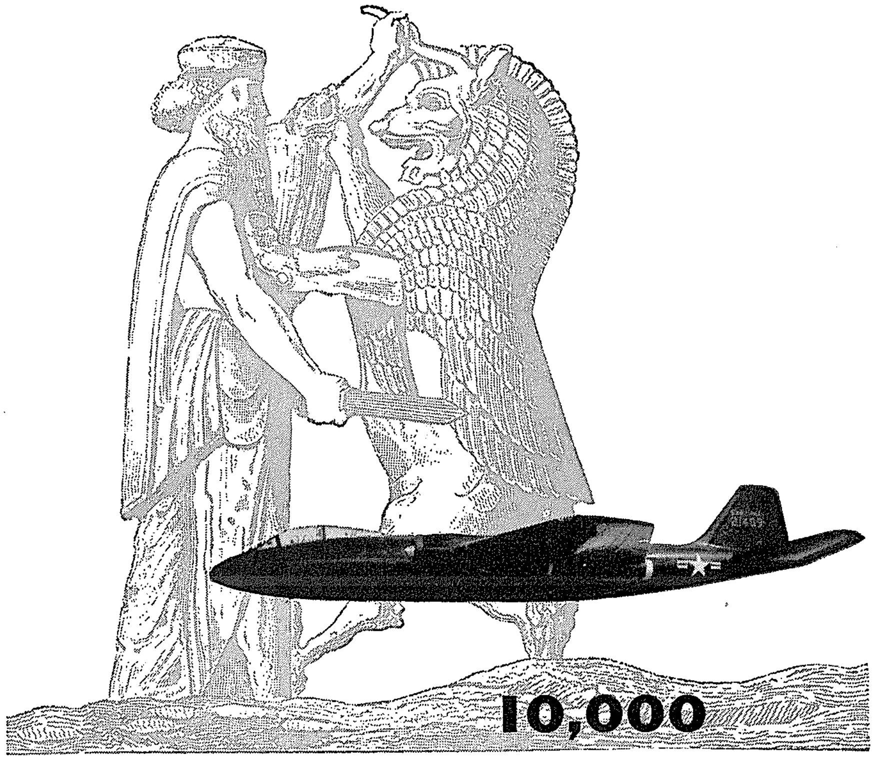
ENGINEERING | AND | SCIENCE

MARCH/1955

Student Elections . . . page 30

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY



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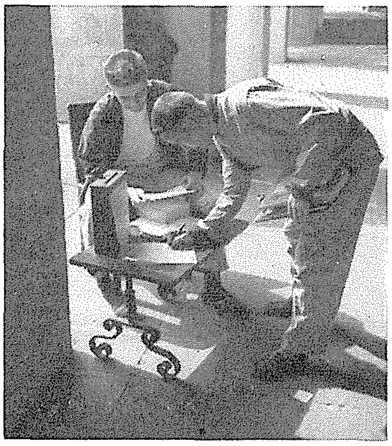
ENGINEERING AND SCIENCE

IN THIS ISSUE



On our cover this month is a student voter, marking his ballot in the annual election of Caltech student body officers. You'll find more pictures of this colorful campus activity on pages 30 and 31.

The Mount Wilson Observatory, operated jointly by Caltech and the Carnegie Institution of Washington, is having its 50th anniversary this year. It was back in December, 1904, when George Ellery Hale was making one of his regular trips up the Mount Wilson trail by burro, that he was called to the telephone at a summer camp about a mile below the summit, to receive the news that the Carnegie Institution had appropriated $150,000 for the establishment of a new solar observatory on Mount Wilson.

Some of the research highlights of the Observatory's first fifty years are noted in the article on page 13.

In "The American Scientist: 1955", President DuBridge considers the radical changes that have swept over the scientific world since 1940, the tasks scientists face today, the role they may play in the future. It's a hard-hitting, outspoken article—on page 18.

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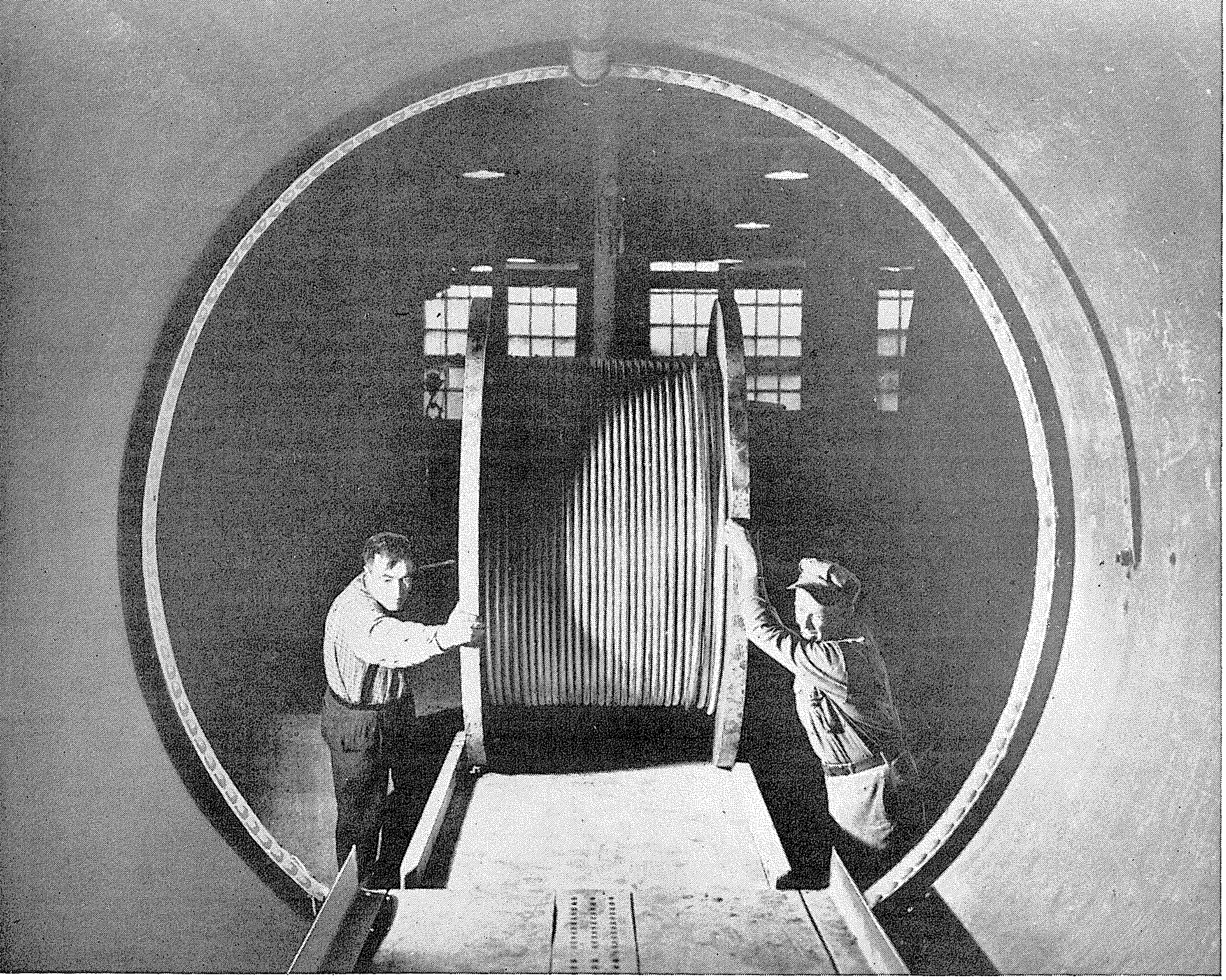


Vulcanizing Chamber

Application of Insulation and Jacket Compounds

Unvulcanized mill-mixed rubber insulating compounds may be applied to conductors and cables by either the strip insulating or extrusion processes. There are two modifications of the extrusion process depending on the method used for vulcanizing the rubber after its application to the conductor, namely, the pan cure process and the continuous cure process. Laytex insulating compounds are applied to conductors by the repeated or continuous dipping process.

STRIP INSULATION—In the strip insulating process, the compound is calendered to the desired thickness and backed with talc or a paper, cloth, or metallic tape to prevent adhesion of successive layers during processing. The rubber sheet and tape are cut into strips of a width slightly greater than the circumference of the conductor to be insulated, and each strip is taken up in a separate roll. A strip and the conductor are then fed into the circular opening formed by aligning semi-circular grooves in the outer surfaces of two rolls whose circumferences contact. The rolls are driven in opposite directions, thus folding the strip longitudinally about the conductor and pressing its edges in firm contact. The tape is left on the wire during vulcanization. If made of a suitable weatherproof material it may be permanent, but if made of metal it must be removed after vulcanization. The strip-insulated, taped conductor is generally taken up on reels for vulcanization.

EXTRUSION—In the extrusion process the rubber insulating compound is applied to the conductor in an extrusion machine similar to the strainer described under the preparation of rubber compounds. The head of the machine supports a guide and die and provides a passage for the compound from the screw through the guide and die assembly to its point of application to the conductor. The guide holds the conductor centered with the respect to the die. The die contains an opening approximately equal to the diameter of the insulation and

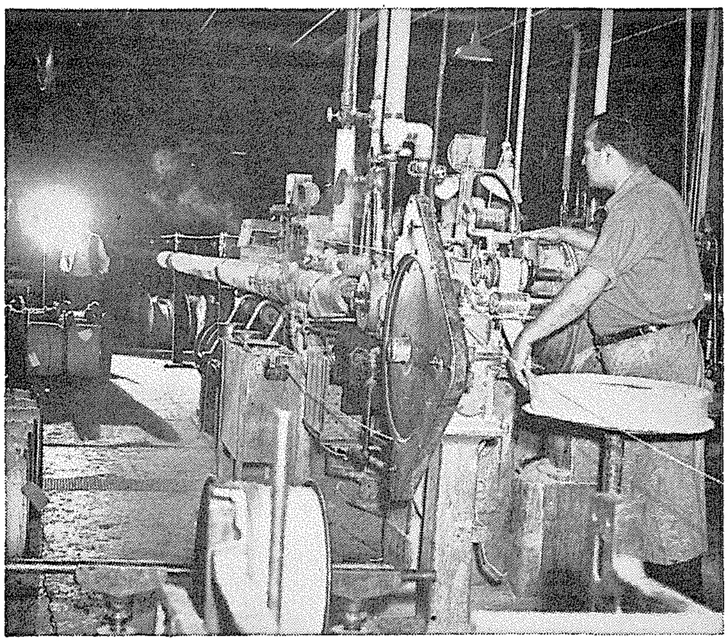
No. 8 in a series

is adjustable with respect to the guide so that proper centering can be obtained. The guide and die are so located that there is an annular space between them through which the rubber compound reaches the conductor.

The driven screw of the extruder forces the unvulcanized compound through the guide and die assembly around the conductor. The equipment is provided with a driven take-up capstan which pulls the conductor through the machine and a revolving pan in which the rubber-covered conductor is laid. Successive layers of the covered conductor are separated with finely divided talc to prevent adhesion of successive layers during vulcanization. A tape may be applied over the insulation on larger conductors before vulcanization to assist in maintaining concentricity of the insulation with the conductor.

Rubber or rubber-like jackets are applied to rubber insulated single conductor cables or over the assembly of multiple conductor insulated cables by the extrusion process. Such jacketed cables are taken up in pans of talc as described for insulated conductors. A continuous lead sheath is applied over the unvulcanized jacket compound and the lead covered cable taken up on reels for vulcanization.

Continuous Cure Process



VULCANIZATION—The pans or reels containing the unvulcanized rubber insulated conductor or jacketed cable are then placed in a vulcanizing chamber where they are subjected to steam at the required pressure and for the required time to suitably vulcanize the rubber. The pressure is then slowly reduced to atmospheric pressure and the pans or reels removed from the vulcanizer and allowed to cool. The insulated conductors are then removed from the pans. This handling of the insulated conductor in pans through the extrusion and vulcanizing processes accounts for the term "pan cure process". Non-permanent tapes are then removed from strip insulated conductors and the lead tube from the jacketed cables.

CONTINUOUS CURE PROCESS—The continuous cure process employs a standard extrusion machine similar to that used in the pan cure process, but equipped with a modified head to which a vulcanizing tube is attached and provided with means for automatically controlling the temperature of the cylinder, screw and head.

The head differs from that used in the pan cure process in that the guide and die are mechanically centered with respect to each other and the compound space surrounding them is smaller. Centering of the guide and die is obtained by the use of accurately machined holders which fit snugly into perfectly centered openings in the head. This provides centering of the insulation or jacket compound at all times without adjustment by the operator. The compound space in the head is reduced to prevent premature vulcanizing of the highly accelerated compounds used in this process. Automatic control of the temperature of the cylinder, screw and head is required for successful extrusion of such compounds.

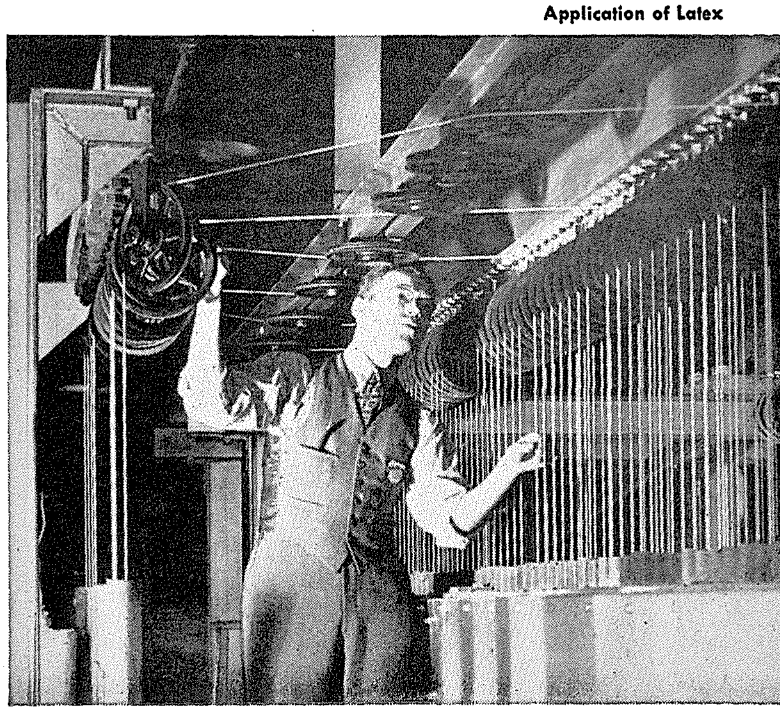
The vulcanizer attached to the tubing machine consists of a 2-inch steel pipe jacketed with a properly insulated 3-inch pipe and is approximately 125 feet in length. Vulcanizing steam pressure is maintained in the annular space between the vulcanizing tube and jacket to insure immediate attainment of the vulcanizing temperature when steam is admitted to the vulcanizer tube. The vulcanizer is provided with a splice box adjacent to the tubing machine and a suitable seal at the opposite end.

The driven screw of the extruder forces the unvulcanized compound through the guide and die assembly around the conductor or cable and directly into vulcanizer containing steam at 225 pound pressure. Highly accelerated compounds capable of vulcanizing in a few seconds are used so that the process can be operated at economical speeds. The speed of travel of a covered conductor or cable and the acceleration of the compound are so adjusted that the insulation or jacket is properly vulcanized while traveling the length of the vulcanizer. The vulcanized insulated conductor or jacketed cable is taken up on a suitable reel directly from the vulcanizer. The term "Continuous cure process" follows from the fact that the insulation or jacket is applied and vulcanized in one operation.

APPLICATION OF LATEX—The application of latex insulation consists of passing the coated conductor beneath the surface of a latex compound from which it is brought vertically into a suitable drying chamber. It continues to travel vertically in the chamber until the film is dry. It is then returned for the application of a second layer of compound. This alternate dipping and drying is continued until a wall of the required thickness is applied and dried. The amount of insulation deposited per application depends on the conductor size, the viscosity and temperature of the latex compound and the speed to which the conductor travels.

The conductor, covered with the required thickness of dried unvulcanized latex compound then passes through a vulcanizing chamber where the insulation is vulcanized and continues through a talc applicator to the take-up reel. This process is thus a continuous one in that the application of the insulation to the conductor and its vulcanization are accomplished in one operation.

Application of Latex



BOOKS

EXPLORING MARS

by Robert S. Richardson
McGraw-Hill, 1955 — $4.00

When interplanetary travel becomes a reality, our first objective will naturally be the moon. But the moon doesn't hold a great many surprises for us; we have a good idea of what's there already. So the moon will just be a stepping-stone to other, more distant worlds. As we look across space, Mars seems by far the most exciting planet for exploration. As the planet closest to the earth, and as the only planet where life as we know it may be possible. Mars has a special fascination for us all.

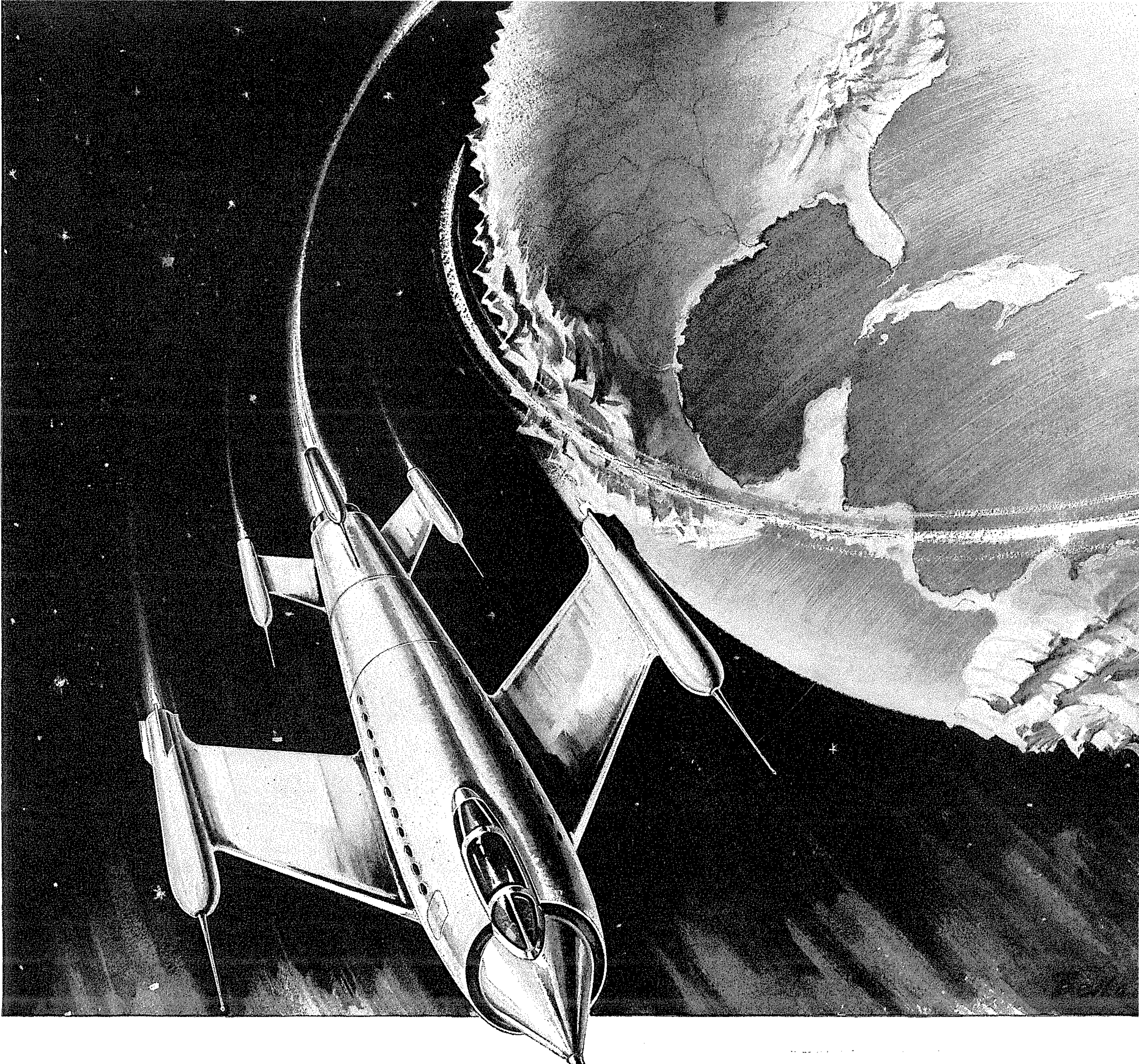
Every couple of years the earth swings past Mars and, for several months, the planet is close enough so that its surface can be studied. The average distance of Mars on these occasions is about 50 million miles—though it may be as much as 63 million miles. At intervals of 15 to 17 years, however, the distance between the two planets is shortened. In September, 1956—for the first time in 30 years—Mars will be only 35 million miles away from us.

Though astronomers are inclined to work in what Dr. Richardson refers to as "splendid isolation," a "Mars Committee" has now been organized, and in September, 1956, astronomers will cooperate with geologists, chemists and representatives of a dozen or more other sciences to find out all they can about Mars.

In the meantime, in this book, Dr. Richardson has collected just about all the pertinent information we have on Mars already. For good measure, he includes information on some other planets, discusses the possibilities of interplanetary travel, describes an imaginary trip to the moon, and offers some basic advice on how anyone can observe objects in the sky without using a telescope.

As a staff member of the Mount Wilson and Palomar Observatories since 1931, Dr. Richardson is an old hand at producing technical papers. This is not one of them. Neither is it another piece of the science fiction he turns out sporadically—and sometimes surreptitiously. It is a straightforward, non-technical account of some of the other worlds in the universe, written in a bright, informal style, with plenty of wry good humor.

"As a youngster," Dr. Richardson says in his preface, "I was intensely interested in astronomy, especially in the planets and Mars. In our little public library there were a few books on astronomy which contained brief descriptions of the planets, but what I wanted was a book that would tell me more about the planets and the possibility of finding life upon them. I also was curious about the men who had devoted their lives to a study of worlds beyond the earth.



Surely they must be strange creatures, far removed from the commonplace people around me. But on this point I could find no information whatever.

"*Exploring Mars* is the type of book I would have liked to own, then and later. I hope it will interest readers of all ages to whom the world is a perpetual source of delight and enchantment."

It will.

SCIENCE IN OUR LIVES
by Ritchie Calder
New American Library—
Signet Key Book $.35

THE CASE for science is presented by the man who is science editor of the London *News Chronicle* and chairman of the British Association of Science Writers.

It is Mr. Calder's thesis that science belongs to the humanities—and he proves it very neatly. In doing so, he gives a popular account of some of the great scientific discoveries, discusses what science means, describes its thought processes, and some of its social effects.

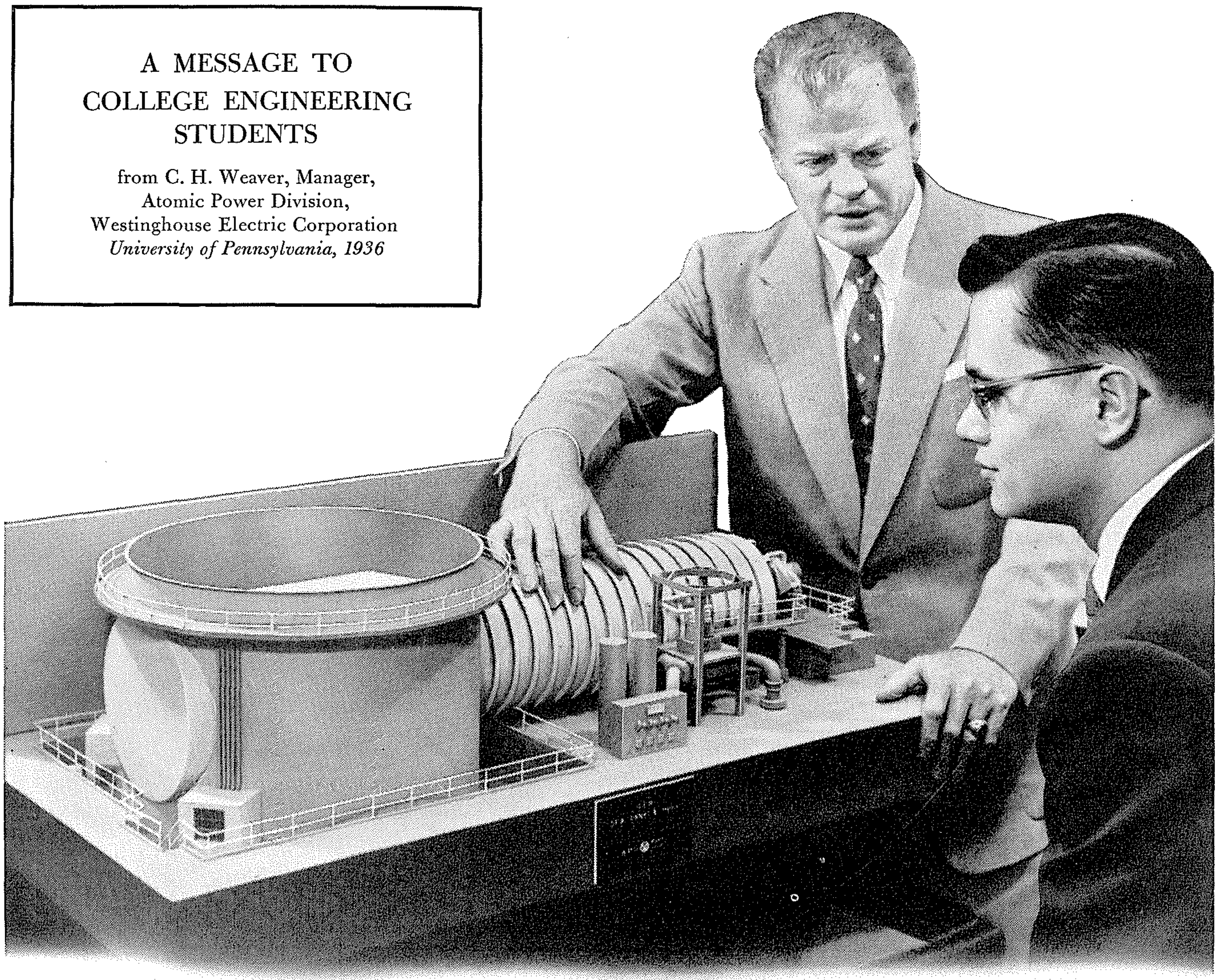
By the time he's finished, Mr. Calder has gone a long way towards explaining science for the benefit of some of the people he mentions in the opening chapter of his book:

"The preacher who complains that material advances in science are outstripping moral responsibilities piously says that he knows nothing of science. Statesmen, who boast their ignorance of science, nevertheless think themselves competent to legislate for the atomic bomb. The man in the saloon-bar, who ribs the . . . "egg heads" of science, and blames them when a new device threatens his job or a new weapon threatens his home, does not bother to understand what science is about, and treats it as gadgeteering or escapes with it to planets in a cartoon strip. He neither asks, 'What makes a scientist tick?' nor, in alternating between fear and jeer, treats him as a life-sized individual, whose training has given him certain qualifications. People of this kind and the scientist are the victims of that kind of journalism which treats any scientific discovery as a miraculous revelation and every scientist as a genius."

Mr. Calder's journalism is quite a different matter, and—meaning no offense—he writes rings around most of his American colleagues.

A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from C. H. Weaver, Manager,
Atomic Power Division,
Westinghouse Electric Corporation
University of Pennsylvania, 1936



To you who want to help create the atomic age

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Since 1948, Westinghouse has had an Atomic Power Division for atomic energy development . . . and it now has an Atomic Equipment Department to develop apparatus for atomic power installations. These are typical of the steps our forward-looking Westinghouse management is constantly taking in leading the way toward development of new sources of energy and new products.

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We at Westinghouse are interested in you as an *individual* . . . interested in your ambitions as well as your technical ability. For your professional development, there is a Graduate Study Program, available in 19 universities, and leading to your Master's and Ph.D. degrees. And there are other Westinghouse programs to fit your individual needs . . . all aimed at helping you reach your goal.

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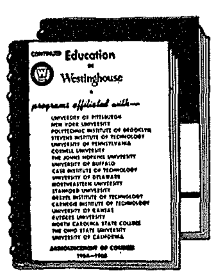

Ask your Placement Officer about career opportunities at Westinghouse, or write for these two booklets: *Continued Education in Westinghouse* (describing our Graduate Study Program) and *Finding Your Place in Industry.*

To get these booklets, write: Mr. S. H. Harrison, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 410 Bush St., San Francisco, Calif.

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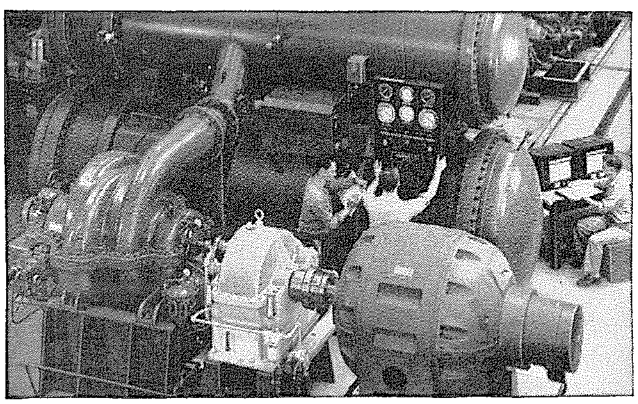
. . . the world's most versatile hydraulic proving ground



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

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Naturally, our new test equipment is a big help to our research engineers, as well as our customers. Now they get performance data on products quickly and accurately. Using it, we can save months, even years, in developing new Worthington fluid and air-handling devices—equipment for which this company has been famous for over a century. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Mgr., Personnel & Training, Worthington Corporation, Harrison, N. J.

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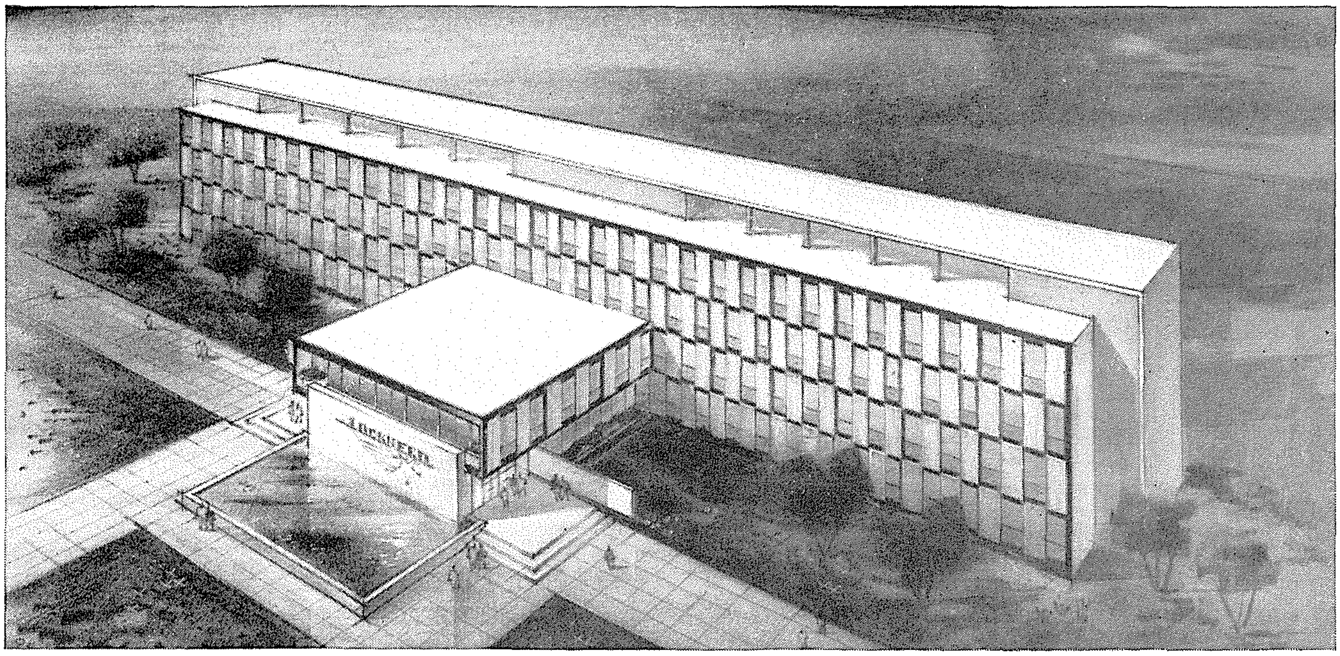
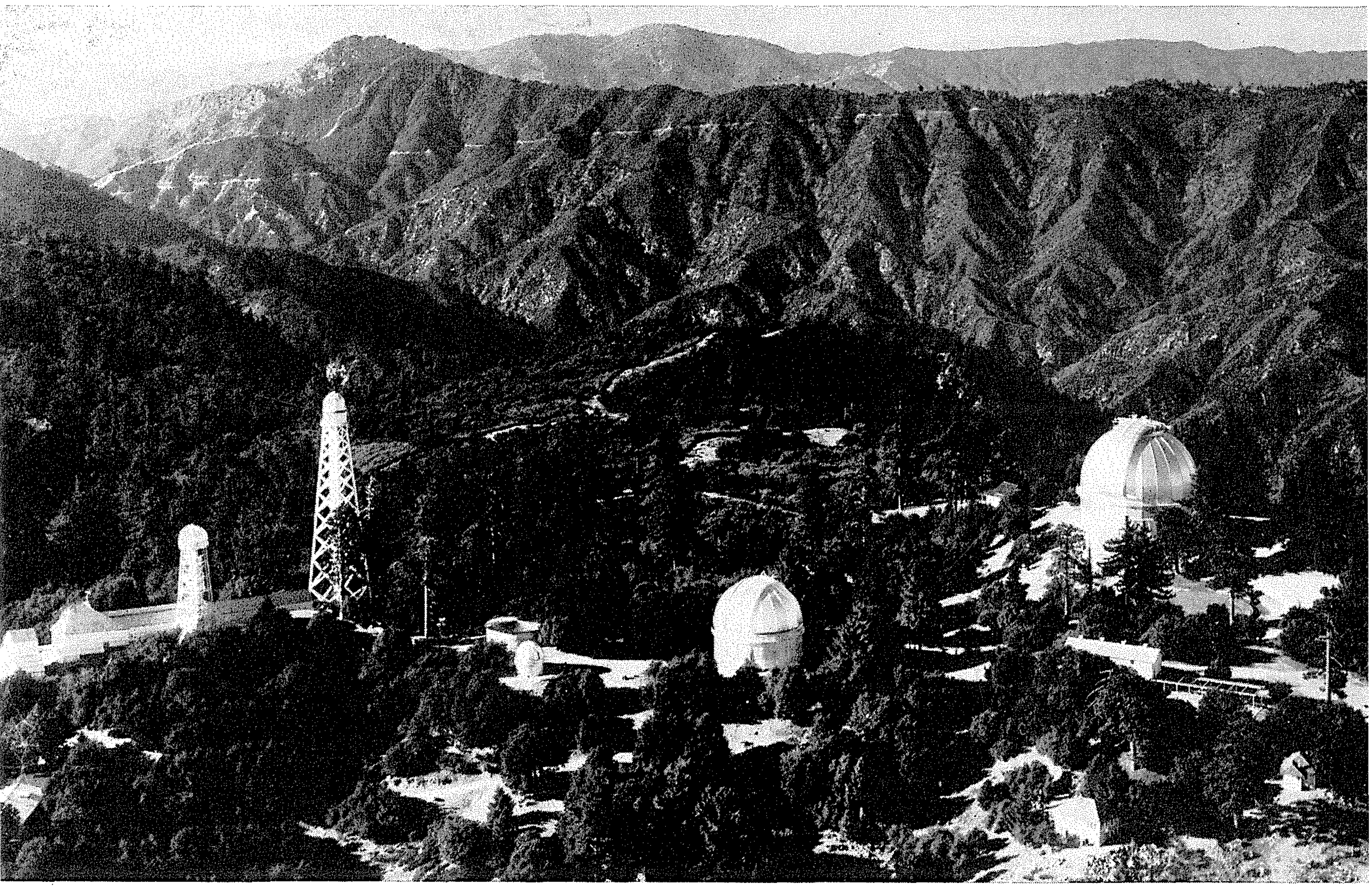


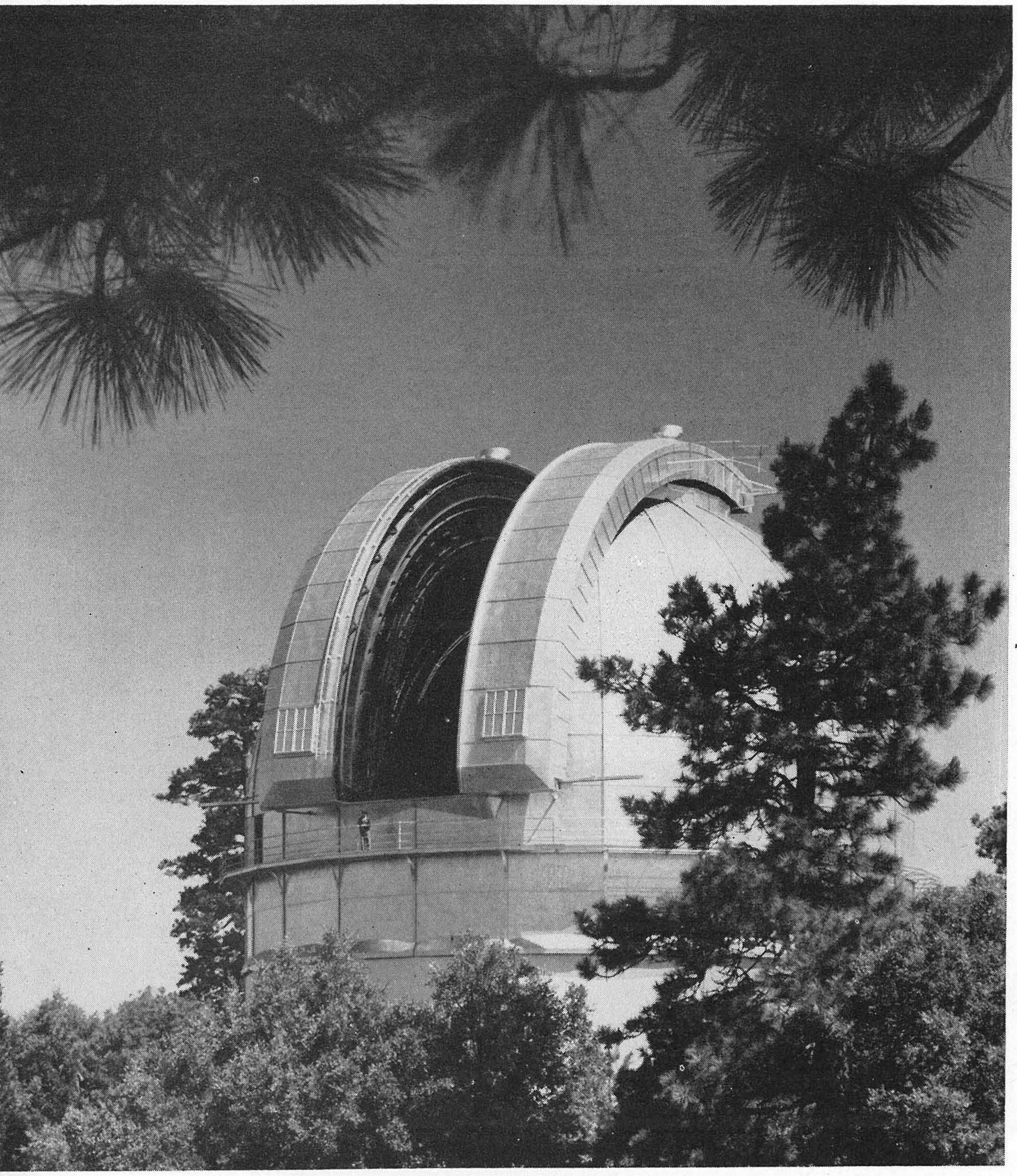
Dr. E. H. Krause, Research Laboratory head (left), examines blueprints of the new laboratory with E. R. Quesada, Missile Systems Division vice president and general manager (center), and W. M. Hawkins, chief engineer, during ground-breaking ceremonies.



The Mount Wilson Observatory today. At left, the solar telescopes—the Snow horizontal telescope (in the long, low building), the 60-foot and 150-foot tower telescopes. At right, the 60-inch and 100-inch reflecting telescopes.

THE MOUNT WILSON OBSERVATORY

Fifty years old this year, the Observatory has made invaluable contributions to man's astronomical knowledge



Mount Wilson's famous 100-inch Hooker telescope, which went into operation in 1918, has probably contributed more to man's astronomical knowledge than any other instrument. It was the most powerful telescope in the world until the construction of the 200-inch Palomar telescope in 1948.

"TAKE A SANTA FE TRAIN to Santa Anita Station; a bus from Santa Anita to the foot of the trail (Sierra Madre); a burro from foot of trail to the summit; ride on burro will take about four hours."

These were the directions George Ellery Hale was given for reaching the top of Mount Wilson, when he came to look it over as a likely spot for astronomical observations in the fall of 1903.

Hale was then director of the University of Chicago's Yerkes Observatory. Always on the lookout for locations that combined good seeing with accessibility, he came to Mount Wilson after it had been recommended to him by astronomers who had searched through California, Arizona, and even Australia for possible locations.

Through the winter of 1903-04 Hale made direct and spectroscopic photographs of the sun on Mount Wilson—with such success that the Carnegie Institution of Washington gave him a $10,000 grant to move a solar telescope from Yerkes Observatory to Mount Wilson on an expeditionary basis.

This experiment, too, was an overwhelming success. On December 20, 1904, Hale was making one of his grueling, but routine trips up the Mount Wilson trail, by mule, when he was called to the primitive telephone at Martin's Camp, a mountain resort about a mile below the summit. That was how he got the news that the Carnegie Institution had decided to appropriate $150,000 for the establishment of a new solar observatory on the mountain.

This year, the Mount Wilson Observatory is having

J. O. Hickox, solar observer at Mount Wilson, checks a sunspot map on top of the 150-foot tower telescope, which is raised high above the ground to keep the mirrors and lens away from disturbing air currents.

its 50th anniversary. When it first began operations, 50 years ago, the Snow telescope—a solar telescope—was the only instrument on the mountain. Moved from Yerkes Observatory to Mount Wilson, it was packed up the mountain, with the aid of mules and burros, along the winding eight-mile toll road—most of it no more than two feet wide.

As Dr. Ira S. Bowen, present director of the Mount Wilson and Palomar Observatories, has written: "Hale's basic policy was to select fundamental problems and then build instruments to solve them, rather than to construct telescopes and then seek for problems to which they might be applied.

"The equipment of the new observatory was therefore planned with the solution of a few definite solar problems in view. Furthermore, Hale believed in making the attack on these problems of the sun from as many sides as possible. Since the sun is a star, this policy called for parallel studies of other stars. Thus during the first year of operation Hale used the Snow solar telescope and its spectrograph to obtain for the first time high-dispersion spectra of a star for comparison with solar spectra obtained with the same instrument."

By 1907 the 60-foot tower telescope was in operation. Designed, like the Snow telescope, for the study of the sun, this tower telescope was the first of its type—its mirrors and lens raised high above the disturbing air currents of the warm surface of the mountain top. By 1910 it was joined by the 150-foot tower telescope.

From the beginning, George Ellery Hale had been working on instruments that would equip Mount Wilson to study the stars farther away than the sun. As early as 1904 he had a 60-inch glass disk being ground in the optical shop in Pasadena, to serve as a giant mirror for a reflecting telescope.

Ground and polished for two years, the 60-inch mirror was finally trucked up the mountain on the old toll road, which had been widened for the occasion.

When the 60-inch reflecting telescope went into service in 1908, stellar observation began to take its place in importance beside solar investigation on Mount Wilson. In its first five years the 60-inch made more than 4,000 photographs. It could range 300 million light years into space—farther than any telescope in the world.

In time, astronomers working with the 60-inch began to reach conclusions that indicated a termination of our galaxy, but at an undetermined distance. What they needed was a larger instrument that would bring a greater number of more distant stars within range.

John D. Hooker, a Los Angeles businessman, agreed to finance the mirror for this larger instrument, and, after years of preparation, the 100-inch Hooker telescope went into operation in 1918.

After the completion of the 100-inch telescope the Mount Wilson Solar Observatory dropped the "solar" from its name. But solar investigations are still a major activity of the observatory, and the long series of solar photographs made almost daily are a nearly complete record of the sun's activities for close to 50 years.

For more than 30 years—until the 200-inch Hale telescope went to work at Palomar in 1948—the 100-inch telescope was the most powerful in the world. Reviewing the advances that have been made with this instrument, Dr. Ira S. Bowen says: "Its great light-gathering power and critical definition made possible Dr. Edwin P. Hubble's studies of the distances and structures of the galaxies, which showed that these are great stellar systems compared to our own Milky Way system. These investigations completely revolutionized the concepts of the dimensions and content of the universe.

"Similarly, the development of very high speed spectrographs permitted Dr. Milton Humason to extend the measurements of the velocities of galaxies out to the most distant known clusters of these objects. Furthermore, the combination of Hubble's distances and Humason's velocities for these objects allowed Hubble to confirm and greatly extend his fundamental law of the redshifts, the linear relation between velocity and distance, and the basis for our present concept of the expanding universe.

"In the spectroscopic field, one important result was Dr. Walter S. Adams' discovery and use of absolute-magnitude criteria to extend greatly our knowledge of stellar distances.

"Similarly, the stellar interferometer yielded first in Dr. A.A. Michelson's and later in Dr. F.G. Pease's hands the only direct measurements that have been made of stellar diameters."

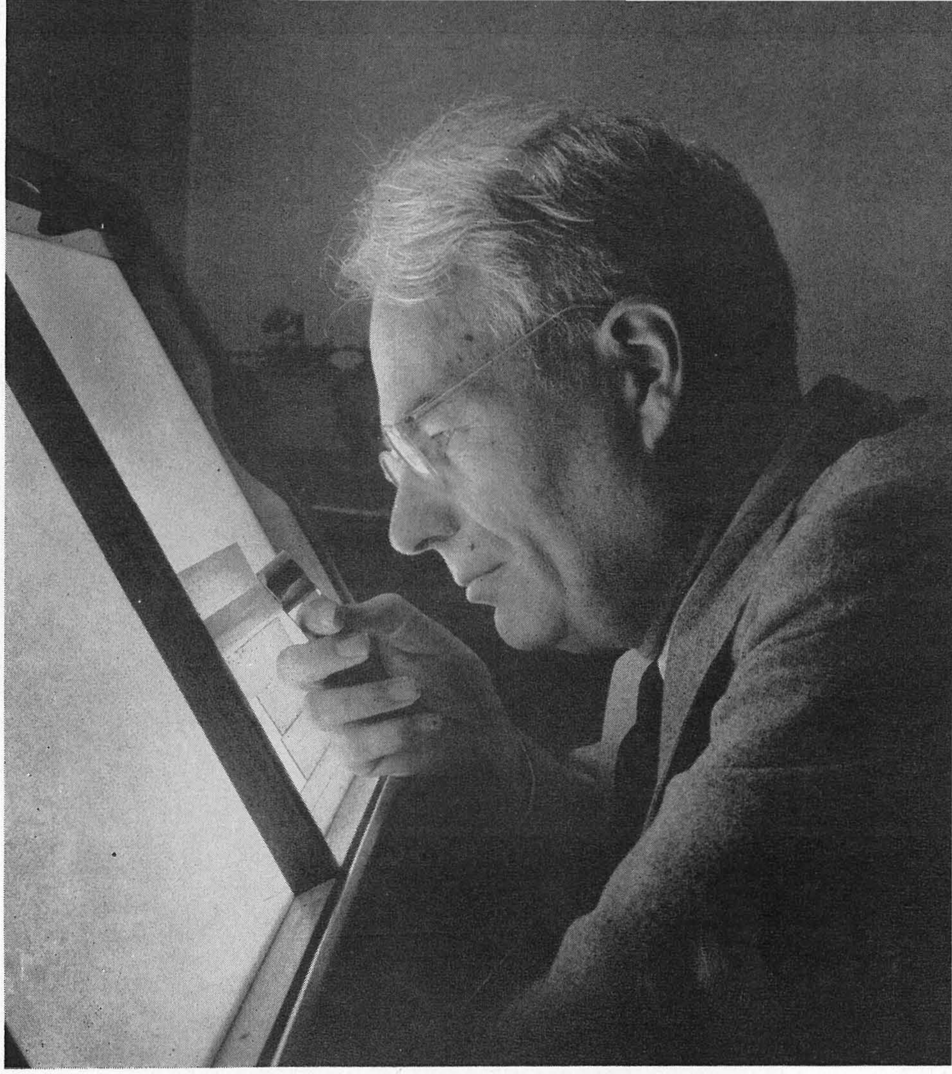
The Mount Wilson Observatory is still an active research center today. In fact, there is every reason to believe it will make as many contributions to astronomy in the next 50 years as it has in the 50 just passed.

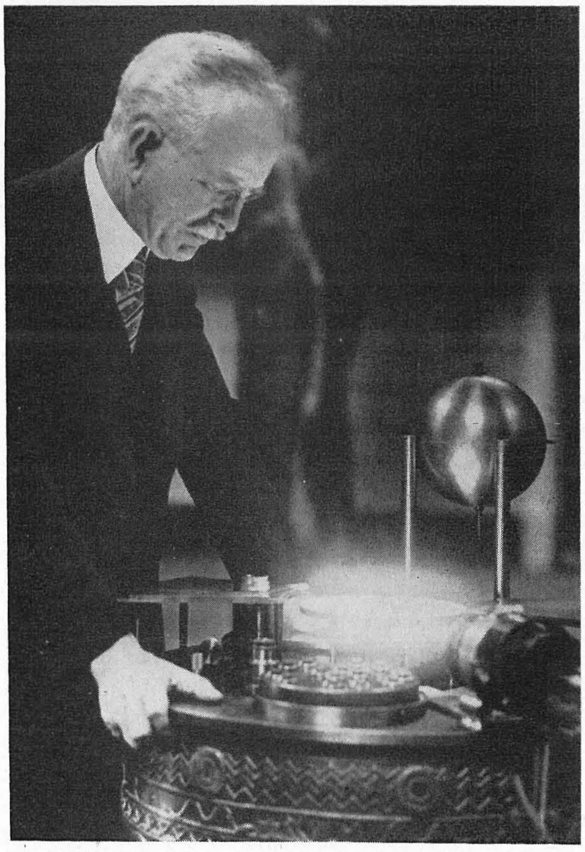
A night view of the valley below Mount Wilson.

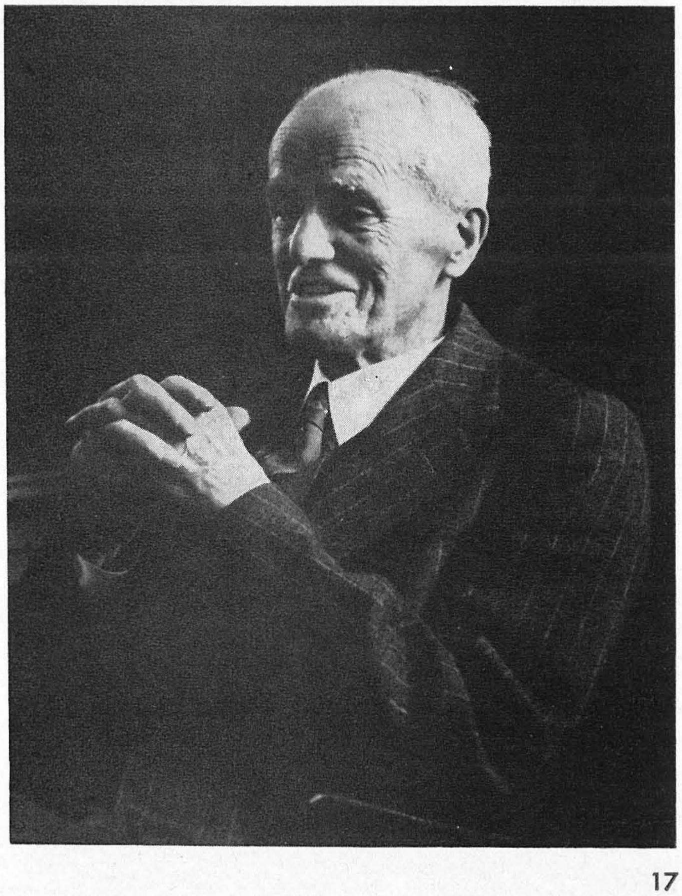
Right: Ira S. Bowen, director of the Mount Wilson and Palomar Observatories since 1946.

Below: George Ellery Hale, founder of the Mount Wilson Observatory and director during the first 20 years. His vision and leadership led not only to the development of all of Mount Wilson's outstanding astronomical equipment, but to the 200-inch Hale telescope at Palomar as well.

Below, right: A recent photo of Walter S. Adams, director of the Observatory from 1923 to 1945. Dr. Adams is now semi-retired after 42 years of service.







THE AMERICAN SCIENTIST: 1955

What are his tasks, duties and functions?

What does the nation need from him—and what can it expect of him?

by L. A. DuBRIDGE

IT IS RATHER STARTLING for some of us to realize that probably over half of the active research physicists of the country today are under 40 years of age. And it is still more startling to note that this younger half received their Ph.D. degrees *after* Pearl Harbor Day in 1941. In other words, about half of the nation's physicists have never had any experience with the days when their science had no noticeable—or certainly no widely noticed—relation to national defense.

In those days there was no Pentagon, no AEC, and the number of physicists who had ever visited the old Navy Building or the Munitions Building could certainly be counted on your fingers. Physicists knew that the Navy existed mostly because of the Naval Research Laboratory, some of whose members regularly attended scientific meetings and gave interesting papers on subjects which appeared to have no military interest whatsoever, such as bouncing radio waves off the ionosphere (the forerunner of radar, we know now).

One gathered that there were things going on at NRL that no one was supposed to know about—but the word "secret," as applied to scientific matters, was quite unknown. The phrase "classified research" would have been wholly without meaning. The term "security" meant either "safety" or something you bought on the stock market. Loyalty was a characteristic like virtue, or honesty, or chastity; something which one took for granted, but never talked about or questioned. "Security risks," "loyalty cases," "clearance procedures" were terms not even yet invented—or at least unknown outside of a military headquarters.

The scientific world has been rudely and radically shaken and transformed since 1940. In 1940 the only rule the scientific world was aware of (and the non-scientific world was hardly even aware of the scientist at all) was to teach, to do research, to announce and publish the results and discuss them with others.

In 1955 the scientist also faces other tasks. Yet one of the great dangers of 1955 is that the scientist himself will forget that his primary functions are still to learn, to teach, to experiment, to seek understanding, to discover ignorance and errors, to gain new ideas and then to challenge them, to prove or disprove them; and always to exchange ideas with others—fully, freely, honestly, vigorously.

This *is* science. This is its mechanism of operation, of advance. This is the way, the only way, it uncovers the truth. Whatever else may happen, whatever other demands may be made or restrictions imposed, these mechanisms of free inquiry are essential to the pursuit of knowledge and the advancement of understanding; they can never be forsaken if science is to survive.

Of course, no one of consequence actively or explicitly opposes the advance of science. But there are many who, through ignorance or absorption in other matters, exhibit little interest in resisting the forces which are eroding away the base on which a free and thriving science rests. There are many fearful souls who believe that science is moving "too fast." There are those who are unaware of the nature of free inquiry, but who yet can participate in destroying it. The power to protect science lies no longer solely in the hands of scientists or even of those who understand its methods and aims.

We can see in retrospect that basic science in the universities of America was, before 1940, in a position which might be described as one of "respectably independent poverty." Needless to say, the hope has been

"The American Scientist: 1955" has been adapted from the Embree Foundation Lecture given by Dr. DuBridge at Yale University on March 14, 1955

expressed that we might have lost the one without losing also the other. We have, indeed, lost most of the poverty; the independence is still in the balance.

World War II brought to the attention of the American people the fact that science was of vital importance to national security and hence should be more adequately supported. Both private and public support have largely increased. However, the scientist worries because the increased support of science has come about partly for the wrong reasons. The nature of the support is thus unbalanced. Hence, the conditions sometimes imposed are unrealistic. Consequently, there is fear that if unrealistic expectations are not fulfilled, if improper conditions are resisted, a part of the machinery may fail and disaster result.

The weak point is, of course, that basic science is being supported primarily—or at least entirely too much—because of its potential military value.

Now I would be the last one to deprecate the military value of science, or the importance of the military objective. The military strength of the nation is absolutely vital to the survival of all freedom—including the freedom of science. A strong, free science is absolutely essential to military security. At no time in the past 15 years have I personally not been engaged in some activity aimed at bringing scientific resources to bear on the nation's defense problem. And I have nothing but admiration for the way in which most military agencies have carried out their activities in support of basic science.

Nevertheless, if the sole reason for support of science is the military one, we have real reasons to be concerned. What are these reasons?

In the first place, under such conditions research activities not having clear relevance to military problems will be neglected; vastly important areas of science will thus suffer.

Secondly: As, or if, military needs are reduced or budgets cut, then research funds will be cut in proportion; indeed, in order to conserve ready fighting strength, the cuts made by defense agencies in research allowances will be relatively large.

Thirdly: Military activities involve secrecy; and secrecy in basic science is a dangerous and subversive influence.

Finally: To label basic science in terms of any specific practical end is to misunderstand and distort its whole spirit and purpose. Basic research means exploration of the unknown. Since what will be discovered in an unexplored field is, by definition, unknown, the practical consequences cannot be foreseen, and we must not pretend that they can be.

Basic science

It is my conviction that basic science is one of man's highest and most noble and most successful intellectual efforts; its activities are among the highest achievements of the human spirit. The advances in scientific knowledge during the past 300 years have laid the basis for the whole pattern of modern industrial civilization. At the same time, I believe that even without such practical results the pursuit of knowledge is valuable in itself; for it liberates the human mind from ignorance and consequent fear. Knowledge is good for its own sake. In addition, it helps us to live better lives—and, incidentally, to improve our military strength.

The support of basic science then, if it is to be stable, useful and stimulating, must be based on a full and not a partial conception of science's values.

Please note that I am not arguing for a reduction in support of science by military agencies. Rather, I wish to advocate increased support by other agencies and increased understanding by everyone.

Not all scientists are engaged in doing basic research —or are occupied exclusively with such work. Many brilliant and well-trained scientists have, especially in recent years, chosen careers in applied science. Many others give a portion of their time to applied science and during World War II of course, most scientists left their basic science entirely to engage in war work.

This response of scientists to patriotic duty has, ironically enough, been a primary cause of misunderstanding of the role of science and scientists. Because scientists left their science to help develop weapons, many people have concluded that science is the development of secret weapons; hence, that science is secret! Nothing could be further from the truth. Science is the search for knowledge. The first and primary thing one does with a new discovery in science is to *publish* it. This is absolutely fundamental and absolutely essential. Only when it is available to all other scientists does it become a part of the structure of science. And only when it is published can it be openly examined, criticized and tested to find out if it is really *true*. A piece of structural steel may be nice to look at, but it does no one any good until it becomes a part of a structure—a building, a bridge or a ship. Isolated bits of knowledge tucked away in a private notebook are not science. But when published, tested and related to other knowledge, that notebook entry may be of great importance.

All of this is in sharp contrast to the business of inventing military weapons. It is true that scientists have proved to be pretty good inventors. Some devote full time to it and others part time. But the design of a new secret weapon is tested and made useful *not* by publishing it, but by *making the weapon* and seeing how well it works. There is no point in publishing the design *before* making the weapon. If the weapon works, you will certainly not publish it and give it to potential enemies. If it doesn't work, there is no use publishing it at all.

This all seems very elementary to a scientist. Yet there are many people who really believe that because scientists habitually publish their scientific findings, *therefore* they are not good security risks because they will probably want to give away weapon secrets. This is like saying that anyone who can *talk* is a poor security risk because he might talk about secret things!

The curtain of secrecy

As far as I know, no American scientist has given away any secrets. It seems clear then that scientists understand this whole problem very well. All they ask is that the public understand the difference between weapon information and scientific information so that the curtain of secrecy which properly surrounds the first will not be improperly extended to cover the second. It needs to be repeatedly emphasized that what the German-born Klaus Fuchs was convicted of in England was not giving away scientific information, but giving away information on the design and manufacture of weapons. That was treason, which no one excuses or condones.

Possibly the distinction between open scientific information and secret weapon design information can be made clear by an example in the field of radar. Radio waves were discovered by Hertz in 1887. He discovered how to produce and detect them and he found that they could be reflected from various objects. He published his results. Marconi used these results to develop wireless telegraphy. For the next 50 years thousands of people experimented with radio waves, measured their velocity, learned of their behavior, designed equipment to generate and detect them, exploited them as tools of science and of technology and published the results. It never occurred to anyone—and doesn't occur to anyone today—that any of this should be secret.

But in 1937 and 1938 some engineers in the United States and in England evolved an idea of how to use radio waves to detect hostile airplanes. The device was built, was tried and it worked. Here was a military weapon—and, obviously, the design was not published. All those concerned, scientists and military, saw that this new device was an important military secret. Not until years later, at the end of World War II, after thousands of soldiers and sailors on both sides had used such equipment, was there anything published about radar. After the war, a great deal about it *was* published, because it was clear that there were many possible peacetime applications. But even today, though the general science and technology of radar are "unclassified" and freely published, the designs of certain military equipment are still secret—and properly so. But, because the design of the radar bombing equipment on a B-52 is secret, it does not follow that all the science and technology of radio and radar are also secret.

In the radio field there is usually very little difficulty in deciding where the boundary lies between secret and non-secret. The layman is quite willing to leave the decision to the experts.

Neither is there any argument about the open nature of the science and technology of metallurgy; we do not keep secret the properties of steel simply because secret types of guns or tanks or ships are made of steel.

Nevertheless, for many years after the first atom bomb, there did exist in many quarters the delusion that now *atoms* were secret—or at least atomic nuclei were. Physicists, of course, had been publishing results in the field of nuclear physics for 30 years before 1945. That is the reason there *was* a science of nuclear physics. Yet there were even misguided attempts in 1946 to "classify" material which had actually been published many years before!

Open science and secret technology

Nuclear physics was a field relatively unfamiliar to the public—and to Congress and the military agencies—and because the atomic bomb was clearly a weapon of such commanding importance, it was natural that there should be some confusion for a time as to where the boundary lay between open science and secret technology. For a while there were warm battles. Scientists who wanted science kept open were falsely accused of trying to give away weapon secrets. Military and government officials charged with guarding our weapon secrets were falsely accused of trying to destroy science. However, reasonable men eventually came to agreements. And though the boundary between them—like the boundary between the East and the Middle West—is still hazy, it is, nevertheless, obvious that even a hazy boundary can separate two large areas within each of which no arguments can arise.

Fortunately, the fact that it is now becoming evident that atomic energy will some day have a substantial dollar value to American industry is stimulating a more widespread agreement on the desirability of openness in the field of nuclear physics. Apparently the dollar can open gates that the scientists' earnest pleadings had failed to budge! Industry knows that rapid progress in science and technology is impossible under secrecy. Free enterprise and competition are as important in the intellectual field as in business. Now that it is clear that the Russians have learned from nature the same "secrets" we have learned about atomic nuclei, the reasons for being so fearful of our former "secrets" have largely evaporated.

It may be too much to expect the public to grasp the idea that secrecy does not necessarily keep things secret. This is not because there may be spies. It is because the secrets in science and technology are wrested from nature. And nature gives the same answers on both sides of the Iron Curtain. All that our secrecy can do is to slow down the enemy's progress. Since it also necessarily slows down our own, the relative risk or advantage is often difficult to weigh. Again the public must be willing to trust the decisions made by the experts.

These relatively soluble problems I have been discussing lead inevitably into other problems which are not easily solved—or at least have not been solved. The first of these is the matter of personnel security.

Personnel security

As long as scientists are called upon to engage in weapons technology, there will be *real* reasons for worrying about who can be trusted with secrets. As long as there is the illusion that science itself is secret, there will be also *false* excuses for so-called "security" measures.

We need not waste time on the false issue—even though it is a serious one. In the non-secret areas of science, security cannot be a problem or an issue; hence real personnel security questions cannot arise. If they do arise, they are false issues and should be exposed as such. It just doesn't make any difference what the political affiliations are of the man who finds the cure for polio. In fact, I would be in favor of offering a handsome bonus and a fine salary to any Russian scientists who will escape from behind the Iron Curtain and come over and help us solve this and other problems in the field of public health and other non-secret areas of science and technology. I would keep a close tab on any Communists around, but I surely would like to pick their brains! And I would surely like to deprive the Soviets of the benefit of their talents.

But there is a *real* issue to be dealt with. How *are* we going to determine who can be trusted to work in the areas of weapon technology where there are secrets to be kept?

The process which the appropriate authorities go through to determine whether a given individual is to be trusted with secrets is called the "clearance procedure"—"investigation," or collecting information about the individual, and "evaluation" of this information. The evaluation may be by a person or a committee. The "file" does not always indicate the degree of reliability of the various pieces of information; its reliability is indeed often unknown. But the evaluator must decide from the information available whether the individual should be "cleared" or not.

Now just what is the evaluator really trying to decide? What criteria does he use in weighing the significance of the various pieces of information? The latest information I have seen lists 21 such criteria for denial of clearance. Naturally, clearance is denied to one who associates with Communists. But how serious is a casual association with one Communist? or a former Communist? or a suspected Communist? A habitual drunkard or pervert would be a serious risk. What about the occasional drinker? Does one expect that a cleared person shall be wholly without sin or blemish? Is a security clearance the same as a character certification? One criterion for denial is "any behavior, activities or associations which tend to show the individual is not reliable or trustworthy." What does that mean? And what about the organizations an individual has belonged to? Does it matter *when* he belonged? Why he belonged? When or whether or how he quit? What about doubtful or disputed information? Shall the word of any unknown informant be given more weight than the sworn statement of the man himself?

The answers to these and many other questions are exceedingly vague. Some are unanswerable. We must realize, in fact, that by the very nature of the problem such criteria cannot be laid down and adopted once and for all. Conditions change. In 1942 a Communist was, presumably, less of a risk than a Nazi. When a war is on and lives are at stake we are, oddly enough, willing to take more of a risk in order to get the job done quickly. People who served competently during the war were disqualified later from classified work. The very term "risk" itself implies a danger not fully defined.

Security risks

The fact is, of course, that every human being is some security risk. No one is perfect; no one is immune to being deceived or blackmailed or tortured into giving information; no one is certain never to commit a slightly careless act in handling secret material. (After all, perfectly decent people are sometimes careless enough to break their own necks!) Very often the question of the best way to guard a secret is a matter of delicate judgment in balancing risks; even the best person makes mistakes in judgment.

At the same time there are urgent jobs to be done. If we trust no one with secrets, then there will be no secrets—for secrets are invented in the brains of fallible human beings. If we disqualify every competent but slightly "imperfect" scientist from working for the government, then we shall surely fail to survive as a nation in the modern world. For scientists are essential and few of them are wholly "perfect."

This is especially true if the definition of perfection includes the requirement that we have never known—or "associated with"—the "wrong" people.

There is a crying need today for a reformation of the concept of a "security risk." Not all character blemishes should be included in a term which clearly implies in the public mind either disloyalty or at least inexcusable ignorance or carelessness. You may fire a man convicted of petty larceny; but you should not call in the security board. We must also formulate the criteria for judgments in security risk cases; clarify the significance of "associations"; define the criteria for admissibility of derogatory evidence. All the appeal procedures and review boards in the world will be to no avail if no one knows what is being decided or what the rules of evidence are.

Security procedure

It is often said that security procedures may be justifiably arbitrary because in any case "federal employment is a privilege, not a right." As far as most scientists are concerned, it is *neither* a privilege nor a right but only a burdensome patriotic duty. As far as selfish desires are concerned, most scientists would prefer not to work for the government. Often they aren't paid at all for their advisory services. Scientists are scarce, especially the really good ones that the government so often needs. The government ought to be out offering positive inducements to them. Often the services of a valuable man can only be obtained for a short period or on a part-time basis. Why waste most of the period on unnecessarily elaborate security clearance procedures —especially if he has already been cleared by other agencies a dozen times before? Yet we do. A prominent industrial engineer in charge of a large, new, and terribly important development program recently told me that the primary cause of delays in the program had been the security clearance procedures. What a perversion of the concept of security! We would prefer not to have an important new weapon at all than to have it invented by someone of whom some security officer doesn't approve!

Now I do not want to be misunderstood. There *is* a danger of losing classified information and we must adopt reasonable precautions. There is also a danger of losing the technological race for military security. We need to find a balance between these two risks—a balance which is more advantageous to the total safety of the United States.

I turn now to the subject which is at the heart of the problem of scientific leadership in modern America, the question of just what are the tasks, the duties, the functions of a scientist in America in 1955. Just what does the nation need from, and what can it expect of its scientists? A clear understanding of this question will do much to clarify the other problems we have been dealing with.

There are about 50,000 scientists in the country, plus about 200,000 engineers, working in universities, in industry and in government. Wherever they work they may be doing basic science, or either military or non-military applied science. In universities the emphasis will be on basic science, though universities also carry on or manage applied science, including military projects. In industry and in non-military government agencies the emphasis is on non-military technology, though industry carries also a large load of military development; especially in aeronautics, electronics and atomic energy.

A young Ph.D. in physics or electrical engineering, for example, may choose any of these various careers. His financial rewards are the greatest, both at the start and in the future, in industry. His freedom of choice of research fields will usually be greatest in a university. Patriotic motives may attract him to a government laboratory. There the starting salaries are moderately good, but the ultimate ceilings are lower than in either industry or university.

But the patriotic motive may attract a man to military projects in industry too, or even in some universities. What then do the government military laboratories have to offer the bright young graduate? To tell the truth, they are not in a good competitive position at all. Some individuals will be attracted to them by geographic factors; others will have a special interest in a particular line of work (for example, radar). On the other hand, civil service rules and security rules constitute fairly effective repellents. Hence, with a few notable exceptions, the government laboratories do not secure the top-grade young scientists. (The Atomic Energy Commission laboratories come in a special category. They are all operated under contract, outside of civil service, and they offer unusual appeal because of the glamour, the newness, the intrinsic interest and the importance of the field.)

Here is a major problem for the government: How to make its own military laboratories more positively attractive to the best young scientists and engineers. In view of complex government red tape, the rigidity and inappropriateness of many civil service and clearance procedures, the problems of fluctuating budgets and unnecessarily rigid purchasing, reporting and hiring procedures, it is doubtful whether there is much hope that the government will regularly attract the best brains of the country into its own establishments.

Attracting the best brains

But why shouldn't we have the best brains working for national security? A Congressman who has just exhausted himself to be elected to a government job cannot believe that some people don't *want* government jobs; hence, he sees no necessity for trying to make them more attractive. As a result, a scientist will be far better off, far freeer and just as patriotic in accepting a job with industry or a university.

My suggestion is then that the government, in the future, contract this task of military research to private organizations who know how to attract good people. Weapon evaluation and test centers and field stations must, of course, be operated under military command, but weapon *research* is a civilian job and had better be done under private auspices.

Whatever is done here, however, it is evident that the government today actually uses the services (directly or on contract) of some 50 percent of the nation's scientists and engineers. That many are required for the work of research and development and engineering of military weapons, atomic energy, public health, agriculture, standards of measurement, and other direct scientific functions of the government. This is clearly a vast change from prewar days—days when possibly only 10 percent of the nation's scientific strength was so required. Furthermore, the 50 percent not directly engaged in government service are still serving the country in direct and indirect ways. They are uncovering the basic knowledge which is essential to future welfare and security. They are increasing the nation's technological strength, its industrial productivity. They stand, furthermore, as a ready reserve, able to turn quickly to the more pressing tasks of war when that becomes necessary.

Encouraging the best brains?

With this great army of scientists, engineers and scientific workers—in every field of science—working so continually for the public welfare and security one might ask what steps the government has taken to insure that these men are effectively used; that more are being educated; that the results of their work are made available promptly and are intelligently employed; that national policy and planning keep step with the rapid advances in both peacetime and military technology.

The answers to these questions are not very encouraging. I will mention only a few examples of ungenerous or misguided attitudes:

1. The National Science Foundation has been given inadequate appropriations, yet it is the only government agency dedicated to the support of science for its own sake (rather than for its military or other direct value).
2. There have been many sweeping and false accusations in government circles of disloyalty or spying by scientists, thus breeding distrust and fear, and repelling scientists from government work.
3. Selective Service policies and procedures, though they give lip service to the importance of scientific strength, actually make little effort to see that men of talent are effectively used. The draftee in uniform has only a small chance of employing any scientific talents or training he may have—even though a military laboratory a few miles away might have been delighted to hire him.
4. An official report of a Congressional committee labels as subversive the activities of some of the great foundations which have been mainstays in the support of science for many years. Even though the report is so outrageously false as to be promptly discredited,

it hardly encourages the formation of new foundations or the continued enlightened support of pioneering scholarly activities by private funds.

Now all these and many other examples of government ineptness or failures in encouraging science can be traced to a lack of any machinery—indeed the lack of any desire for machinery—to bring scientific advice to bear in the policy-making agencies of the government. It is true that the military agencies have quite generously provided themselves with scientific advisory committees to assist with the planning of research and development programs. Scientific teams have been assembled to carry on "studies" of national defense problems in which new weapons and techniques were important. Some of these studies and committees have been spectacularly successful. Some of the "operational research" groups have also successfully brought scientific and analytical techniques to bear on military problems.

All this is fine but it is not enough. In these days when the whole military posture of the country—and consequently its whole foreign policy—is based on military weapons and techniques and on industrial transportation and communication technologies which existed, if at all, only as laboratory curiosities some 15 or 20 years ago, it might be expected that a deep understanding of these technologies should be found somewhere in prominent places at high levels of government. Do we find it?

Scientific resources

There are of course hundreds of scientists and engineers directly employed by the AEC, the Department of Defense, the Public Health Service, the National Advisory Committee for Aeronautics, the Smithsonian Institution, the National Science Foundation. Surely no national government in the world is so richly equipped with scientific resources.

And yet a couple of years ago the head of the National Bureau of Standards was suddenly dismissed because of the allegation by a small manufacturer that his product had not been "objectively tested." The charge was later investigated (why not before?) and disproved, and the director was reinstated—but not before the world's finest laboratory of standards had been shaken to its roots, its morale shattered, and an untold number of valuable man-years of effort wasted in putting things together again. Does the government *have* to insist that working for it shall be unpleasant and distasteful?

The Public Health Service has rendered enormous aid to medical research by its unclassified research grants to universities and medical schools. But because of fear of a Congressional committee, it eliminated from its list of grants the names of certain research workers about whom questions of political conformity might be raised. (No Communists were involved.) The men eliminated were usually not informed as to why their admittedly valuable work no longer merited support—or why the support had to be given in the name of a co-worker or assistant. It has never been explained why politics should encroach upon non-secret medical research or be a test by which universities shall be deemed worthy of encouragement. These "administrative decisions" of the Department were opposed by almost the entire scientific staff of the Public Health Service; but the scientists were apparently not consulted nor their advice followed.

In a very different field: There exists no regularly established mechanism whereby the scientific talent employed by the AEC can be brought face to face with national policy problems which depend critically on our atomic strength. Those who create our atomic weapons and who therefore, presumably, best understand them are not brought into the high councils of government when the impact of these weapons upon national policy is being discussed. It is true that when need for technical information becomes apparent it can be asked for and, after filtering up through a few layers of non-technical officialdom, it is brought into the high councils—at which point it is often disputed by someone who has heard a different story from *his* experts. But why does not Congress have its own scientific advisors? Why doesn't the Cabinet? The National Security Council? The Department of State?

Scientific advice

It may be simply that it is too new a thing that highly technical matters which are not easily reduced to non-technical terms may have a decisive effect on a nation's affairs. Problems, ranging from the question of whether to draft scientists to whether tactical A-bombs could be effectively used in a small war, are being debated without full access to the scientific facts—without, indeed, any realization that such facts may be important. Worse still, when such facts are brought forward by men of competence they are often ignored, because anyone who knows what he is talking about "must clearly be prejudiced." "Anyway," it is said, "scientists should stick to their knitting." They "should be on tap and not on top." (When was one ever "on top"?) One senator recently suggested that scientists had no business expressing their views on the immigration laws—even to point out that these laws are sometimes used in a way to keep top foreign scientists from visiting the United States and thus to weaken our scientific strength.

I believe scientists themselves are partly to blame for this situation. We ourselves have not been able to devise a suitable mechanism whereby the best and most balanced scientific thought of the country can be focused on the country's most important problems. We must find such a mechanism. For problems of large technical content cannot be satisfactorily solved by Gallup polls or even by the election returns. They can be solved only by intelligent leadership which is democratically chosen, and then given the full support of the finest brains and the finest and most broadminded citizens of the nation.

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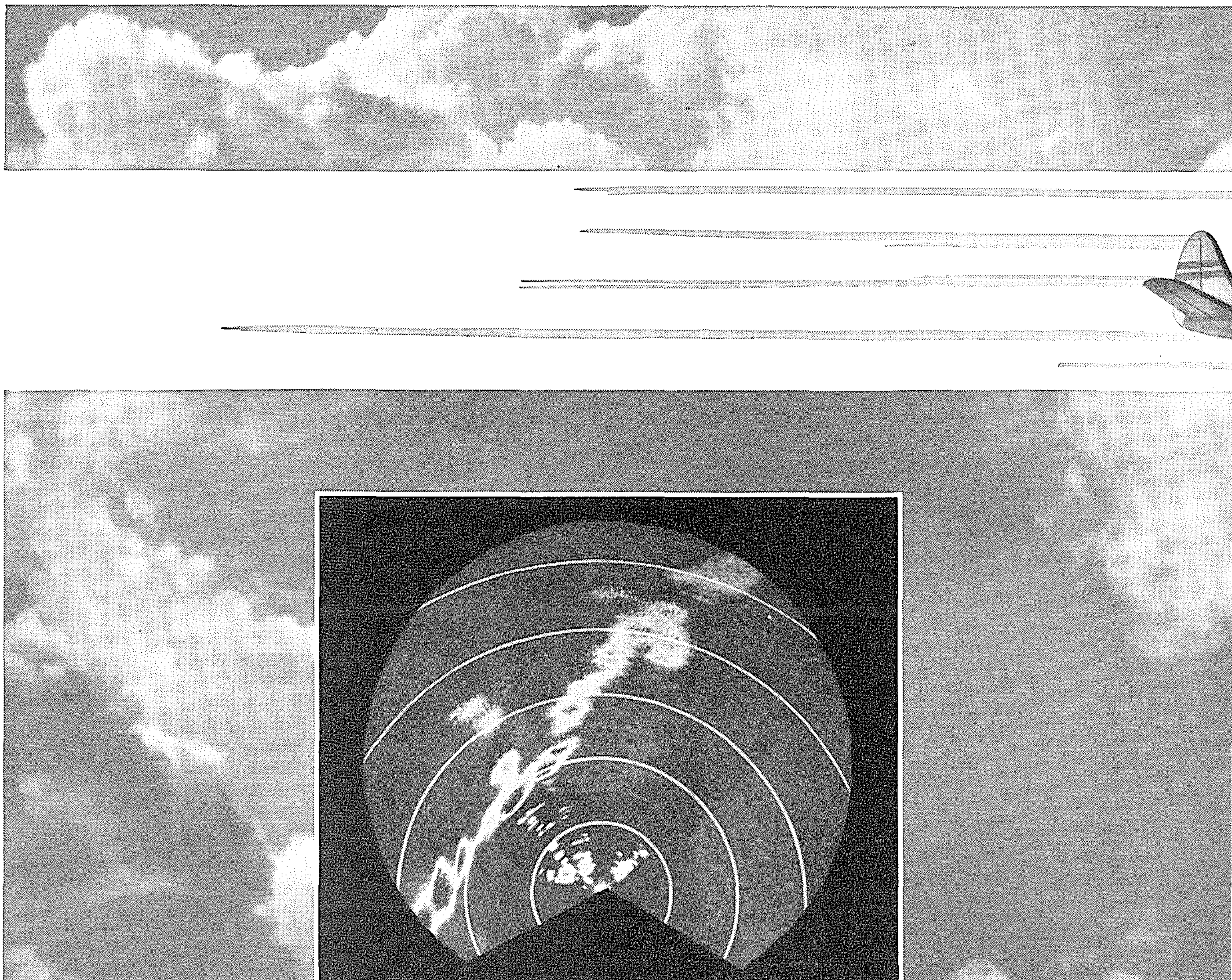

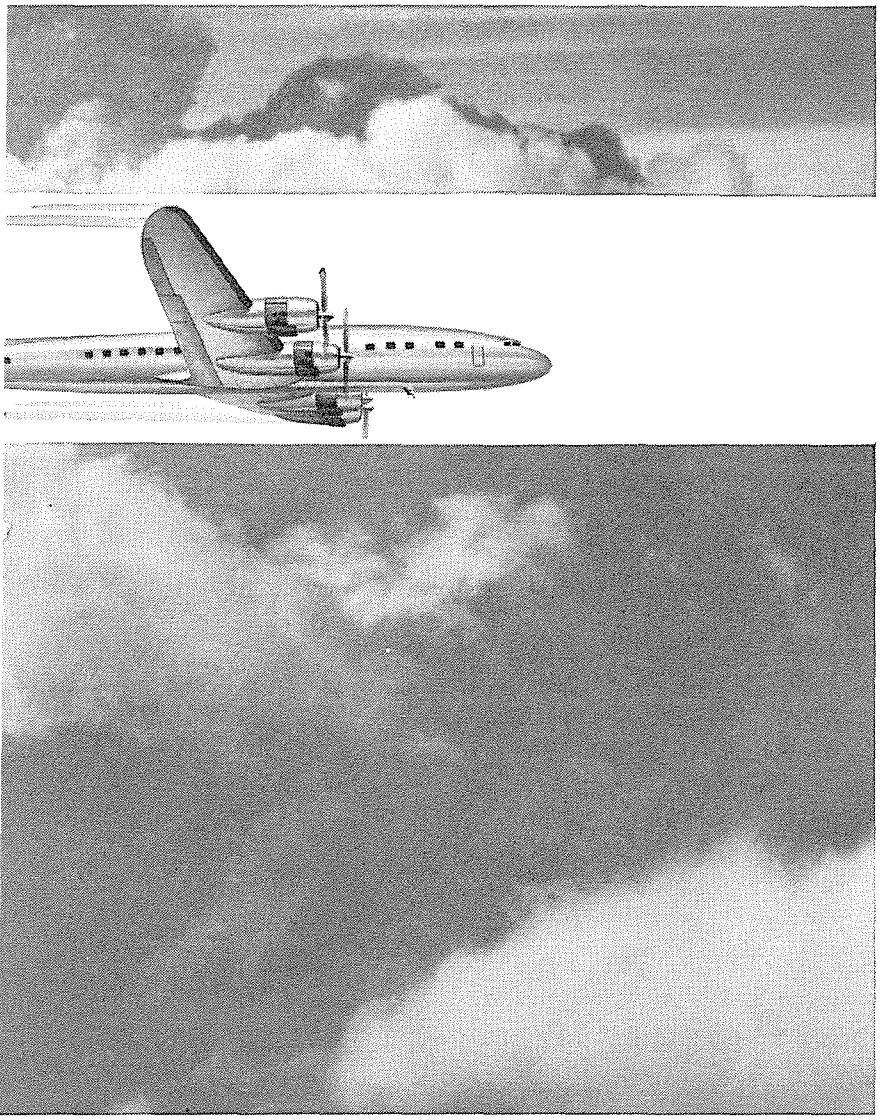

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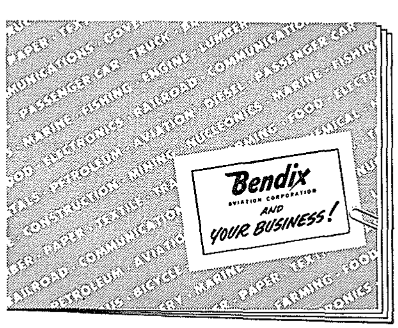

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A LOOK BACK, A LOOK AHEAD

THE SOPHOMORE kicked off his loafers and sat down on his bed, leaning back up against the burlap wall. So this is spring vacation, he smiled to himself.

It was always an unsettling experience to be around the student houses when they were deserted, as they were now. There was something wrong about seeing the same old rooms and alleys and courtyard, and not seeing the dirty socks in the corner of the lounge, or the puddle where the water balloon had hit, or the little groups of Techmen standing around laughing and talking and complaining.

Almost everybody was away for the week of vacation, it seemed. Even by Wednesday of finals weeks the meal count had dropped heavily in the dining rooms; now all but about fifty of the residents of the houses were home, or climbing mountains, or visiting friends, but anyway gone.

The Sophomore lived in the East and it never had seemed worthwhile to him to go home for the spring week, although he had almost weakened when he heard of an opening in a car that was driving back that would only have cost fifty dollars or so.

But he had a long list of things to get done, and it sat there on his desk and laughed uproariously at him, and he knew that he would be lucky to get one or two of them done, much less the whole list.

He could hardly believe that finals were over and that before ten days had passed it would be third term. Third term! That meant he was half done with his four years at Tech—but right now it seemed as though he'd barely started.

The out-of-it term

They always said that second term was the out-of-it term, and during the term the Sophomore hadn't believed it. But now that it was over he could look back on the last three months and they seemed just like a day or two—and maybe that was what they meant. Actually, he thought, there weren't any out-of-it terms at Tech, if you yourself kept your own little ball rolling. There had been ASCIT elections and there had been basketball season (a very bad one) and four big dances at the end of the term coming on consecutive weekends (he'd only gotten to two, the ASCIT formal and the ICC dance) and there was the Interhouse Sing and, for some guys, the Mobilgas Economy Run.

Come to think of it, there was something special about this second term. There was a gymnasium and a locker room and a swimming pool special about this second term, and he'd become so used to them now that it was hard to remember the days in the miserable old fieldhouse. He had just been over at the gym playing basketball the day before, and he hadn't even realized that a few weeks beforehand he wouldn't have had that chance.

The power-packed term

But of course it was third term that he was really looking forward to. Ever since he was at frosh camp and the upperclassmen had told him the exciting stories of third term, he had looked forward to it in eager anticipation of beach parties, barn dances, outdoor formals, snaking in the sunlight on the Athenaeum lawn, and baseball season, and everything. It could really be a power-packed ten weeks if you wanted it to be. It seemed like the pressure had lifted somehow in the class rooms and you didn't have to work quite as hard; and you had more time than ever to relax and talk and go out and just enjoy yourself.

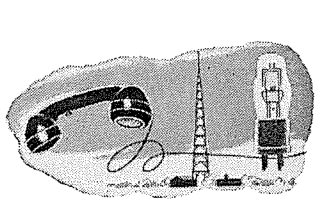
The Sophomore picked up the defenseless little slip of paper on which he had written the list of things to get accomplished during spring vacation. Third term wasn't a time to get things accomplished, he thought with a quick rationalization. Third term was a time to let your responsibilities go to hell, and to see what you could do about having such a good time that it would make up for every painful hour of studying in all the other terms together.

He crumpled up the little sheet of paper dramatically and tried to hook it into his wastebasket but he missed it completely. Somewhat embarrassed, but not discouraged, he got his gymn shoes from the closet and took off for the new gymnasium for a couple of hours of basketball.

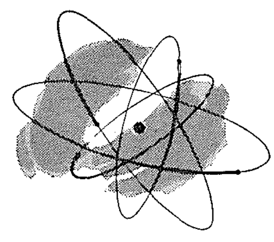
He was all in favor of vacations.

—Marty Tangora '57

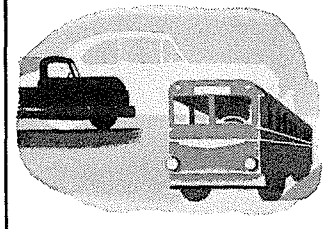
12 of the basic industries in which Bendix products play a vital role



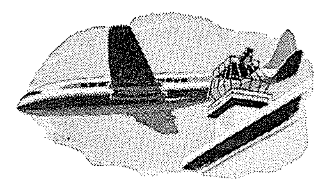
ELECTRONICS



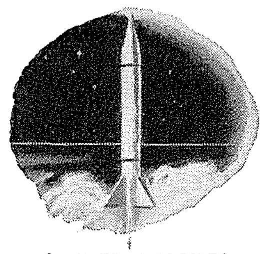
ATOMIC ENERGY



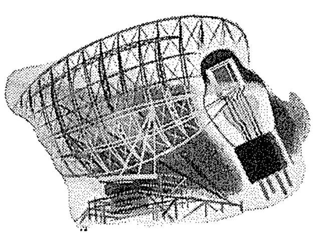
AUTOMOTIVE



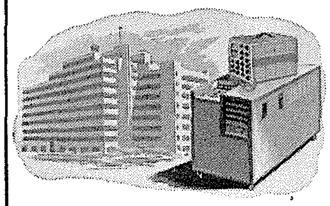
AVIATION



GUIDED MISSILES

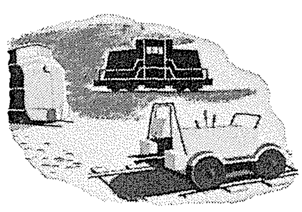


RADAR

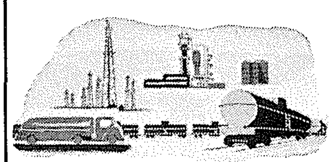


COMPUTERS

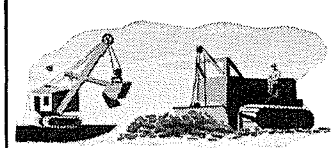
MARINE



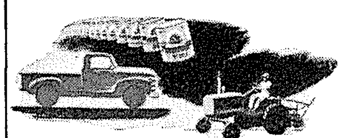
RAILROAD



PETROLEUM



CONSTRUCTION



AGRICULTURE

A SOUND REASON WHY Bendix OFFERS TODAY'S ENGINEERING GRADUATE AN UNLIMITED FUTURE!

Diversification is an important asset in business.

Especially so from the viewpoint of the engineer because:

It encourages and promotes freedom of ideas. Keeps engineering ingenuity flexible and adaptable. In short, gives full vent to an engineer's creative ability . . .

While at the same time it provides a healthy, stable, secure foundation for both the company and the individual to build and expand.

If diversification in business appeals to you as a graduate engineer, you'll be greatly interested in the Bendix Aviation Corporation.

For Bendix is unlike any other company in America in its versatility, facilities, experience, range of products and different fields of engineering endeavor. Nearly a thousand different products are produced by our 24 manufacturing divisions.

As a result, we not only offer a wide choice of locations coast to coast but also career-building opportunities as broad as your ambition and ability in mechanical engineering . . . hydraulic mechanisms . . . electronics . . . magnetics . . . computers . . . servo-mechanisms . . . radar research . . . metallurgy . . . solid-state physics . . . instrumentation . . . radiation detection . . . nuclear physics . . . guidance and control systems plus many more engineering fields of challenge.

Write for your copy of "Bendix and Your Future." It gives the full story about Bendix, its products and employment opportunities.

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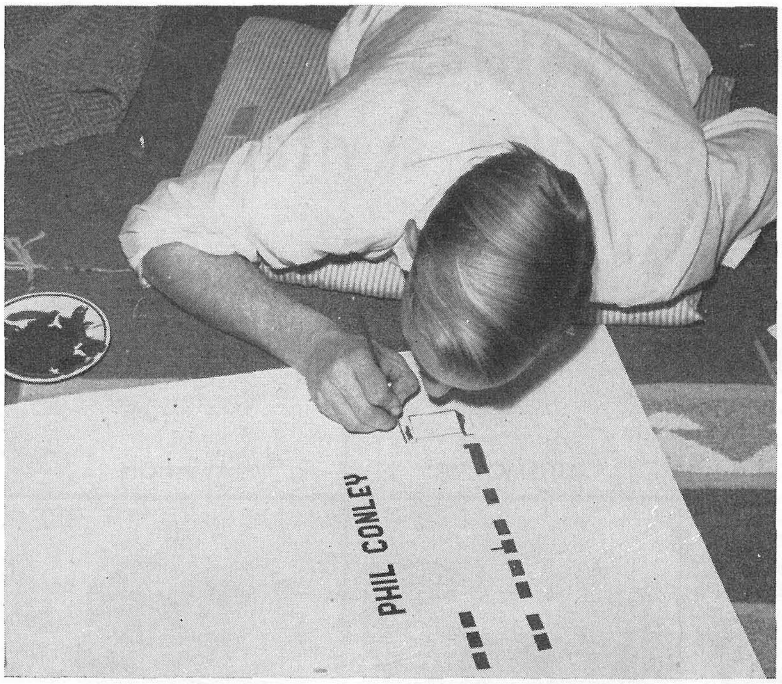
A Bendix representative will be at your campus soon. Make a note now to talk with him. Check your placement bureau for time and date.

THE NAME Bendix AVIATION CORPORATION MILLIONS TRUST



STUDENT ELECTIONS

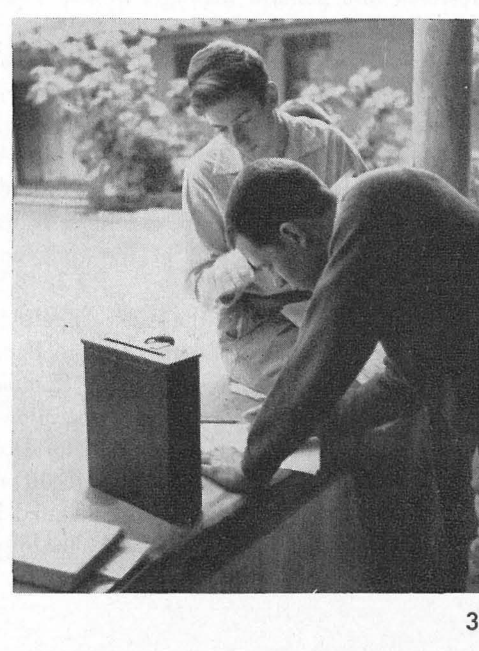
Politics takes over the Caltech campus at the end of February. Nominations are in order, then the political machines begin to grind — and promptly produce campaign posters in wholesale lots.

Campaigning is confined to pithy speeches delivered at mealtime in the student houses. Candidates blossom out in coats, ties, and toothpaste grins, as they do their earnest best to distract the determined diners.

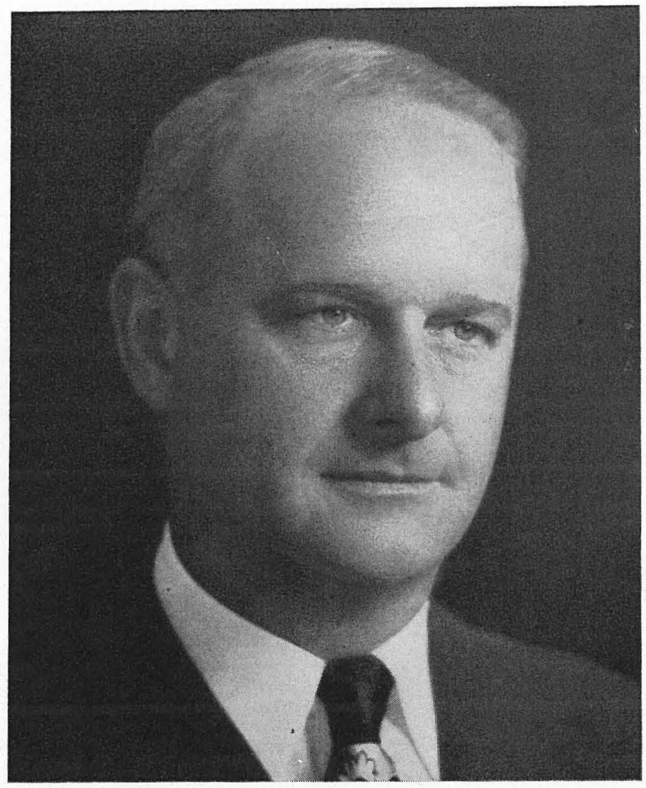
Presidential candidate Phil Conley hopefully awaits the final tally in a close election. P.S. — He got the job.

Confused voter weaves through Poster Alley

Informed voter casts his ballot



F. M. Banks, president and general manager of the Southern California Gas Company, is the newest member of the Caltech Board of Trustees.



THE MONTH AT CALTECH

Radio Astronomer

JOHN G. BOLTON, who in 1948 discovered the first of the so-called "radio stars," came to Caltech last month to serve as scientific director of a new project in the field of radio astronomy. Mr. Bolton, who has been appointed a senior research fellow in physics and astronomy, comes from Sydney, Australia. For the past 10 years he has been a research officer in the division of radiophysics of the Commonwealth Scientific and Industrial Research Organization.

The major goals of Caltech's radio astronomy project will be to detect radio signals from outer space, to find out what their sources are, and to discover as much as possible about the position, strength and size of these sources.

The tools used in radio astronomy are ultra-sensitive receivers with very large antennas. The antennas pick up high-frequency noises, some of which are believed to be generated by enormous masses of gas colliding at velocities up to 5,000 miles per second. The analysis of these radio signals provides information about the nature of matter in outer space which can be gained in no other way.

Some of these large antennas are radio-wave reflectors, or "dishes" resembling oversize radar antennas. Several of this type, up to 50 feet in diameter, are already in operation in this country, and one 250 feet in diameter is being built in Manchester, England. Other antennas, for receiving longer waves (but not of the reflector type) are up to one mile in length. Caltech will begin construction of several different types of antenna and

New Trustee

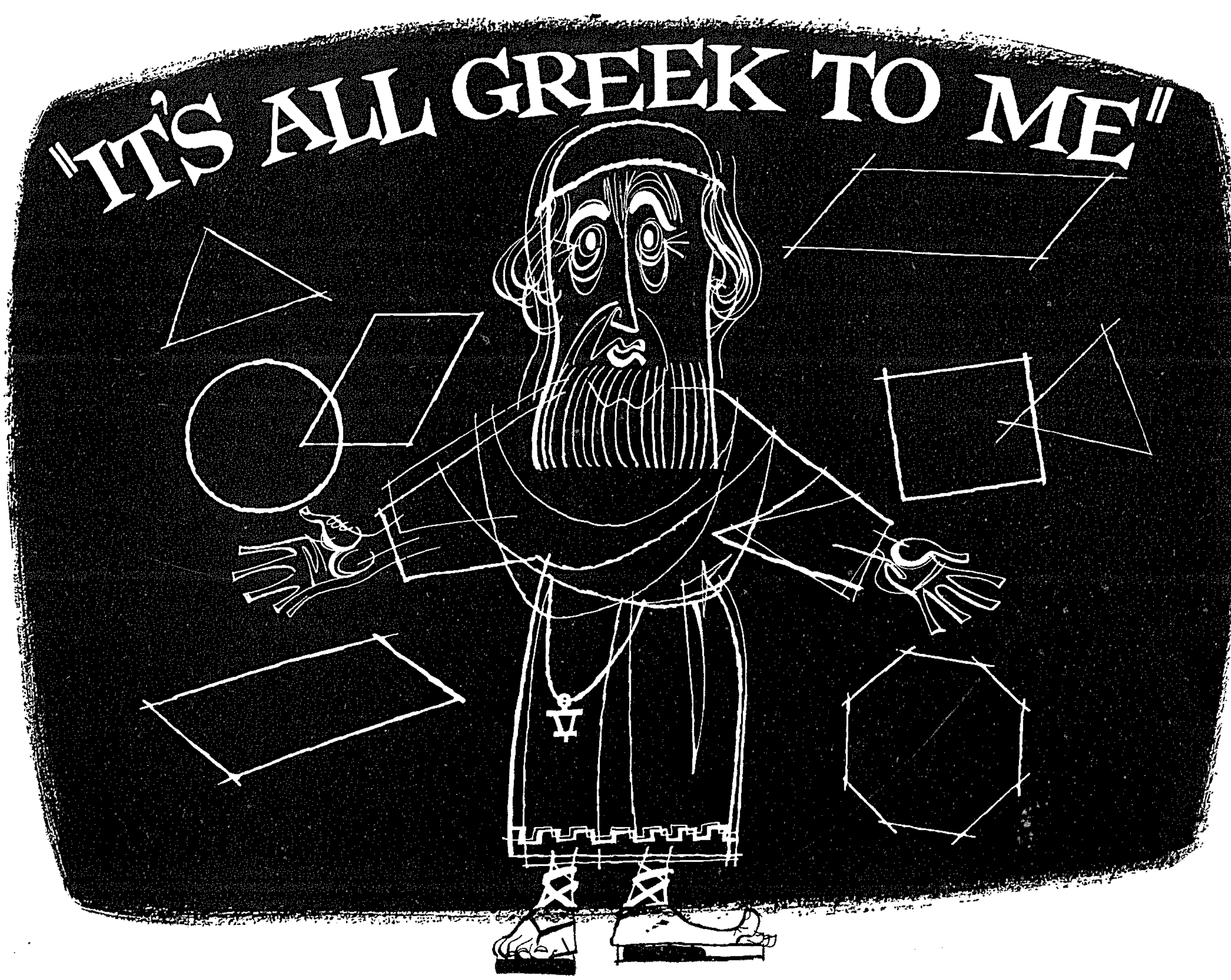
NEWEST MEMBER of the Board of Trustees of the California Institute of Technology is F. M. Banks, president and general manager of the Southern California Gas Company.

Mr. Banks joined the civil engineering staff of the gas company in 1922, became vice-president and director of sales, advertising and public relations in 1934, and president in 1950. He is president of the American Gas Association, national organization of gas companies, as well as a past president of the Pacific Coast Gas Association and a director of the Independent Natural Gas Association.

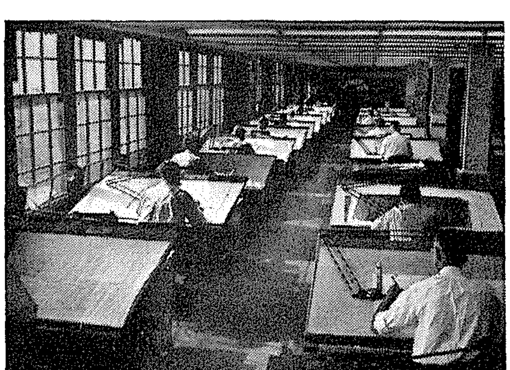
He is a director of the Los Angeles Chamber of Commerce, a director of the Union Bank and Trust Company and the Pacific Indemnity Company, a trustee of the Southern California Air Pollution Foundation, and a director of Associated In-Group Donors.

Mr. Banks attended schools in California and the Colorado School of Mines, and graduated in 1922 from the Massachusetts Institute of Technology in electrochemical engineering.

"NEW DEPARTURES" IN SCIENCE & INVENTION



LUCKILY, EUCLID WAS A GREEK



From the drawing boards at New Departure have come many of the world's ball bearing advancements. Such leadership is one reason why engineers everywhere specify New Departure ball bearings.

If Euclid had lived 2,300 years longer, he would have made Tau Bete. That's why he's pictured here wearing the Tau Beta Pi key.

After all, every engineer owes Euclid a big debt. At New Departure, for example, we work with circles and spheres. Without Euclid, we might still be getting started.

As it is, though, New Departure has gone further with spheres and circles in relation to moving parts than anyone else in the world. From this knowledge have come such advances as the Sealed-for-Life and the double-row angular-contact ball bearings. And it's advances like these that make New Departure the world leader in ball bearings.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.

NEW DEPARTURE
BALL BEARINGS

NOTHING ROLLS LIKE A BALL

receiving equipment sometime within the coming year.

This new radio astronomy project will be an important supplement to the astronomical work being carried on at the Mount Wilson and Palomar Observatories, and will be greatly aided by Caltech's current research and development in ultra-sensitive radio receivers and high-frequency tubes.

Mr. Bolton, although only 33 years old, is regarded as one of the pioneers in the discovery of radio noise sources. Shortly after his 1948 discovery of a radio source in the constellation Cygnus, he made the first identification of a radio source with a visible object, the Crab Nebula. Since then he has had a long record of achievement, culminating in the recent discovery of an intense radio source at the center of our own galaxy, the Milky Way.

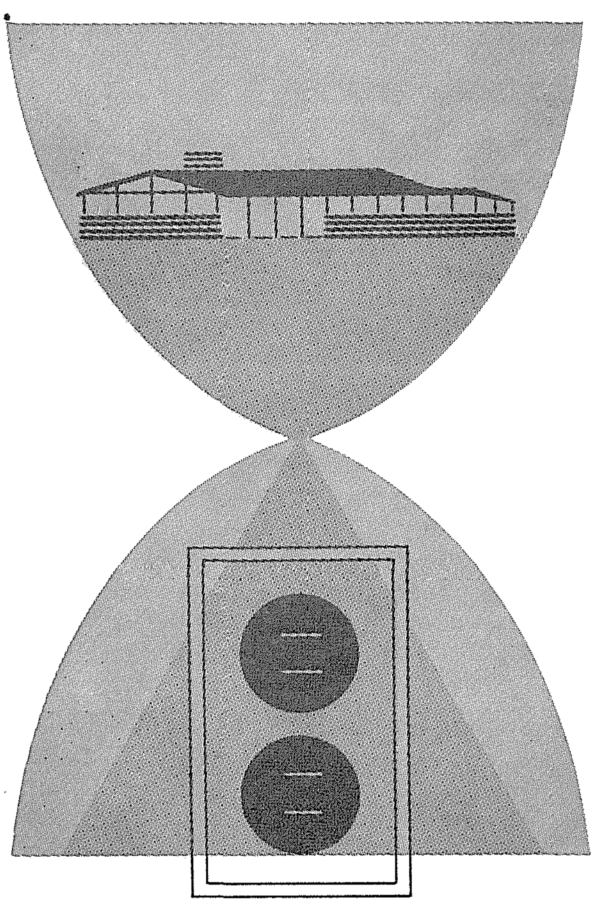
Mr. Bolton received his BA, with honors in physics, at Cambridge University in 1941. The following year he entered the Royal Navy, and at the end of the war left the British Pacific Fleet to join the Commonwealth Scientific and Industrial Research Organization. A little over a year ago he became the youngest man ever appointed to the rank of Principal Research Officer in that organization. In Australia he has also recently worked on problems of weather control and cloud seeding.

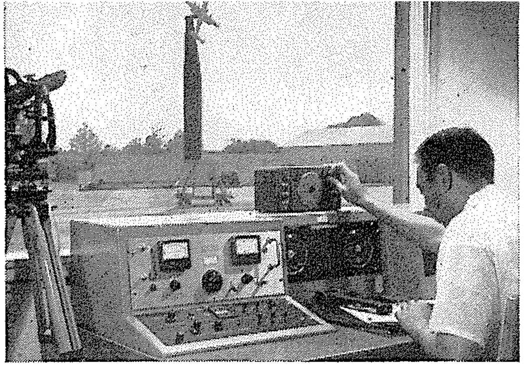
"Ambassador" to Australia

PRESIDENT AND MRS. DuBRIDGE will make a two-month trip to Australia and New Zealand this summer, visiting universities and scientific establishments.

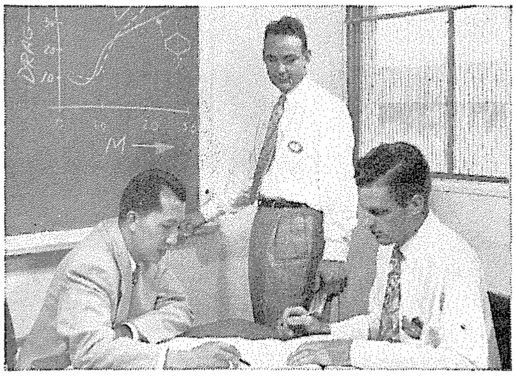
Dr. DuBridge will travel under the sponsorship of the Carnegie Corporation of New York, whose officers have asked him to serve as an "ambassador" in connection with their travel grant program for an international exchange of scholars and educators. One of his main missions will be to discuss with Australian education officials the future of technical training in that country, the question there now being whether to build new technological institutions or to provide technical training in large universities.

Dr. and Mrs. DuBridge plan to leave Pasadena in mid-July and will return in mid-September, with brief stop-overs in Hawaii each way.

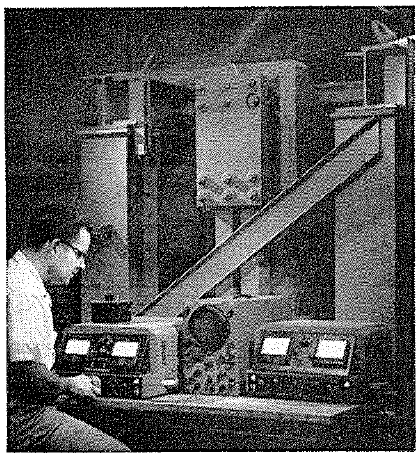




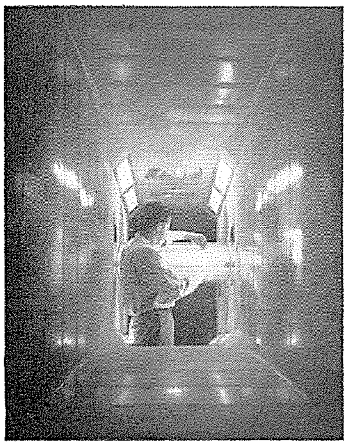
Electronics Research Engineer Irving Alne records radiation antenna patterns on Lockheed's Radar Range. Twenty-two foot plastic tower in background minimizes ground reflections, approximates free space. Pattern integrator, high gain amplifier, square root amplifier and logarithmic amplifier shown in picture are of Lockheed design.



Jim Hong, Aerodynamics Division head, discusses results of high speed wind tunnel research on drag of straight and delta wing plan forms with Richard Heppe, Aerodynamics Department head (standing), and Aerodynamicist Ronald Richmond (seated right). In addition to its own tunnel, Lockheed is one of the principal shareholders in the Southern California Cooperative Wind Tunnel. It is now being modified for operation at supersonic Mach numbers.



Research Engineer Russell Lowe measures dynamic strain applied by Lockheed's 500,000 lb. Force Fatigue Machine on test specimen of integrally-stiffened Super Constellation skin. The Fatigue Machine gives Structures Department engineers a significant advantage in simulating effect of flight loads on a structure. Among other Lockheed structures facilities are the only shimmy tower in private industry and largest drop test tower in the nation.



C. H. Fish, design engineer assigned to Lockheed's Icing Research Tunnel, measures impingement limits of ice on C-130 wing section. The tunnel has a temperature range of −40°F. to +150°F. and maximum speed of more than 270 mph. It is the only icing research tunnel in private industry.

Advanced facilities speed Lockheed engineering progress

Lockheed's unmatched research and production facilities help make possible *diversified* activities in virtually all phases of aviation, military and commercial.

They enable engineers to test advanced ideas which would remain only a conversation topic in firms lacking Lockheed's facilities. They help give designers full rein to their imagination. They make better planes — and better careers.

Engineering students interested in more information on Lockheed's advanced facilities are invited to write E. W. Des Lauriers, Lockheed Student Information Service, Burbank, California.

Lockheed AIRCRAFT CORPORATION

BURBANK **California**

ALUMNI NEWS

Board Nominations

THE BOARD OF DIRECTORS of the Alumni Association met as a nominating committee on February 22, 1955, in accordance with Section 3.04 of the By-Laws. Five vacancies will occur on the Board at the end of the current fiscal year, one vacancy to be filled from the present Board and four members to be elected by the Association. The present members of the Board and the years in which their terms of office expire follow:

W. E. Baier '23........1955	D. G. Kingman '28..1955
R. R. Bennett '45....1955	W. F. Nash, Jr. '38..1956
H. C. Carter '49........1956	C. V. Newton '34 1955
Philip Cravitz '29....1956	K. F. Russell '29......1955
C. P. Strickland '43....1956	

The four members of the Association nominated by the Directors are:

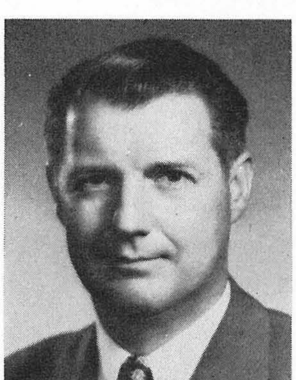
R. H. Bungay '30	R. H. Jahns '35
W.R. Donahue '34	R. W. Stenzel '21

Section 3.04 of the By-Laws provides that the membership may make additional nominations by petition, signed by at least ten (10) regular members in good standing, provided the petition is received by the Secretary not later than April 15. In accordance with Section 3.05 of the By-Laws, if further nominations are not received by April 15, the Secretary casts a unanimous ballot for the members nominated by the Board. Otherwise a letter ballot is required.

Statements about the nominees of the Directors are presented below.

—Donald S. Clark, Secretary

The Nominees

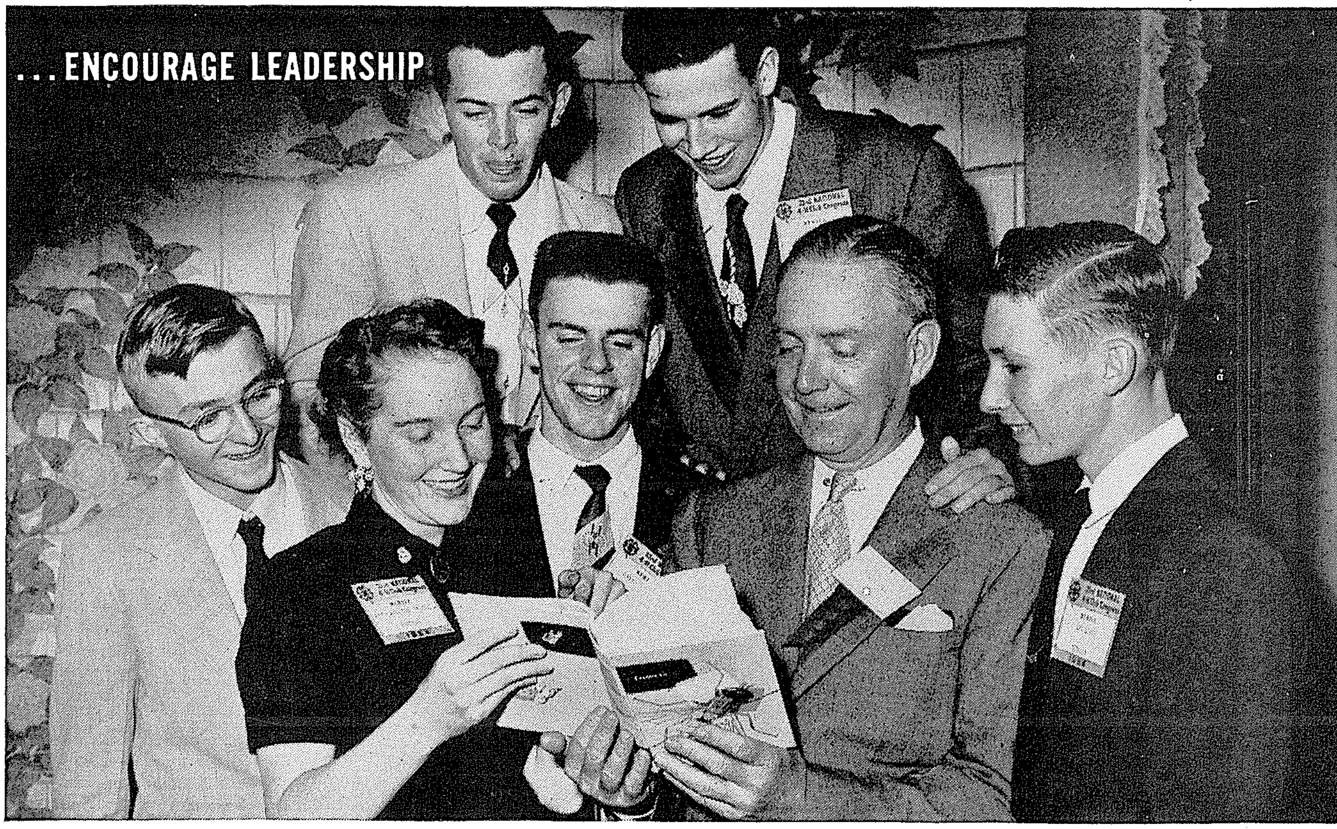


ROBERT H. BUNGAY received his BS in mechanical engineering in 1930. During World War II he was a Colonel in the U.S. Army Engineers, in charge of drilling, refinery, and pipeline construction programs in Canada and Alaska. He also saw active duty in the Philippine Islands and Okinawa. Immediately following his release from the Army in 1946 he joined the Union Oil Company of California as a project engineer in the manufacturing department, and is now manager of Engineering and Construction, Manufacturing Department.

WILLIS R. DONAHUE received his BS in biology in 1934 and later, by attending night school, became a registered chemical engineer. He was first employed by the Shell Union Oil Company, and stayed with them for three years. He was a junior technician when he left in 1937 to join the General Petroleum Corporation as a chemist at Santa Fe Springs. He is now assistant manager of the gas department at Vernon, California—a position he has held since 1952. He is serving as Chairman of the 1955 Caltech Alumni Seminar Day.

RICHARD H. JAHNS received his BS in geology in 1935, his MS (from Northwestern University) in 1937, and his PhD from Caltech in 1943. Shortly after graduation in 1935 he joined the staff of the U.S. Geological Survey. His work in subsequent years took him through most of the eastern, Rocky Mountain, and far western states, where he studied and mapped numerous non-metallic deposits. During the war he surveyed deposits of strategic minerals for the Geological Survey. He returned to Caltech as Assistant Professor of Geology in 1946, became Associate Professor in 1947, and was made a full professor in 1949.

RICHARD W. STENZEL received his BS in chemical engineering in 1921, an MS in chemistry in 1930, and his PhD from the University of Michigan in 1932. After his graduation from Caltech he went to Amoy, China, for three years, where he was head of the Tung Wen Institute, a Middle School. He returned to the U.S. as chief chemist for the city of Pasadena and the Metropolitan Water District, during construction of the Morris Dam and the Colorado River Aqueduct. He later joined the Petrolite Corporation and was director of research until 1947, at which time he entered the consulting field. As a consultant he has been working chiefly in the petroleum and plastics fields.

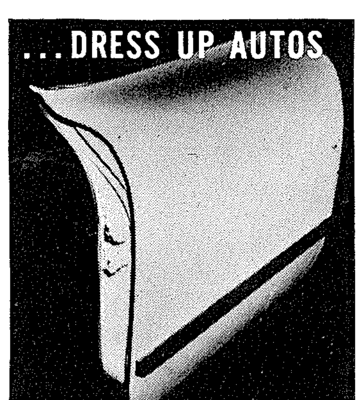


▲ **LEARN BY DOING**—Each year thousands of boys and girls learn how to become better farmers and better citizens through 4-H Awards Programs, such as the Entomology Program sponsored by Hercules. Top awards are college scholarships. Hercules' interest in improved farming methods stems from its development of agricultural chemicals, notably toxaphene for insecticides.

HOW HERCULES HELPS...

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.

STANDARD MODELS and plastic-bodied sports cars alike rely on nitrocellulose lacquers for durability and beauty. In the manufacture of these polyester laminates, such as this car door, Hercules hydroperoxides act as the catalyst in their polymerization. ▸



▲ **WHITER, BRIGHTER CLOTHES**—Hercules® CMC is a key ingredient in detergents . . . suspends soil, prevents its redeposition on clothes. This excellent property of suspension enables Hercules CMC to serve in a variety of consumer and industrial products.

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G55-1

PERSONALS

1921

Alfred Stamm, who has been conducting research at the U.S. Forest Products Laboratory in Madison, Wisconsin, since 1925, has received a Fulbright research award to conduct research on the surface properties of wood and cellulose at the Australian Forest Products Laboratory in Melbourne. The award is for nine months, beginning next September.

Al's family will accompany him, and they plan to make this a trip around the world. They will travel to the West Coast in July, stopping awhile in Los Angeles and San Francisco before sailing for Hawaii, where they will spend a short vacation. They will then continue to Australia by boat. When the Stamm family returns to the U.S. next year they will travel the long way around, going by way of India and stopping over in Europe.

This spring Al's oldest daughter, Virginia, will graduate from the University of Wisconsin; younger daughter Bonnie will be graduating from high school, and Al Jr. will be completing eighth grade.

1925

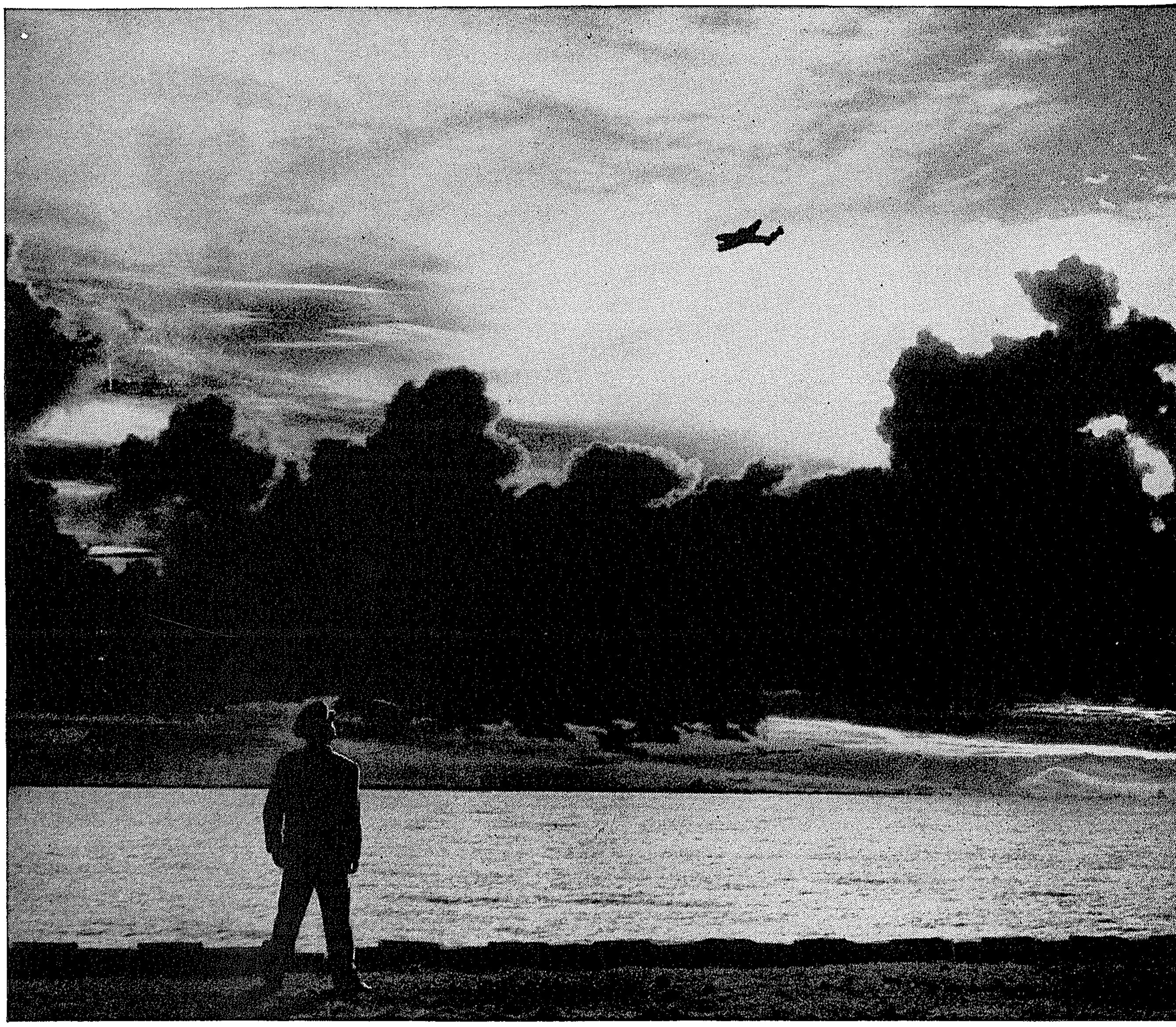
Thomas P. Simpson has been elected vice president and director of manufacturing for the General Petroleum Corporation of Los Angeles. Tom joined the company right after graduation, but later went to Socony-Vacuum, where he most recently served as director of the research and development department. In 1953 he returned to General Petroleum to act as assistant director of manufacturing.

1926

Roscoe Gockley, who was employed as an electrical design engineer with the Southern Califorina Edison Company in Los Angeles, died on January 7th from coronary thrombosis. Roscoe returned from military service in 1944 and was hospitalized for six months with this heart ailment. Since 1944 he has had a number of attacks which hospitalized him, but after resting for a few months was always able to go back to work and lead a very normal life. Roscoe's home was in Garden Grove.

1927

James Boyd has been appointed vice president of the exploration department of the Kennecott Copper Corporation of New York. During the last 3½ years Jim has actually been manager of the exploration department, and the job has taken him to remote and mountainous regions, as far away as the Arctic Circle. From now on he will direct, from 42nd Street in New York, the explorations of 75 permanent geologists and a summer crew of about twice that number through-



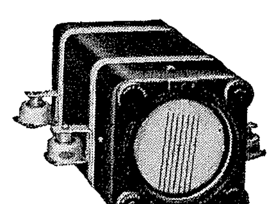
New RCA Radar "Weather Eye" Sees Through Storms

In our time, Man has won round after round in a contest against the elements that started thousands of years ago.

The most recent scientific victory is something new in Radar—an electronic "Weather Eye" developed by RCA.

In airplanes, this supersensitive instrument peers miles ahead. It gives advance warning of weather disturbances. The signals on its radar screen point the way to a safe course *around* storm areas, or even *through* them.

The leadership in electronic research that made the "Weather Eye" possible is inherent in all RCA products and services. And at the David Sarnoff Research Center of RCA, Princeton, N. J., scientists are continually at work to extend the frontiers of "Electronics for Living."



New RCA Weather Mapping Radar weighs under 125 pounds, takes little space in a plane.

For information regarding design and development engineering positions on such projects as "Weather Eye" Radar and military electronic equipment—write to Mr. Robert Haklisch, Manager College Relations, Radio Corporation of America, Camden 2, N. J.

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RADIO CORPORATION OF AMERICA

ELECTRONICS FOR LIVING

out the U.S., Canada, Mexico, Peru, and Surinam. They will come in to confer with him twice a year. Before joining Kennecott, Jim held the position of director of the U.S. Bureau of Mines for almost five years.

1930

Loren P. Scoville, MS, is the new vice president and general manager of the Diamond Alkali Company's Chlorinated Products Division in Cleveland, Ohio. Loren has been with Diamond Alkali since last March as director of engineering, following 10 years with the Jefferson Chemical Company in New York, where he last served as vice president in charge of engineering, purchasing, and operations.

1931

Isadore Thompson, who has his own consulting engineering firm in San Francisco, is responsible for the engineering of the U.S. Naval Post Graduate School at Monterey, California.

1932

Robert Wherritt writes: "I am still living in Salinas, Calif., where I can still breathe without inhaling smog. I am the manager of the Liquid Ice Company. We make ice, operate cold storage rooms, furnish refrigeration for a freezing plant and maintain tractors and trucks. I have a daughter 11 and a son 15. Besides work I am busy folk-dancing, wood carving, drawing house plans, and tinkering in my shop. Regards to all Tech men."

1933

Gregory K. Hartmann has been appointed the new technical director for the Naval Ordnance Laboratory at Silver Spring, Maryland. Dr. Hartmann has had a major part in the management of research at the Laboratory for the past three years, and has been associate technical director for research since 1951.

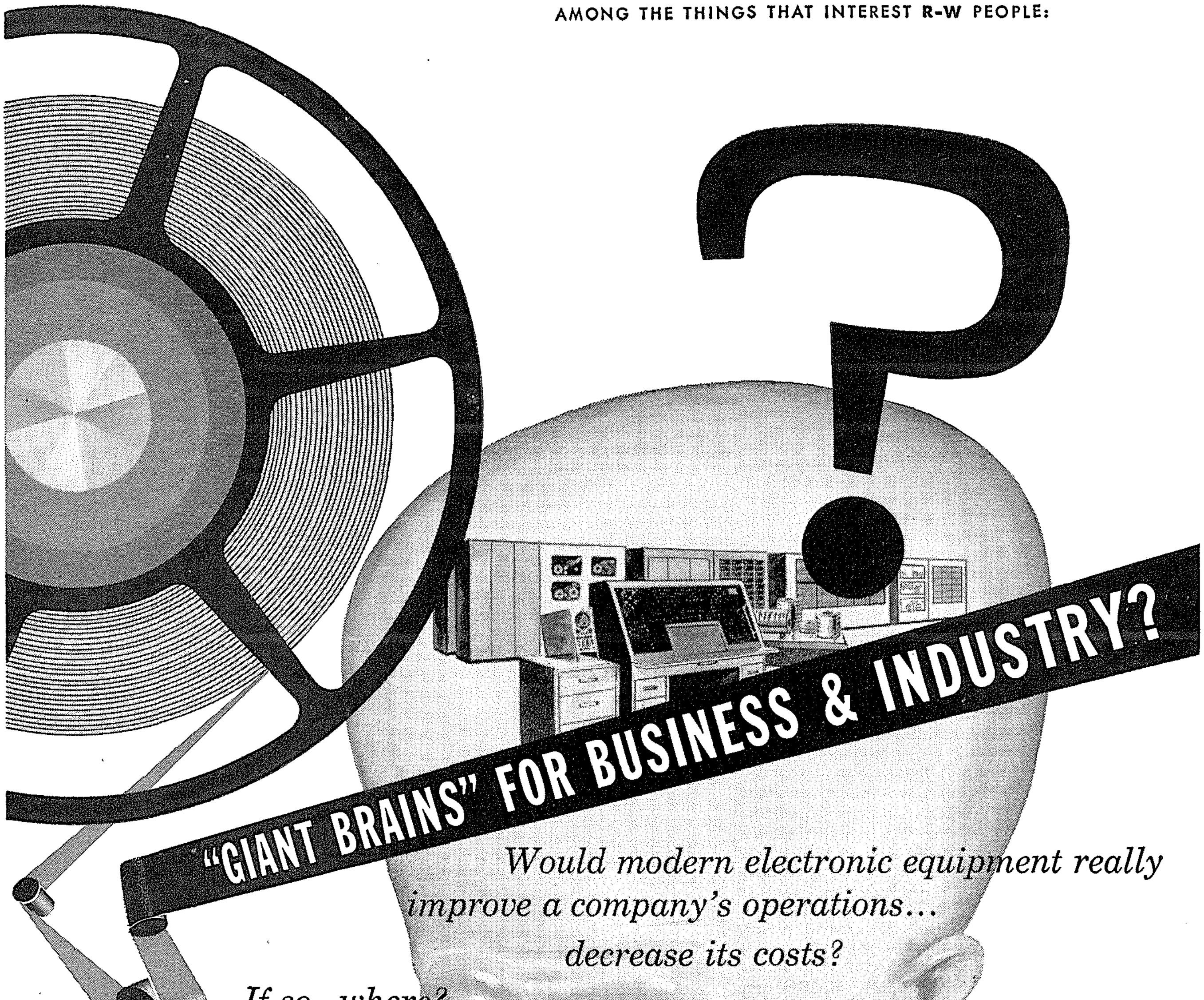
"Dr. Hartmann was an authority on explosives phenomena before he came to NOL early in 1946," reports the newspaper published at the Laboratory. "His work has been so vital to national security that it cannot be detailed here. However it can be said that he has pioneered in the determination of the effects of atomic explosions, and is one of the very few scientists to have witnessed most of the atomic tests following the fall of the Japanese Empire. He was in charge of scientific groups at operations . . . As technical director of the Bureau of Ordnance's Instrumentation Group with the Bikini Task Force he had responsibilities for measurement of air blast and water shock for both Bikini tests and for measuring radiation intensities at the time of these explosions.

"He holds the Navy's highest civilian honor—the Distinguished Civilian Service Award—for his contribution to the successful outcome of World War II. His work in the Bureau of Ordnance goes back to the months before Pearl Harbor, where he had an important part in the then-expanding mine research program."

1934

Robert Felt has been transferred to the Richmond Refinery of the Standard Oil Company of California, where he is an assistant superintendent of the Cracking Division. Before this, Bob worked as a refiner at the Bakersfield Refinery.

Edward B. Doll, MS '35, PhD '38, was director of the military effects group at the atomic tests held in Nevada the latter part of February. Ed received a special commendation from the Secretary of Defense while serving in a similar job for the 1953 Nevada tests, and his services were requested again this year. Ed is head



Would modern electronic equipment really improve a company's operations... decrease its costs?

If so—where?

In production control? Payroll accounting? Customer billing? Factory automation?

What make of equipment is best? What changes in company methods and procedures would be required?

To assist managements in answering such questions, The Ramo-Wooldridge Corporation through its Computer Systems Division, offers to business and industry the consulting services of a team of scientists, engineers and business methods and procedure analysts experienced in the application of modern analytical and machine methods. With no equipment of their own to sell to non-military customers, but with understanding of available machines and techniques, this group is in a position to be objective in its recommendations.

Positions are available at The Ramo-Wooldridge Corporation for scientists and engineers in these fields of current activity:

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Radar and Control Systems Development | Digital Computer Research and Development
Communication Systems Development | Business Data Systems Development

The Ramo-Wooldridge Corporation

8820 BELLANCA AVENUE, LOS ANGELES 45, CALIFORNIA of the Stanford Research Institute's Physics Department.

Jack M. Desmond and his wife announce the arrival of John Michael on December 17th.

1938

Daniel A. Okun, MS, is going to Peru this year, on an exchange program between the University of North Carolina and the National School of Engineering in Peru. This program is sponsored by the Institute of Inter-American Affairs of the United States Foreign Operations Administration. Dan will help integrate laboratory teaching with the undergraduate program, and initiate and develop research at the Peruvian School of Engineering.

1940

W. M. MacKay, Jr., who recently rounded out seven years as a torpedo engineer with the Naval Ordnance Test Station in Pasadena, has resigned to go into the real estate business. The MacKays and their two daughters now live in San Clemente, where the new business is located.

Roswell J. Blackinton is a new research associate at the General Electric Research Laboratory in Schenectady, New York. Ross, who will be doing research in the organic chemistry section, has been associated for the past four years with GE at their Anaheim, California plant. Before joining GE he was chief chemist for the Western States Lacquer Corporation of Los Angeles. Ross and his wife have one daughter, who is now 15.

1941

Joseph Trindle, MS '49, sends the following from Algiers: "I have been here in North Africa since October. Since leaving the Caltech JPL, I have finished the three-year course at Fuller Theological Seminary, and am learning French and Arabic in preparation for my life as a missionary here. My present status as a student in the University of Algiers has enabled me to be something of a missionary already to the French and Moslem students . . .

"My future appears to lie in Tangier, where my future wife and I hope to build a rescue home for Arab children . ."

1942

Stanley Corrsin, MS, PhD '47, is now teaching a special University of Delaware extension course for graduate students in chemical engineering. The course is called "Special Topics in Fluid Mechanics."

1943

Herbert Lassen, MS '47, PhD '51, became a member of the Advisory Council at Hughes Aircraft last year. Aside from his work, Herb also keeps busy serving as chairman of the Board of Directors of his church, and teaching a night course in kinematics at UCLA. Herb and his wife have two children, ages 3½ and 1½, and are expecting a third member of the family in May.

Howard Farmer has joined the Development and Research Division of the International Nickel Co., Inc., as a member of the West Coast Technical Field Section at Los Angeles. Before joining International Nickel, Don was chief research engineer with the Security Division of Dresser Operations, Inc.

1944

Ruben Mettler, MS '47, PhD '49, has received the 1954 award of Eta Kappa Nu, national honorary fraternity of electrical engineers, "for his outstanding planning and development of air defense control systems and his participation in civic affairs."

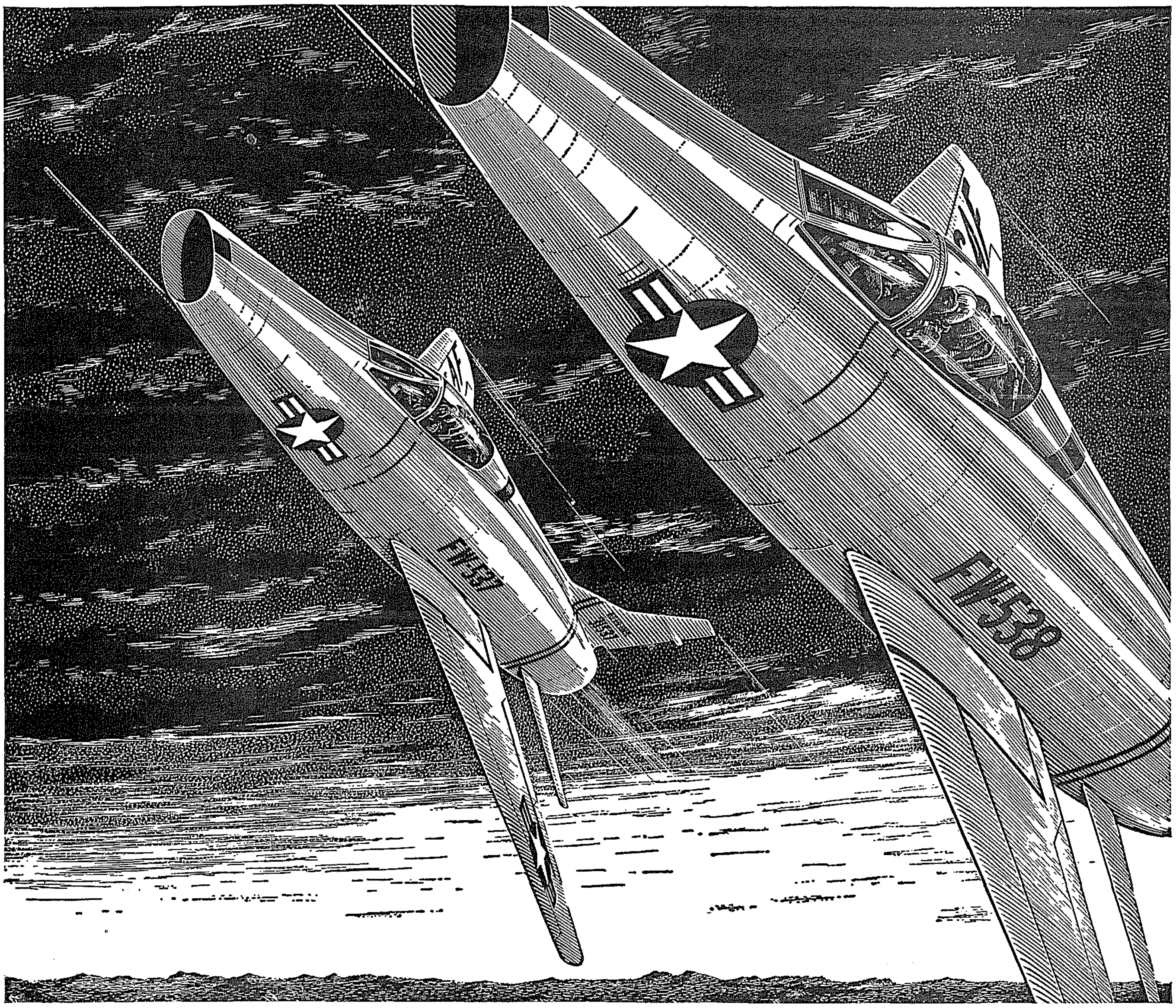
The award was presented to Rube at the fraternity's annual dinner on January 31 in New York City. It is given each year to a young electrical engineer for technical achievement and meritorious community service.

Rube is the fourth Caltech alumnus to receive the award. The others: *Jesse E. Hobson*, PhD, '35, now Eta Kappa Nu president, *J. R. Pierce*, BS '33, MS '34, PhD '36, and *A. M. Zarem*, MS '40, PhD '44. (In addition, four Caltech alumni have received honorable mention and Dr. *R. W. Sorensen*, Caltech professor emeritus of electrical engineering has been named an Eminent Member of the society.)

Rube Mettler joined the Hughes Research and Development Laboratories after receiving his PhD from Caltech in 1949, and he has been active there in the development of an all-weather interceptor-fire control system and an integrated electronic system. The latter system includes navigation, radar, and fire control for both rockets and guided missiles, and homing, landing, and automatic pilot functions for supersonic interceptor aircraft. Earl in 1954 he was appointed an associate director of the Hughes Radar Research and Development Division, and is currently a Special Consultant to the Department of Defense.

Rube served as a director of the Caltech Alumni Association in 1948 and 1950.

Paul H. Winter, back in Pasadena, reports: "I have returned from my two-



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Engineers at North American also find opportunities in the expanded programs in atomic energy, rocket engines, advanced electro-mechanical equipment and guided missiles. When the time comes for you to enter the engineering profession, consider the well-paid careers at North American. Write for information concerning your future in the aircraft industry.

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ENGINEERING AHEAD FOR A BETTER TOMORROW

NORTH AMERICAN AVIATION, INC.

PERSONALS . . . CONTINUED

year tour in Afghanistan with the United Nations Technical Assistance Mission. It was an interesting opportunity for my wife, two boys, and myself to travel and learn a little of the East.

"We are now again settled in our home in Pasadena. I have resumed partnership in an architectural engineering firm and our work has been varied and active. We are mainly doing schools, churches, and shopping-center work.

"I am teaching one night a week at USC, enjoying the meetings of the Structural Engineers Association, and as a family we are active in the program of the Lake Avenue Congregational Church."

1945

Clarence Woodward has been elected vice president in charge of engineering and sales and a member of the Board of Directors of the Rucker Company of Oakland, California. The firm is engaged in hydraulic engineering and manufacturing.

Richard Honey is working as a research engineer in the microwave group at the Stanford Research Institute. Dick received his PhD from Stanford several years ago. He is married and has two daughters.

1946

Albert O. Klein is now a missionary and will be arriving soon in Formosa, to work under the Evangelical Albanee Mission of Chicago, Illinois, for a 5½-year term. Al's wife and baby will be with him in Formosa.

Robert Grube is now the father of three children, with the arrival of Victoria Mae last November. Bob, an engineer with Aerojet, is making a telescope in his spare time.

Laurence Haupt, MS '47, holds the post of Fleet Captain of the Sacramento Penguin Class Sailboat fleet. He notes that there were two boats sailing when he bought his a year ago, but this summer there will be 10 boats sailing on Lake Washington, which is across the Sacramento River in Yolo County. Laurence has been speaking before service clubs in the local campaign for the Association for Retarded Children. This is part of a public service program of Toastmasters International.

1947

Edward A. Flanders, MS, is now a colonel in the Army Engineering Corps, in Casablanca on a three-year detail. His wife and three daughters are with him, and they are enjoying Morocco very much. Before this transfer, Ed had just finished working on the Limestone, Maine, Air Base.

George Epprecht, MS, sends in the following report on life in Switzerland: "Job: Got a PhD from the Swiss Federal Institute of Technology two years ago, with a thesis on noise of sliding contacts. For two years have been working on microwave measuring technics. Working conditions are very good compared to other Swiss companies . . . except for salary possibilities. Am living in an old farmhouse built in 1782 at the edge of a wood overlooking the Aare River and with a view of the mountains. Distance from Bern is half an hour riding on a bike, as long as there is no snow. Our two boys are happy to have been joined by a little sister recently. The weather? Well, I sometimes long for some real warm California sunny days."

1948

Richard Roehm writes from Yonkers, New York: "I am still on a single, unmarried basis although by no means a confirmed bachelor. Very much interested in my work with the IBM Corporation. This month I was made a special representative at World Headquarters in New York City. Duties . . . to represent the company on a national basis to life insurance companies, with emphasis on those who use or are contemplating the use of IBM's newly developed Electronic Data Processing Machines. I was on a planning group for electronic computer developments at Poughkeepsie, New York prior to this, for a period of eight months. New York City is a wonderful place, but as far as I'm concerned it's extremely cold this time of the year, and I recall fondly the balmy winters of Pasadena."

1949

J. Frank Valle-Riestra, MS, has been in the uranium business for the last few years — but, as Frank says, "unfortunately not in the money-making end of it." He is designing and supervising construction of plants for the AEC on the Colorado Plateau. He is employed by the Dow Chemical Company of Pittsburg, California.

J. Richard Love has been with Douglas Aircraft Company at El Segundo for the past five years. He is a member of their engineering section, working as a research lab analyst.

Mehmet A. Turkkan, MS, is serving his term of military service in the Turkish Air Force as a lieutenant engineer for the maintenance and repair of jet aircraft.

1950

Wilson Bradley, Jr. has been appointed assistant general manager of the Endevco Corporation in Pasadena.

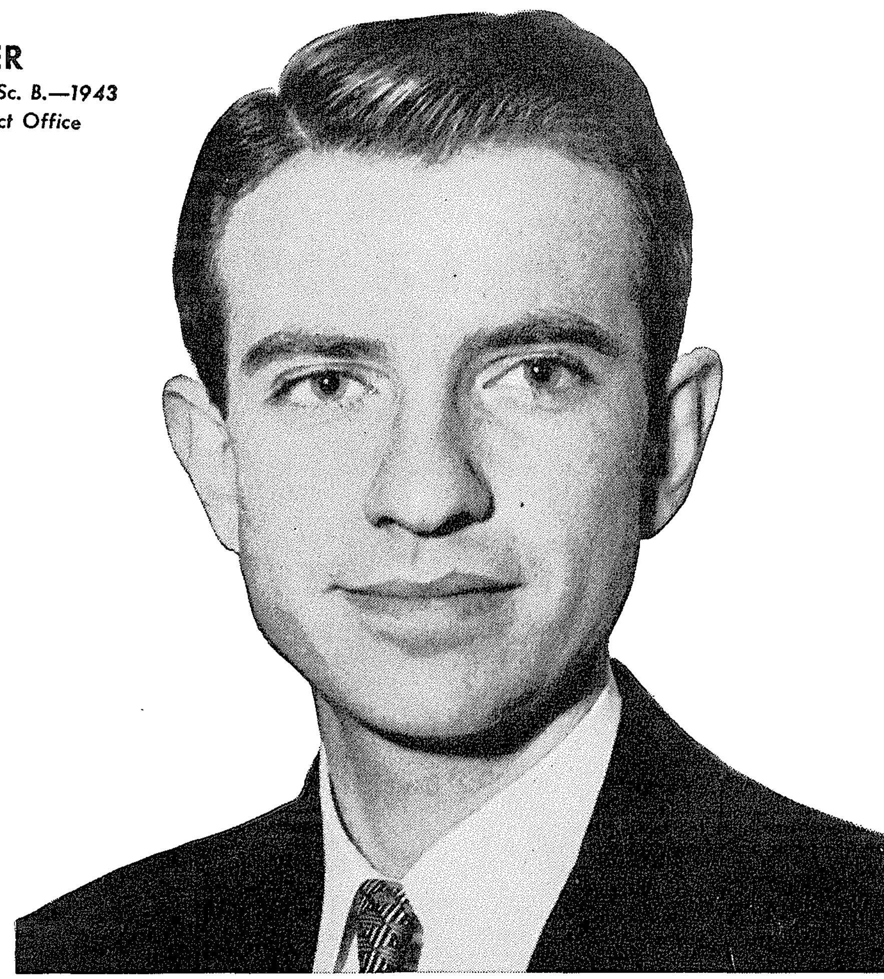
Almon E. Larsh, an electronic engineer at the radiation laboratory of the University of California, happily reports the birth of his first child, a boy, on Feb. 5.

1951

Dean C. Daily II has been transferred

"I needed to 'Find' Myself— that's why I picked Allis-Chalmers,"

says A. J. MESTIER
Massachusetts Institute of Technology Sc. B.—1943
and now Manager, Syracuse District Office



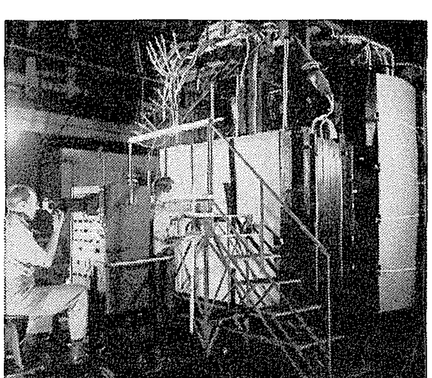
"I WAS LOOKING for an engineering job, but I wasn't very sure just what phase of this broad field would interest me most. I didn't know whether I wanted straight engineering, sales engineering, production or some other branch of industrial engineering.

"Allis-Chalmers Graduate Training Course gave me a means of working at various jobs—seeing what I liked best—and at the same time obtaining a tremendous amount of information about many industries in a very short time."

Experience Typical

"My experience is typical in many ways. I started the Graduate Training Course in 1946, after three years in the Army. My first request was to go to the *Texrope* V-belt drive department. From there I went to the Blower and Compressor department; then the Steam Turbine department. By the time the course was completed in 1948, my mind was made up and I knew I wanted sales work. I was then assigned to the New York District Office and in 1950 was made manager of the Syracuse District. The important thing to note is that all Allis-Chalmers GTC's follow this same program of picking the departments in which they want to work.

"Best of all, students have a wide choice, for A-C builds machines for every basic industry, such as: steam and hydraulic turbine generators, transformers, pumps, motors and other equipment for electric power; rotary kilns, crushers, grinders, coolers, screens and other machinery for mining, ore processing, cement and rock processing. Then there is flour milling machinery, electronic equipment and many others."

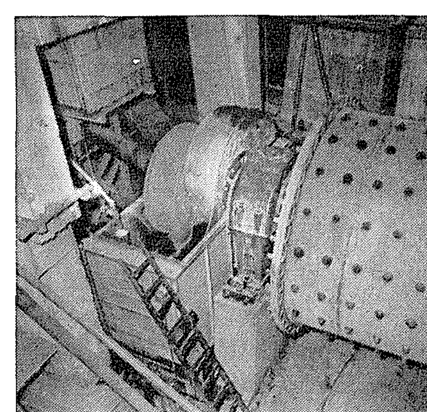


Taking surge voltage distribution tests on power transformer in A-C shops with miniature surge generator and cathode-ray oscilloscope.

A Growing Company

"In addition, new developments and the continuing growth of the company offer almost endless opportunities for young engineers.

"From my experience on the Graduate Training Course, I believe it is one of the best conducted in the industry and permits a young engineer to become familiar with a tremendous variety of equipment—both electrical and mechanical—which will serve him in good stead in his future profession."



Ball Mill grinds ore for large copper producer. Same type of equipment from Allis-Chalmers pulverizes much of nation's cement.

Texrope is an Allis-Chalmers trademark.

ALLIS-CHALMERS

For information call the Allis-Chalmers District Office in your locality or write to Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin by North American to their rocket testing field laboratory at Santa Susana. Dean is with the Budgets & Planning Unit there. Dean and his wife welcomed their first daughter, Virginia Diane, last June.

G. Berk Welch and *Frederick Baily* were graduated last December from the U.S. Naval Officer Candidate School at Newport, R.I. They are now commissioned Ensigns, and will be assigned to duty or continue further schooling within the Navy's Special Training Command.

David T. Manning has joined the research and development department of Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation, at South Charleston. He will be working on synthesis of new organic chemicals. Dave completed requirements for his PhD from Caltech a short time ago.

1952

Richard S. Winkler, MS, sends the following from Saudi Arabia: "I am presently employed in Dharan, Saudi Arabia, by the Arabian American Oil Company. I worked for this company in New York City approximately one year after receiving my MS. I have recently visited Kashmir where I climbed some mountains and did a little fishing. These mountains are even more beautiful than our Sierras.

"One month ago I attended a banquet for the King of Arabia which was given in Damman. It was given in a large tent, the food was native, and we ate using our right hands as utensils. All I can say is that it was different. The temperature has dropped to 70° F. and it is pleasant. Occasionally it is necessary to wear coats.

"I intend to return to the U.S. this June and take the P.E. registration exam."

Paul D. Arthur, PhD, returned from a year overseas, and is now on the staff of the Ramo-Wooldridge Corporation. "Last year in Baghdad was very interesting," Paul says. "I taught at the government engineering college under the auspices of a Fulbright grant. Mary and I drove out from Europe, visiting Yugoslavia, Greece and Turkey on the way to the Arab countries of Syria, the Lebanon, Jordan and Iraq.

"We saw many American assistance projects, but their effectiveness is greatly reduced by our clumsy foreign policy record in the Near East. Even so, we were received with cordial hospitality everywhere."

1953

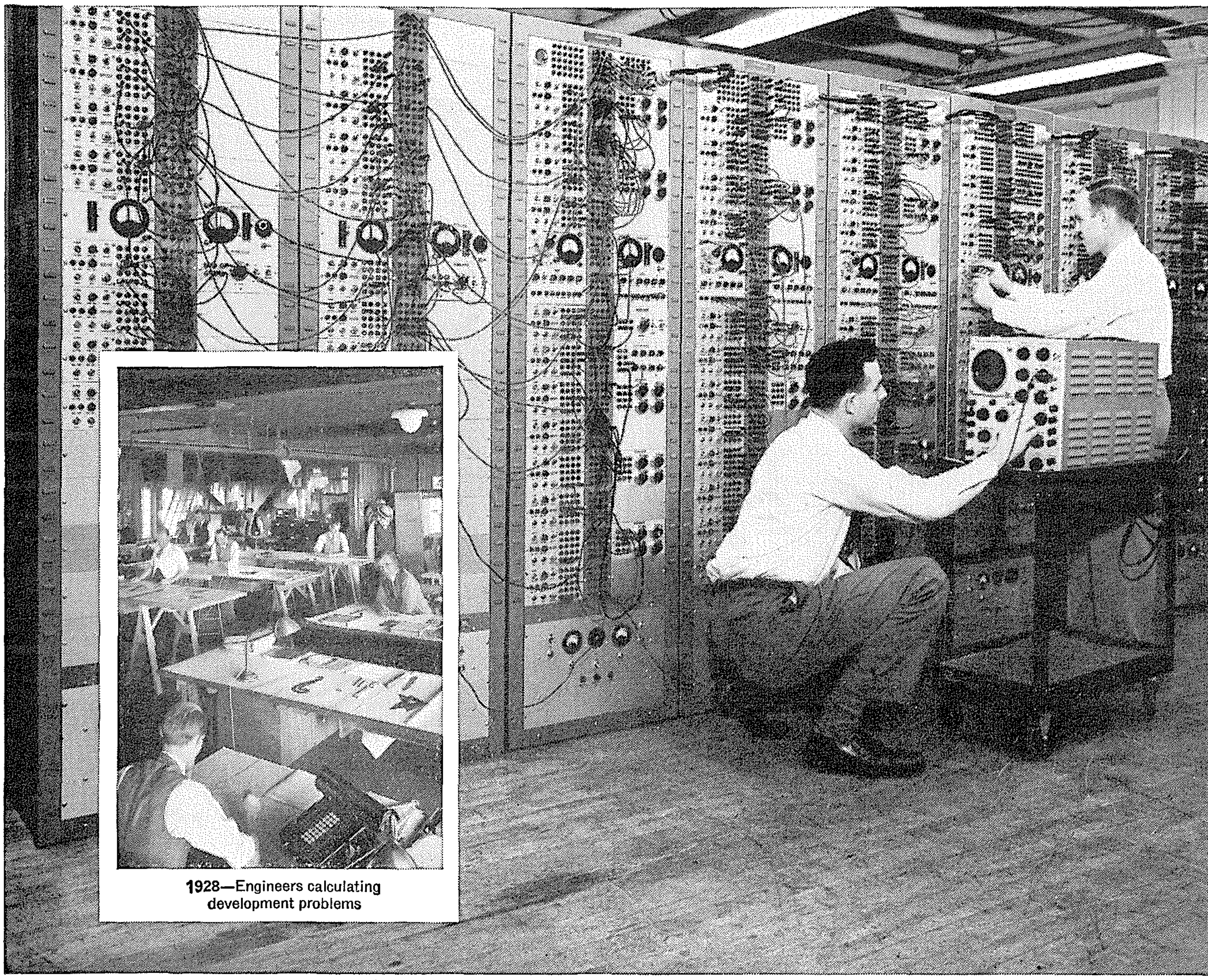
Eugene B. Muehlberger was married on January 22 to Sue Davis of Brentwood, Missouri. Sue attended Occidental, but received her degree from the University of Missouri. Gene got his MS from the University of Kansas in February, and is now employed in the training program of the Shell Oil Company, at La Habra, California. Upon completion of this training he will be an exploitation engineer located somewhere in California.

A. Henry Sturtevant now lives in Alexandria, Virginia, with his wife, the former Anne Fox of Pasadena. Henry is a Pfc in the Army and is working as a company clerk.

Walter J. Eager, Jr. received his commission as an Ensign in graduation exercises held at the U.S. Naval Officer Candidate School at Newport, R.I., last December.

1954

George N. Huntley is planning a June wedding to Miss Charlotte Irwin of San Marino. Charlotte attended Scripps last year, and is now studying at the Los Angeles County Art Institute. George is working for his MS degree at Caltech.



1928—Engineers calculating development problems

1955—Solving complex engineering problems with Boeing computer

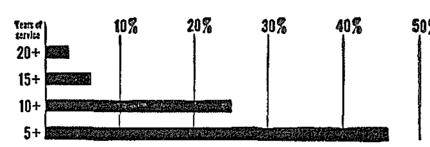
The best research facilities are behind Boeing engineers

The Boeing-designed electronic computers shown above solve in seconds problems that once required weeks—typical of the advanced "tools" that help Boeing engineers stay at the head of their field.

Boeing engineers enjoy such other advantages as the world's fastest, most versatile privately owned wind tunnel, and the new Flight Test Center—the largest installation of its kind in the country. This new Boeing Center includes the latest electronic data reduction equipment, instrumentation laboratories, and a chamber that simulates altitudes up to 100,000 feet. Structural and metallurgical research at Boeing deals with the heat and strain problems of supersonic flight. Boeing electrical and electronics laboratories are engaged in the development of automatic control systems for both manned and pilotless aircraft. Other facilities include hydraulic, mechanical, radiation, acoustics, and rocket and ram-jet power laboratories.

Out of this exceptional research background engineers have developed such trend-setting aircraft as America's first jet transport, and the jet age's outstanding bombers, the B-47 and B-52. Research means growth—and career progress. Today Boeing employs more engineers than even at the peak of World War II. As the chart shows, 46% of them have been here 5 or more years; 25% for 10, and 6% for 15.

Boeing promotes from within and holds regular merit reviews to assure individual recognition. Engineers are



encouraged to take graduate studies while working and are reimbursed for all tuition expense.

There are openings at Boeing for virtually all types of engineers—electrical, civil, mechanical, aeronautical and related fields, as well as for applied physicists and mathematicians with advanced degrees.

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

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EIGHTEENTH ANNUAL ALUMNI SEMINAR - SATURDAY, APRIL 16, 1955

8:30-9:15 A.M.—REGISTRATION
Dabney Hall of the Humanities

MORNING PROGRAM

9:30-10:20 A.M.
Your choice of the following:

A. CHEMICAL HAY FOR MECHANICAL HORSES

Peter Kyropoulos, Associate Professor of Mechanical Engineering

Over the last thirty years we have observed a steady increase in horsepower of automotive engines as well as in the octane requirement of the fuels on which these engines run. This talk will outline some of the problems of engine fuel relations from the point of view of the engine. We shall take a look into the crude oil barrel, and see from what portion of the barrel today's high octane motor fuels come.

B. FRENCH DISTRUST OF UNCLE SAM

Dan Piper, Assistant Professor of English

French-American friendship has been a cornerstone of American foreign policy since the days of the Marquis de Lafayette. Yet today we are worse friends than at any other time in our history. France, more than any other country in Europe, is suspicious of the United States' emergence as a world power. What are the grounds for this distrust? Dr. Piper will suggest a few of the answers be found during his recent year's stay in France.

10:20-10:50 A.M. COFFEE TIME

10:50-11:40 A.M.—
Your choice of the following:

A. THE SIZE OF THE UNIVERSE—TODAY

William A. Baum, Staff Member, Mount Wilson and Palomar Observatories

Far out in the vast reaches of the cosmos lie millions of galaxies much like our own, each galaxy an enormous swarm of suns numbering in the billions. From the faint light that reaches our microscopic planet, Earth, we try to figure out how far away these colossal inhabitants of outer space are, how they're distributed through space, and of what they consist. The large telescopes of Mount Wilson and Palomar, equipped with modern instruments, are rapidly yielding fascinating new information about the nature of the universe.

B. AROMAS OF THE PAST

A. J. Haagen-Smit, Professor of Bio-organic Chemistry

Perfumes and flavors are but two of the many uses of essential oils, the natural volatile oils which give many plants their taste or fragrance. Ointments and lotions had their start in ancient times when the ladies of Pharaoh's Court applied essential oils to enhance their charms. Dr. Haagen-Smit will discuss and illustrate with slides the many interesting uses found for these products from earliest civilizations to the present.

11:55-12:45 P.M.—
Your choice of the following:

A. CONQUERING THE MICROWAVE

Lester M. Field, Professor of Electrical Engineering

The story of microwave tubes is the story of how apparent basic limitations were overcome by novel inventions which struck at fundamental concepts rather than by slow improvement. Now devices are available which perform their complete function one hundred thousand million times a second or more. Electronic warfare, microwave television links, other communication systems, industrial processing and control and physical and chemical research have been benefited or profoundly affected.

B. VEGETATION—GREEN GUARDIAN OF EROSION

Henry Hellmers, Research Fellow in Biology

After each heavy rain the question is raised: Can the threat of dangerous floods be diminished by increasing the vegetation on the mountains? Studies on this have brought out many interesting facts concerning the rugged characteristics of the native plants. They have the ability to live and grow under conditions that would amaze even the most amateur gardener. Dr. Hellmers will discuss the problems and successes encountered in trying to make these plants grow better or to replace them with exotic species.

1:00-2:00 P.M. LUNCH—STUDENT HOUSES

AFTERNOON PROGRAM

2:15-3:05 P.M.
Your choice of the following:

A. SURPRISES NEAR ABSOLUTE ZERO

John R. Pellam, Professor of Physics

The nature of some materials changes remarkably as absolute zero temperature is approached. Iron is made to float in space. Electric currents appear to ignore normal laws. See these phenomena, as well as the strange properties of liquid Helium II and super-conductive lead, demonstrated and explained by Dr. Pellam.

B. TROPICAL AQUARIUM FISHES

W. H. Hildemann, Graduate Teaching Assistant, Biology

Amateur aquarists or fish fanciers are more numerous today than ever before. With a vast variety of tropical fishes from which to choose, the home aquarium may be stocked with fish of brilliant colors, unusual finnage, and spectacular breeding habits. Mr. Hildemann will show color slides of Siamese Fighting Fish and Guppies, offer suggestions to the prospective or beginning aquarist, and discuss some current research with fish.

3:30-4:15 P.M.—AT THE ALUMNI SWIMMING POOL

Dedication of the Pool—Kenneth F. Russell '29, President, Alumni Association, presiding.

Exhibition—a water ballet and diving program starring Olympic champions.

4:15-5:30 P.M.—YOUR CHOICE

Pool open for swimming by Alumni and guests. Locker room facilities will be available for women as well as men. Towels will be provided.

Gymnasium open for badminton. Bring your own rackets, tennis shoes and shuttlecocks.

Dabney Lounge open for relaxation.

Bar at Elks Club opens at 5:30.

EVENING PROGRAM

6:30 P.M.—DINNER

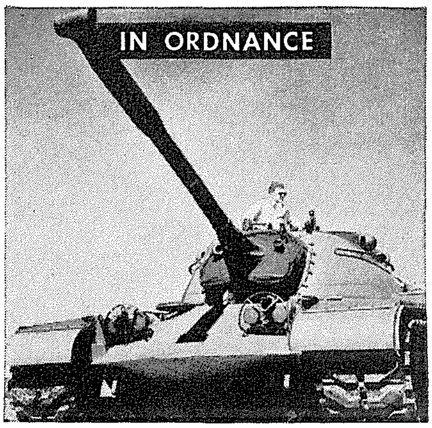
Elks Club, 400 West Colorado Street, Pasadena.
Dress—Informal for men and women

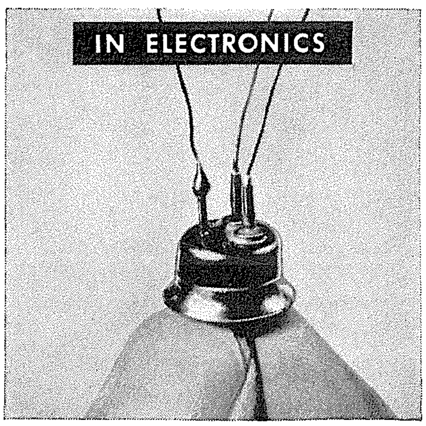
AFTER DINNER

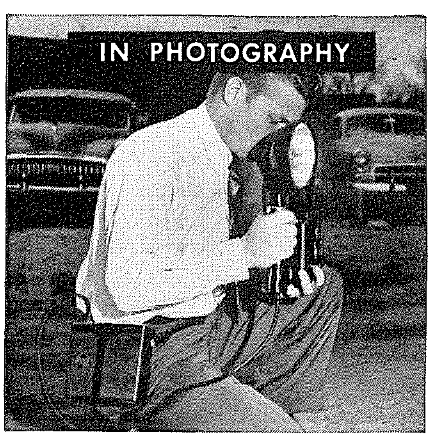
Introductions by Willis R. Donahue '34, General Chairman, Alumni Seminar Day. Remarks by Dr. Lee A. DuBridge.

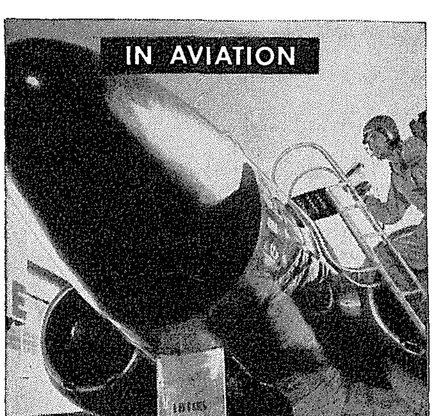
THE SOURCES OF NATIONAL STRENGTH

Dr. Robert M. Hutchins, Former President and Chancellor of the University of Chicago, former Associate Director of the Ford Foundation, and now present President of The Fund for The Republic, Inc.









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THE opportunities for engineers in the automatic control field are unique in their variety and in the insight provided into all of the industries of today's modern world.

The development and manufacture of tiny transistors for electronic control . . . the design and manufacture of quality electronic photo flash units . . . the challenge of finding fish with underwater sonar . . . of providing automatic flight for supersonic jets . . . temperature controls for today's modern home . . . for atomic piles . . .

These are a few of the fields in which Honeywell's several divisions are engaged, providing automatic controls for industry and the home.

These controls are made possible by the creative imagination of highly trained engineers working with the very latest research and test facilities.

With twelve separate divisions located throughout the United States and with factories in Canada, England and Europe, Honeywell offers unlimited opportunities in a variety of challenging fields. Based on diversification and balance between normal industry and defense activities, Honeywell will continue to grow and expand because automatic control and instrumentation are so important to the world's progress.

That is why we are always looking for men with ideas and imagination and the ambition to grow with us. In addition to full time engineering and research employment we offer a Cooperative Work Study program, a Summer Student Work Study program and Graduate Fellowships. If you are interested in a career in a vital, varied and diversified industry, send the coupon for more information.

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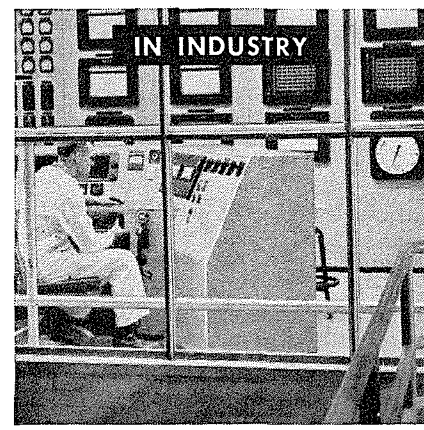

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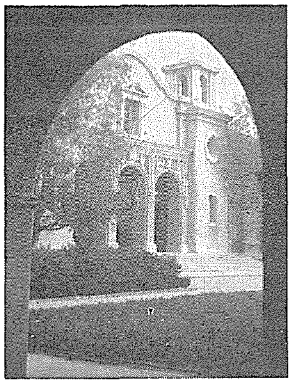

CALTECH CALENDAR

March, 1955

FRIDAY DEMONSTRATION LECTURES

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

April 1—
Daylength and Sexual Activity in Plants and Animals
—Dr. Arthur Galston

April 8—
Evolution—
Dr. George Beadle

April 15—
Peaceful Uses of Atomic Energy—
Dr. Robert Bacher

April 22—
The Production of Nuclear Power—
Dr. Milton Plesset

April 29—
Radio Astronomy—
Dr. Jesse Greenstein

May 6—
Dollars from Rocks in Southern California —
Dr. Thane McCulloh

ATHLETIC SCHEDULE

Varsity Baseball

April 1—Pomona at Caltech
April 2—Westmont at Caltech
April 5—Cal Poly at Caltech
April 9—Caltech at Whittier
April 13—LaVerne at Caltech
April 16—Caltech at Redlands
April 20—Loyola at Caltech
April 23—Caltech at Pomona
April 26—L.B. State at Caltech

Varsity Track

April 1—Caltech at L.A. City College
April 7—Fullerton J.C. at Caltech
April 13—Orange Coast at Caltech
April 15—Caltech at Redlands

ALUMNI CALENDAR

April 16	Seminar Day
June 8	Annual Meeting
June 25	Annual Picnic

E&S SCIENCE WRITING CONTEST

for undergraduates & graduate students

$100 first prize **$50 second prize**

Articles should be based on some phase of scientific or engineering research, or some individual, connected with Caltech. They may be from 1,000 to 5,000 words, typed, double-spaced.

All manuscripts submitted will be sent to editors of Scientific American for judging. Contest closes May 1, 1955.

E&S will publish all suitable articles throughout the year, paying at rate of $10 per published text page, or roughly a cent a word.

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