Nov. 24—
The Decline of American-French Friendship—Dr. H. Dan Piper

Dec. 8—
European Reaction to Cold War—Mr. Max Beloff

CALTECH ATHLETIC SCHEDULE

BASKETBALL

Nov. 30, 4:15 p.m.—
Cal Poly (S.D.) at Caltech

Dec. 2, 3, & 4—
Invitational at Redlands

Dec. 7, 4:15 p.m.—
L.A. State at Caltech

Dec. 10, 8:00 p.m.—
Redlands at Caltech

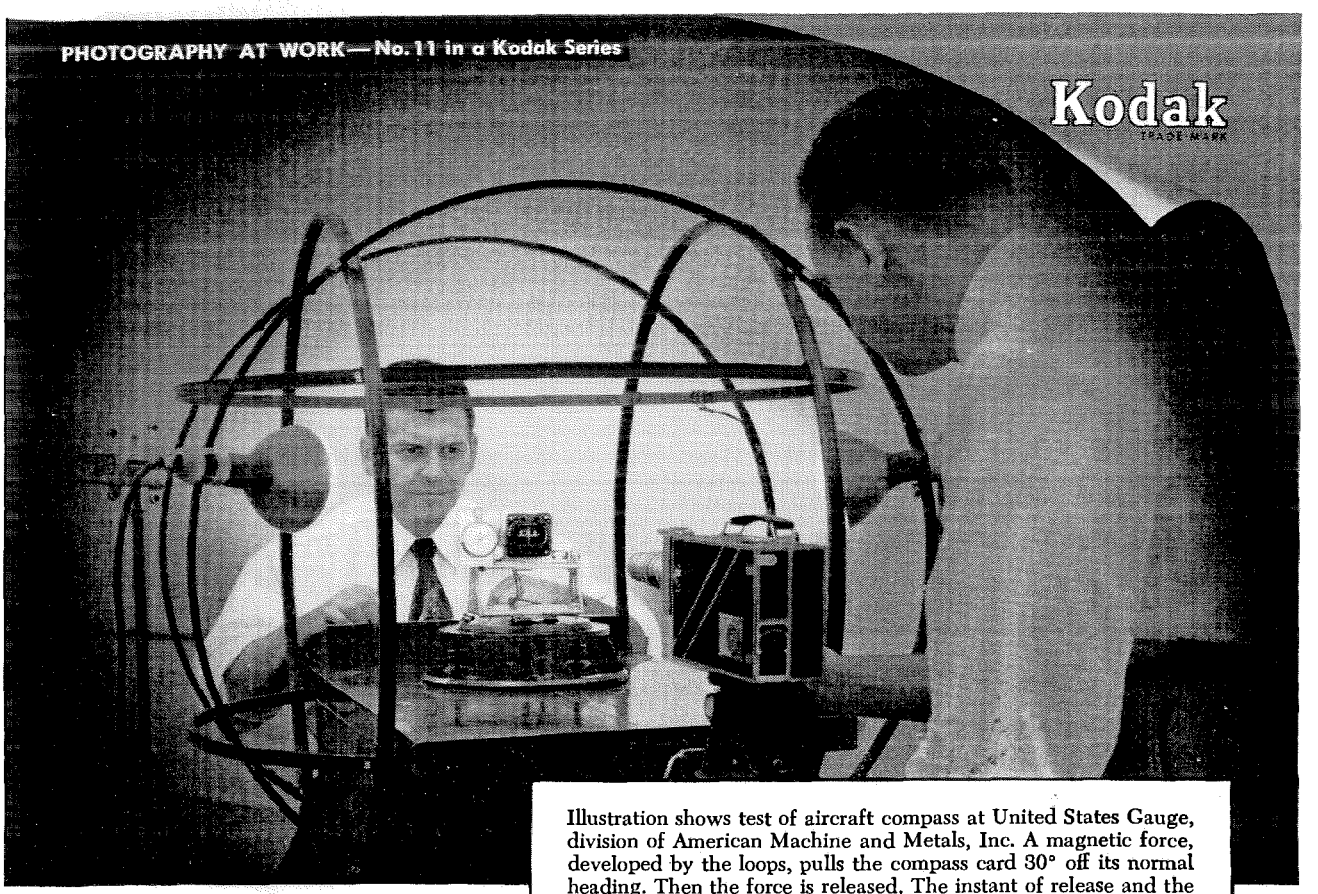


Illustration shows test of aircraft compass at United States Gauge, division of American Machine and Metals, Inc. A magnetic force, developed by the loops, pulls the compass card 30° off its normal heading. Then the force is released. The instant of release and the moment the compass recovers by 5° are both recorded on the film—become positive evidence of proper performance.

Wanted: an inspector with a split-second eye —*photography got the job*

A difference of 2/10ths of a second means the compass passes or fails. So the maker pits it against a stop watch—gets definite proof of performance with movies.

Uncle Sam said this aircraft compass must respond by 5 degrees in not less than 1 second or more than 1.2 seconds. That's only 2/10ths of a second leeway—far too little for human hands and eyes to catch the action accurately.

So, side-by-side, the stop watch and compass act their parts before the movie camera. Then individual frames along the film show the precise instant that the 5-degree mark is reached.

Product testing and quality control are naturals for photography. They are typical examples of the many ways photography works for businesses, large and small. It is improving production, saving time, reducing error, cutting 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.

45,000 G-E people working on jobs created by new products since 1945 could almost fill Princeton's Palmer Stadium.

In 9 years, new products created G-E jobs for enough people to fill a football stadium

Coming years promise even more progress.

One out of every five people at General Electric owes his job to products G.E. didn't make before 1945. And the future looks even brighter.

We can see new and exciting possibilities in many different fields. Atomic energy, jet engines, electronics, silicones—all promise to create new products, new processes and new jobs.

As we see it at General Electric, America's industrial progress in a free economy is not only continuing, it's rapidly accelerating.

Progress Is Our Most Important Product

GENERAL ELECTRIC