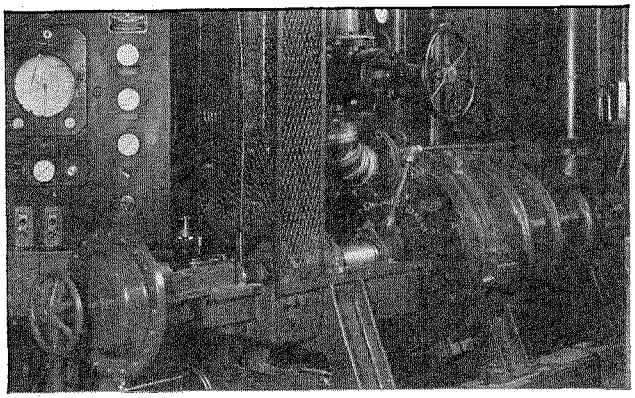
ENGINEERING | AND | SCIENCE

DECEMBER/1951

Bikini Corn . . . page 15

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Another page for YOUR BEARING NOTEBOOK



How to help a plug keep plugging

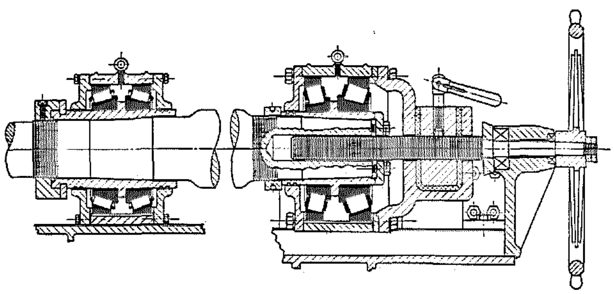
Pulp for paper making is chewed up inside this Jordan engine by a cone-shaped plug that forces the pulp against knife edges in the shell. Clearance between plug and shell must be held extremely close, so the designers mounted the plug shaft on Timken® bearings. Timken bearings take radial and thrust loads in any combination, keep shafts in positive alignment. Deflection and end movement are eliminated.

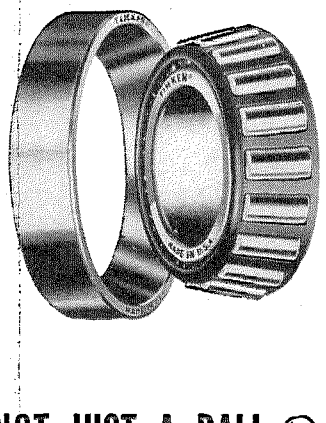
Mounting plug shaft bearings

The application shown here uses four single-row Timken tapered roller bearings mounted in pairs for the thrust and floating ends of the plug shaft. They are mounted directly on tapered sleeves and adjusted by means of shims between the cup follower and bearing housing.

The right hand or thrust end bearing assembly carries the thrust load and is clamped on the shaft by means of an end cap and cap screws. A nut next to the tapered sleeve facilitates removal of the bearing assembly.

Both thrust and floating ends are free to move laterally as the plug and shell are adjusted for clearance. Closures are of the piston-ring type.





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BOOKS

ROGUE QUEEN
by L. Sprague de Camp
Doubleday & Co., New York $2.75

Reviewed by John S. Campbell
Instructor in Engineering Drafting

ROGUE QUEEN, the latest work from the prolific pen of L. Sprague de Camp '30, is a light and charming fantasy with a faintly discernible moral, which describes the effect of an expedition from Earth upon the inhabitants of another world. These people, the Avtini, have developed a beehive society of female workers and drones which is quite uncomplicated by sex, until the advent of the Earthmen.

What happens then is told in tongue-in-cheek fashion, mostly from the Avtini viewpoint. The terrestrial influence is at first mainly psycholoical, but presently the hormones are involved too, and then the situation gets completely out of hand. Both Earthmen and bee people go through a series of chase adventures somewhat like those in the late Edgar Rice Burroughs' Mars stories, but without the color of Burroughs' rough and tumble planet; in fact, de Camp's tale is a sort of pastel-shaded version of the Martian horse operas.

There is one point which should be corrected: *Rogue Queen* is described on the jacket as science fiction. This it definitely is not. *Rogue Queen* is a delightful bit of fantasy, but between fantasy and science fiction there is, or should be, a wide gap. In science fiction a plausible "scientific" idea is developed, and the story is centered about the struggle of the characters with the logical consequences of the idea. In fantasy, on the other hand, the fantastic situation serves merely as a background for the development of a normal human problem. The problem may be presented in disguised form, as it is in *Rogue Queen*, but it is nevertheless reducible to a familiar form—in this case to the age-old struggle between convention and instinct. The Avtini may be most unearthly in appearance and customs, but their troubles turn out, in the end, to be very human.

Rogue Queen is not science fiction, but it *is* a nicely written bit of fantasy with a slightly racy flavor and a moral at the end, if one looks for it.

A CONCISE HISTORY OF ASTRONOMY
by Peter Doig, F.R.A.S.
The Philosophical Library, Inc., New York $4.75

Reviewed by Edison Pettit
Staff Member,
Mount Wilson Observatory

THIS BOOK fills a long-standing need for a brief survey of the history of an old science. The first chapter, called "The Oldest Astronomy," is highly speculative and cannot be called history. The succeeding three chapters, divided according to geographical origin ("China," "Egypt," etc.) cover the well-known ancient and medieval history of the subject in a commendable manner. Chapters V to XI cover the early modern astronomers by name, from Copernicus through William Herschel and Schröter, and bring the subject matter up to the year 1800. Personnel covered here are reminiscent of the catalogue of lunar formations.

The form then changes into classification by century, and this form is retained with the subclassification according to subject throughout the rest of the book—e.g., *Nineteenth Century: Second Half*, "Mercury," "Mars," etc., and such operational titles as "Star Catalogues," "Stellar Radial Velocities," "Stellar Parallaxes," "Rotation of the Galaxy," "External Universes," etc., in *The Twentieth Century*. A reference list and index complete the book.

The large type makes easy reading and the subject matter is the end result of extensive reading by the author. However, it is axiomatic that the local associations and special interests of the author are reflected

CONTINUED ON PAGE 6

in the accuracy and detail of the subject matter reported upon.

The treatment of planetary astronomy leaves little to be desired, but in solar astronomy some passages could be improved. The classification of prominences remains where Lockyer and Young left it in the 1880's. This passage is a prize: "Eruptive prominences appear only in the belts of the sun where spots are found, and are usually connected with spots, or rather with disturbed areas surrounding spots. Generally they are not very large, but they may, however, attain enormous heights. One observed on June 4, 1946—."

It could be pointed out that this was the largest prominence of any kind ever photographed either on the disk or against the sky. It was not associated with a spot or "in the belts of the sun where spots are found." And, as a matter of record, only a few eruptives were associated with spots.

Probably the most important piece of observational evidence about prominences obtained in recent years was the discovery that some types form in coronal space and rain down upon the sun, indicating that chromospheric matter in considerable extent pervades the corona, but this entirely escaped the author.

ON THE ORIGIN OF SPECIES
by Charles Darwin
Philosophical Library, N. Y. $3.75

THIS HANDSOME, pocket-sized book is a reprint of the original edition of Darwin's great work. This edition has never been reprinted before, and most of the people who have read Darwin have read him in one of the later (there were six in all) and longer, revised editions. This, then, is Darwin's book as he first presented it to the world, "unspoilt by later hesitation," says C. D. Darlington, F.R.S., in his introduction, "unimpaired by yielding to the trivial and captious critic . . . the bare body of (Darwin's) *argument* with its strength and its weakness unconcealed."

LOS ANGELES: A Guide to the City and its Environs
Hastings House, N. Y. $4.50

This guidebook was originally published in 1941 as one of the series of American Guides compiled by workers of the WPA writers' program. The guides were one WPA project which successfully withstood all criticism. They were the best guidebooks going.

In recent years Hastings House has begun to update a number of the WPA Guides, and this 1951 edition of the Los Angeles one (which covers not only the city but the near-by beach and mountain resorts from Malibu to Palm Springs) is still the best guidebook to the area—and good reading besides.

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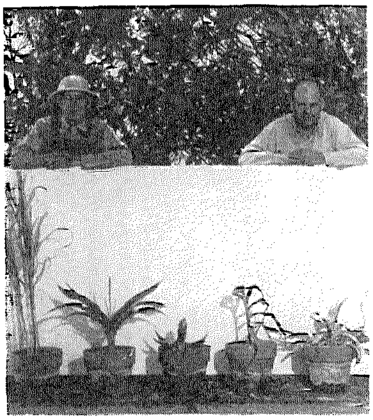
IN THIS ISSUE



This month's cover shows John Dale, gardener at Caltech's Biology Experimental Farm in Arcadia, and Dr. Ernest Anderson, Professor of Genetics in charge of the Farm, with a few samples of their unusual corn crop. All the plants shown on the cover are descended from seeds which were exposed in either the Bikini or Eniwetok atom bomb tests. Caltech's biologists are using them in fundamental studies of heredity and transmitted traits—as well as in studies of how radiation affects plants and humans. The story's on page 15.

We have a couple of news bulletins to add to the story about James Bonner, Professor of Biology at the Institute, on page 17. He's been given a $50,000 grant ($10,000 a year for five years) by the Herman Frasch Foundation for studies of the biochemistry of plant growth. And he's co-author with his co-worker, Arthur W. Galston, Associate Professor of Biology at the Institute, of *Plant Physiology*, to be published next month by W. H. Freeman & Co.

PICTURE CREDITS

Cover	James W. McClanahan
p. 9	Pasadena *Star-News*
pps. 15, 16	James W. McClanahan
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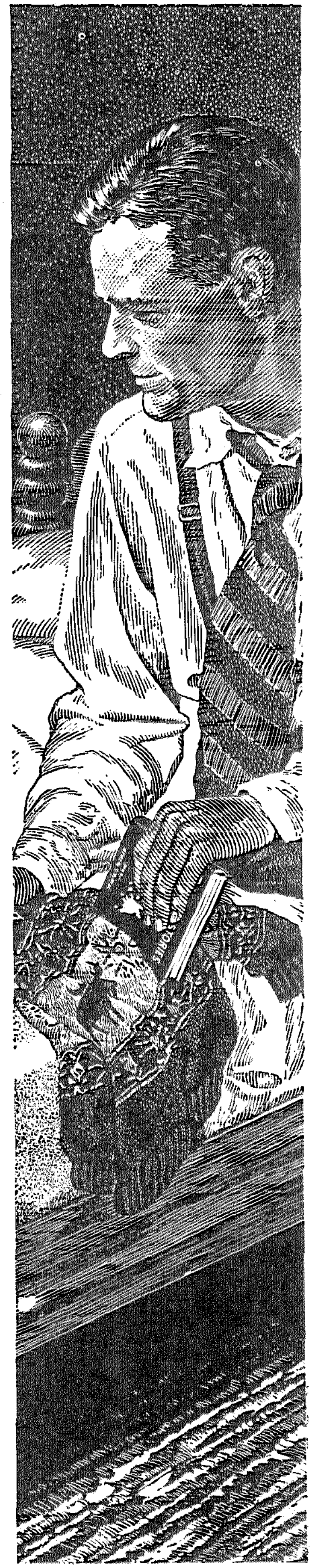
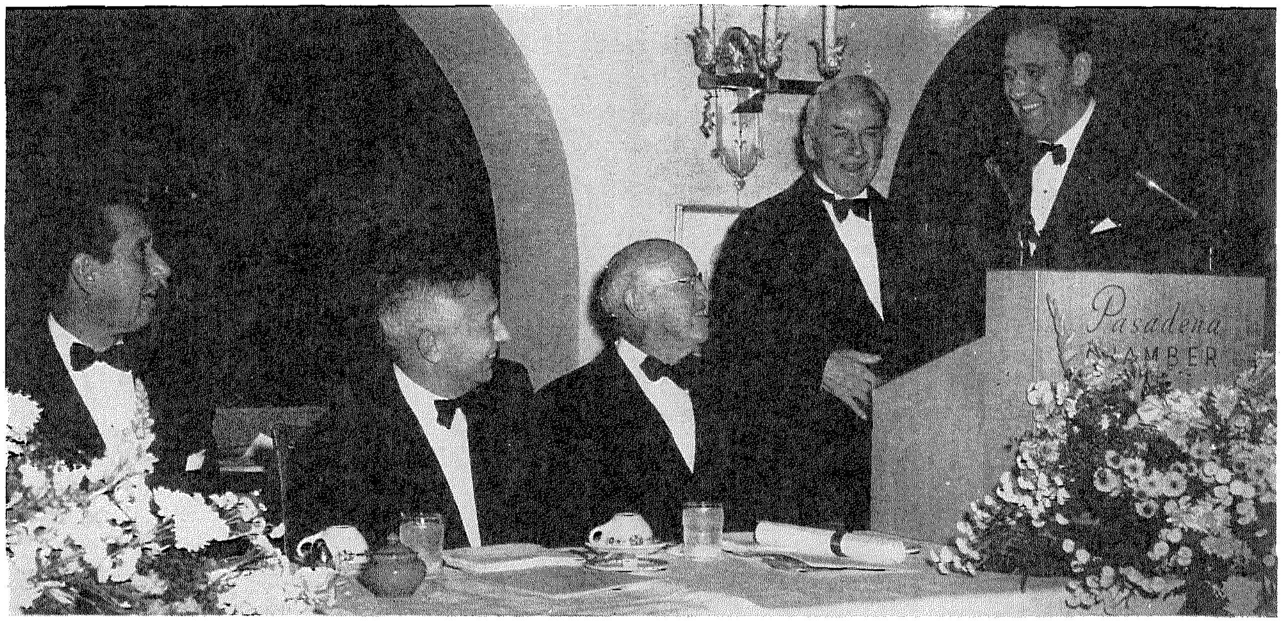




Speakers at the Caltech 60th Anniversary Dinner held on November 9—Pasadena Chamber of Commerce President Leon Delbridge, Caltech President L. A. DuBridge, Robert G. Cleland, R. A. Millikan, and J. E. Wallace Sterling.

CALTECH'S 60TH BIRTHDAY

LAST MONTH Caltech celebrated its 60th birthday. On November 2nd, 1891, The Throop University opened its doors to students for the first time. This marked the humble beginning of the privately-endowed institution now known as the California Institute of Technology, one of the world's leading scientific and engineering education and research centers.

The anniversary passed without ceremony on the Caltech campus, but was commemorated on Friday, November 9th, at a formal dinner at the Huntington Hotel sponsored by the Pasadena Chamber of Commerce.

Speakers at the dinner were President L. A. DuBridge; Dr. R. A. Millikan, Chairman of the Institute's Executive Council from 1920 until his retirement in 1945 and now Vice-President of the Caltech Board of Trustees; and Dr. Robert G. Cleland, a member of the permanent research group at the Huntington Library in San Marino. Dr. J. E. Wallace Sterling, former member of the Caltech faculty and now President of Stanford University, served as toastmaster at the banquet.

The following excerpts from the speeches of Dr. Millikan, Dr. Cleland and President DuBridge constitute a brief review of the Institute's first 60 years, as well as a glance at its present and future.

THE FOUNDERS OF C. I. T.

by R. A. MILLIKAN

THE FIRST OF THE early founders of C. I. T. was Amos Throop, creative pioneer, who believed that American intermediate education in the 1890s was far too bookish and greatly in need of an injection of the manual arts. He therefore gave himself and all that he had (his fortune was of the order of $200,000) to the first steps of the founding of what soon became known, and remained known for eighteen years, as the Throop Polytechnic In-

The early days: Cooking class at Throop Institute

stitute. This, then, served well its own community and the cause of private education in the United States for nearly twenty years.

By that time the educational needs of the country, particularly of Southern California, had changed radically. The public school system, responding to the stimulus of Throop's work here, and similar leadership by Messrs. Belknap in Chicago and Woodward in St. Louis, had developed *within the public school system* the present well known manual training high school. This development left these three private manual training schools free for expansion into, respectively, the California Institute of Technology, the School of Education of the University of Chicago, and the Washington University in St. Louis.

Eight new founders

This absorption actually took place in the case of Throop largely through the addition to the founding pioneers, Amos Throop and Norman Bridge, of eight new founders: Arthur Fleming, George E. Hale, Henry M. Robinson, John Wadsworth, Hiram Wadsworth, and James Culbertson.

In taking Hale into its membership this new Board of Trustees had accepted the condition on which he had agreed to join, namely, that the Polytechnic Institute as it had thus far existed be discontinued and a worthy rival of M. I. T. be created in its place in Pasadena.

Hale's blueprint for a new institution adequate to begin to meet the enormous scientific and industrial needs of the great new population which by 1908 was beginning to flow in big waves into Southern California, was adopted by the enlarged Board, and in 1911 the first graduates of the new institution, three in number, were handed their B. S. degrees.

In 1910 Throop Hall was built, just as it now is, on the campus opposite Tournament Park, this campus being the gift of Arthur Fleming and his daughter Marjorie to the new institution. The funds for the erection of Throop Hall, about $170,000, were raised by subscriptions made by the citizens of Pasadena, the largest contributors being Arthur Fleming and James Culbertson.

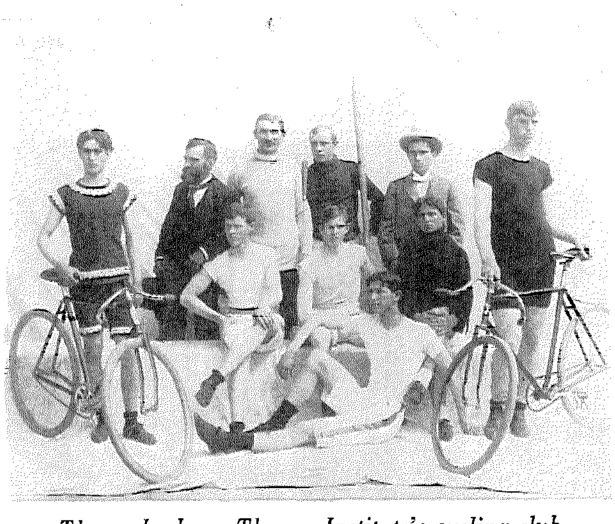
By the year 1916 three new founders had appeared: Charles W. Gates had been added to the Board of Trustees and he, with the help of his brother, P. G. Gates, had built at a cost of $70,000, the first, or eastern-most, unit of the present Gates-Crellin Laboratories. Arthur A. Noyes, who had been acting President of M. I. T., had secured sufficient release from his responsibilities there to be able to act as Director of this new Gates Laboratory during the winter of each year.

Up to the time of our entrance into World War I, on April 6, 1917, there had been scarcely over a dozen graduates of the new institution. From that day on, in view of the enlistments in our defense activities and the draft, the whole institution was absorbed into war duties and did not get back to the campus in appreciable numbers before January, 1919.

But shortly after Armistice Day, November 11, 1918, Dr. and Mrs. Bridge offered to build the Norman Bridge Laboratory of Physics if I would direct it. I agreed to do such directing as I could in spending one quarter a year at the Institute, and I was here in the first quarter of 1920 when the name of the Institute was officially changed to the California Institute of Technology, a name which the public quickly abbreviated to Caltech.

When I returned to Pasadena a year later, in January, 1921, I found that Dr. James A. B. Scherer, who had been President of the Institute since 1908, was absent on sick leave, with definite indications that he would not be able to return. My close friends here began urging me to accept the presidency of Caltech and to transfer my full-time activity from Chicago to Pasadena, just as Noyes had by that time made his full-time transfer from M. I. T. to Caltech.

I was at first deaf to these suggestions because I was engaged at Chicago in a very heavy, and to me inspiring, research program which I did not feel that I could give up for any kind of administrative post. At this juncture Mr. Fleming told me that if I would transfer full time to C. I. T., with or without taking the title of President,



The early days: Throop Institute's cycling club he would turn over in trust to the Institute his whole fortune, the value of which he estimated at $4,200,000. Further, since what the Trustees wanted me to do first was to get physics, the foundation of all science, on the map at C. I. T., he would begin by providing from his own income $90,000 a year for the physics budget alone, and would see to it that that annual physics budget rose in subsequent years to not less than $130,000.

When great-souled Noyes came to me urging me to accept Mr. Fleming's offer, despite the fact that this meant that the great bulk of available funds would go into physics and leave chemistry in a quite subordinate place, I decided to make the change from Chicago to Caltech.

To enable me to do this, Hale, Noyes, Robinson and I set up a new form of organization which was designed to distribute as much of the administrative load as possible among the whole staff of the Institute so as to leave me free for doing and directing more of my own research problems than a president could normally successfully handle.

We set up the so-called Executive Council, consisting of four members of the faculty and four members of the Board of Trustees. The title which the Trustees gave me was Chairman of the Executive Council, rather than President, and I was able through it to follow and to participate in the research work of the Institute very much more fully than I could have otherwise done.

I list here a few of our early decisions, all of which were approved by the full Board of Trustees:

(1) To remain small and compact, so as to facilitate the cross-fertilization of ideas, both with respect to the faculty, the graduate and the undergraduate students, the size of the total student body being maintained, if possible, between 1,000 and 1,500.

(2) To concentrate on quality and leave mass education to other institutions. This means large selectivity in the matter of admissions.

(3) To encourage undergraduate teaching in moderation by all faculty members.

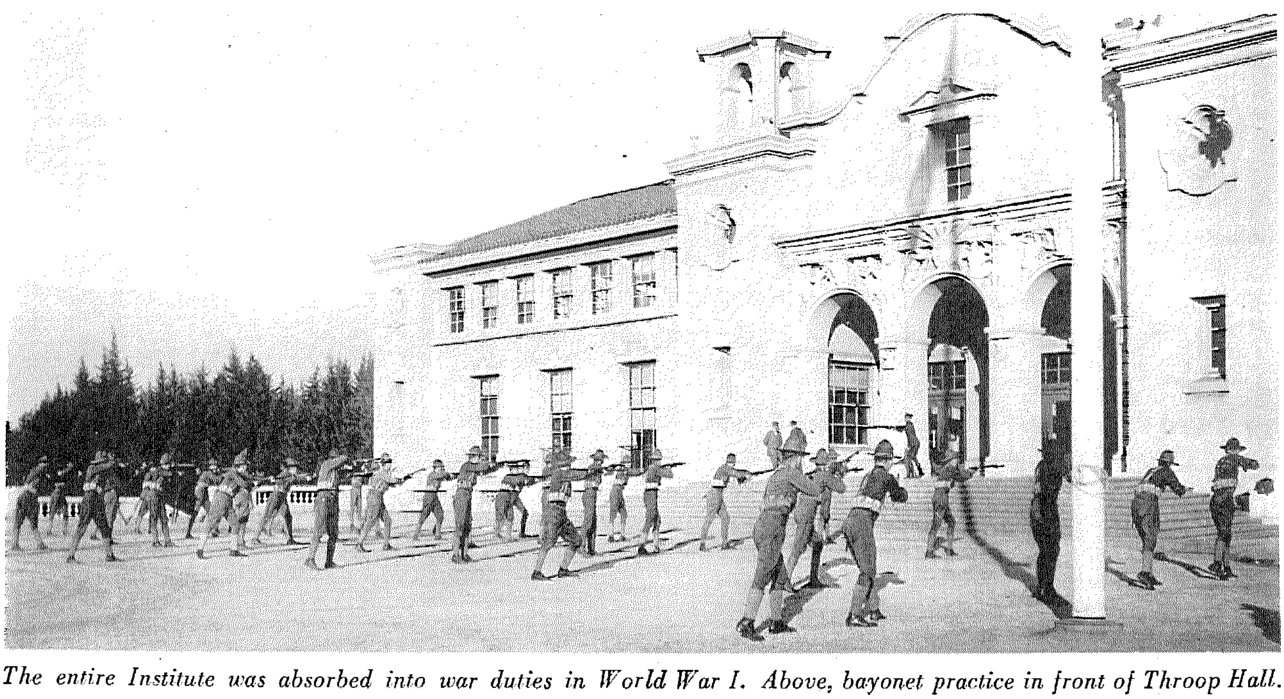
(4) To organize graduate and research work in science and engineering more thoroughly than had generally been done in other technical institutions.

(5) Since most C. I. T. graduates became industrial or civic leaders, to require all undergraduates to devote one-fourth of their time to courses in the field of the humanities.

For the first three years of my life here I devoted myself, night and day, as per contract with the Trustees, to trying to put physics on the map at C. I. T. Then one day Mr. Blacker, himself a Michigan lumber man and a C. I. T. Trustee whom I had met in Chicago, told me that the outlook for the Sugar Pine Lumber Co., from which Mr. Fleming derived most of his income, was pretty dark.

I conferred with Henry Robinson, and between us, with invaluable and very active aid from Allan Balch, Henry O'Melveny, Harry Chandler and Dr. Ricketts, we worked up the plan of the California Institute Associates with the idea of thus getting current funds sufficient to keep the Institute going until Mr. Fleming's investments returned to their old yields. That time never came! Instead, the crash of 1929 carried the Fleming trust down with it. But we tightened our belts, cut salaries of everybody, and balanced our budget.

But I fear we could not have done it without Mr. Allan Balch, who about 1924 had sold out his public utility holdings to advantage, and in 1925 became Vice President of the Board of Trustees. He told me a dozen times in those dark days not to worry (as did also Dr. Ricketts), for all that he had was ultimately going to the



The entire Institute was absorbed into war duties in World War I. Above, bayonet practice in front of Throop Hall.

Institute, and by 1925 he had actually turned over his first million dollars, which meant two million for Caltech, since at that time the Rockefeller Foundation had agreed to match dollar for dollar what we secured here. Three and a half million more came from the Rockefellers through their matching technique. Also in 1931 Mr. and Mrs. Balch presented us with the Athenaeum at a cost to them of $600,000.

But Mr. Balch was only one of the men of means in Southern California who in the twenty-five years between 1920 and 1945 invested the bulk of their fortunes in irrevocable trusts or legacies in this tax-free institution.

One afternoon I was visiting Dr. Norman Bridge in his home in Los Angeles and as I came out Mr. Kerckhoff, who lived next door, beckoned to me that he wanted to have a word with me. What he said to me was, "I have been watching how through the research output of the Norman Bridge Laboratory Dr. Bridge's name and fame is now spreading through the world, and I want to do the same thing in biology that he has done in physics." Very soon thereafter he turned over a million dollars for the establishment of the Kerckhoff Biological Laboratories at Caltech.

I could name at least twenty other men, who in the years from 1920 to 1945, developed enough confidence in Caltech's objectives and management to put their funds into it, either by will or through irrevocable trusts to the extent all told of at least $40,000,000 by the year 1945.

In a word, under the daring and devoted leadership of the early founders, who could only picture in their dreams the great educational and scientific research institution which they had faith to believe would sometime rise here, a large number of later founders have also given themselves and their all to securely build substantial foundations for that structure which the coming generations will continue to build to greater and greater heights in the service of mankind.

FICTION LAGS AFTER TRUTH

by ROBERT G. CLELAND

When Amos Throop established Throop University sixty years ago, Pasadena had only about 5,000 inhabitants and the older members of the community could remember when Los Angeles County had neither public school, college, library, newspaper, nor Protestant Church. The town's chief assets were its climate, location, and the quality of its people, a people who to an unusual degree met the requirement laid down by a man of large experience and judgment who answered the question, "What should the emigrant bring to Southern California?" with the laconic but all-inclusive statement, "Religion, money, brains, and industry."

"Search the world around," said the author of the Board of Trade annual brochure for 1894, "enjoy the sunny clime of Southern France; wander among the Alpine valleys of Switzerland; indulge in daydreams under the cloudless skies of Italy; muse among the ruins that border the banks of the beautiful Nile; eat the luscious fruits of the tropics as you pluck them from the fronded branches of the Isles of the Pacific; even spend a winter in our own fair Florida; then, if you would know the one spot that most nearly approximates the ideal . . . come to Pasadena and make your home!"

Well, many thus invited came—and many have been coming ever since. So the Pasadena of today bears but faint resemblance to the Pasadena of that day—and the California Institute of Technology of 1951 bears even less resemblance to the Throop University of 1891. In both cases, "fiction lags after truth, invention is unfruitful, and imagination cold and barren." Of the institution of those distant years, however, I would at least say this: It lived through long, difficult, discouraging times because its founder had a stubborn, unquenchable belief in the inestimable value of education and because the members of its faculty made sacrifices that to many of us today seem foolhardy and quixotic to keep the faint flicker of light from going out.

Of the California Institute of Technology of today, it would be gratuitous for me to speak at length. But let me at least say this: The Institute is an integral, inseparable part of Pasadena. Its roots go almost as deep as those of this community. It has been served and nourished by your hands; in return it has brought you large material returns, an element in your population that any city in the world might envy, a more desirable prestige and reputation than any of your other institutions.

I confess, even at a dinner given by the city's Chamber of Commerce, that I do not know what new industries the presence of the Institute has brought to Pasadena. I do not know what funds are spent within the community under its government and corporation contracts, I do not know how large a part of its monthly salary and payroll expenditure goes to local merchant, house owner, professional man, tax collector, and charity. The sum total of all these things, I am sure, must be very, very large.

But the noblest debt that Pasadena owes to the California Institute, to men like Amos Throop, Robert

Millikan, William B. Munro, and Lee DuBridge, is not for what the Institute has done financially or industrially for Pasadena, but for what it has done for the nation, for society, for all mankind in the realm where values are not measured by the standards of the clearing house and market place, but by the enlargement of man's knowledge, his penetration into hitherto unexplored mysteries of the universe, his command of forces that seem to lie within the borders of the Infinite.

How can we evaluate or adequately recognize contributions of such magnitude, contributions that the whole world and all mankind will profit from not for a year or a decade, but, in some instances, at least, for as many generations as man shall live?

Of all Pasadena's many assets, the greatest and probably the most enduring is the California Institute of Technology. It is a city set upon a hill. "Neither do men light a candle and put it under a bushel but on a candle stick," said the great Teacher, "and it giveth light unto all that are in the house." For my purposes this evening I should like to shorten that last sentence so that it simply reads, "and it giveth light unto all."

THE FACTS ABOUT CALTECH

by L. A. DuBRIDGE

THE TWO PREVIOUS SPEAKERS have told you about how Caltech has developed from an obscure manual training high school to one of the great scientific centers of the country. It is a fascinating—an almost unbelievable story. It is a story about which those of you who have been very close to Caltech through the years have been well aware. Sometimes you have been even painfully aware of it. A big and hustling neighbor with a big and sometimes noisy family is bound to attract attention. And people are bound to wonder what this neighbor is up to—and whether he is really as important as he thinks he is.

Tonight I would like to ask you for a few moments to forget you are Caltech's neighbors. Let's pretend you are a stranger to the community—as I was a stranger just five years ago. Suppose you had never before heard of Caltech but were curious to find out about it. Suppose you came to me and said, "Look, I don't want any of your sales talk. I want the real facts about Caltech. What is Caltech's place in the field of education? What has Caltech done for the community and what has it done for the country?"

All right, let us look at a few facts. First, what is Caltech's place in the educational world?

First I take from my shelf the yearbook of the Association of American Universities. This is an organization of 37 of America's leading universities, each individually selected after a careful examination of the quality of its educational and research program, the quality of its faculty, the adequacy of its physical facilities. The membership list includes all the big name universities—Harvard, Yale, Princeton, Columbia, Cornell, Michigan, California, Stanford and the rest. Caltech has been a member of the A.A.U. for many years. Caltech is the only member whose student body numbers less than 4000 students. We have hardly more than 1000.

Why is Caltech classed as a *university* at all?

That is an interesting point, too. A Commission of the A.A.U., of which Wally Sterling and I are both members, has been making a statistical study of all the institutions of higher education in the United States—some 1700 of them. It was found necessary for various purposes to attempt a classification of these institutions—and in view of their very diverse nature this proved to be quite a task. But they finally ended up with the following classes: junior colleges, liberal arts colleges (like Occidental and Whittier), complex liberal arts colleges (like the Claremont group and a few others), separate professional schools (schools of medicine, of law, of theology, etc.) and universities. When all the schools had been sorted out into these classes there were two left over; M.I.T. and Caltech. They did not fit the class of separate professional schools which typically offer one degree for a fairly specific curriculum of study. On the other hand, most universities have a whole collection of schools and colleges—law, medicine, engineering, agriculture, journalism, liberal arts and so on. But there is one distinguishing feature of a university—a substantial program of graduate work and research. Caltech and M.I.T. certainly have these—so they were classed as universities.

So the educational world then recognizes Caltech as an important center of graduate work and research. What other evidence is there in this direction?

The next volume I take off my shelf is the membership list of the National Academy of Sciences. This organization was chartered by the U. S. Government under President Lincoln to advise the government on scientific matters. The Academy elects its own membership and restricts it to only 450 men and women in the whole country who have reached eminent positions of leadership in some field of science or engineering. Since there are at least 45,000 professional scientists in the country who might be eligible for election, you can readily see that only one scientist in 100 is a member of the Academy. There are about 300 scientists and engineers employed on the Caltech faculty. If the national average held, we should expect three of these men to be members of the Academy. The actual count is not three—but twenty-seven—nine times the national average. And, incidentally, one of the greatest figures in the history of the Academy during the past forty years, one who played a commanding role in guiding its critical role before, during and after World War I was Robert A. Millikan. And his close companion during those years in Academy affairs was that other great Pasadenan—George Ellery Hale.

Higher education and the war

I think everyone agrees that never in the history of this nation was the value of the nation's system of higher education more conspicuously exhibited than during World War II. Every institution placed its facilities loyally at the disposal of the government for training officers and technicians and for military research. There is hardly a college professor in the country who was not either in the service, or employed as a specialist by the government or engaged in one of these college and university programs of training or research. And what were the major or most spectacular achievements of American science in the field of new weapons of war? Everyone knows the answer. The atomic bomb, radar, the proximity fuse and the artillery rocket. The proximity fuse came largely out of the Carnegie Institution of Washington—a private research laboratory in Washington, D. C. at which several Caltech professors were engaged in the early stages. The principal university participators in the atomic energy program were the University of Chicago and the University of California. Radar came out of M.I.T.—and rockets from Caltech.

To whom does the Defense Department now turn as the present cold war gets warmer and as the needs of the military for scientific help get more critical? Again it turns to all universities and especially to those who rendered such conspicuous service before. Again it turns—with confidence and with expectations which are almost frightening—to Caltech. And again Caltech is prepared—far better prepared because of its recent experience than it was ten years ago—to render what assistance it can, in education and in research to contribute to the present and future welfare and security of this country.

And Caltech's services go far beyond what it does on its own campus. For sixty years—and more especially during the past thirty years—Caltech has been bringing to its campus each fall as freshmen some of the finest and most talented young men that could be found among the country's high school graduates. And after four years they have gone out to take their places in the world of science or engineering or industry or government service. And each year hundreds of graduates of this and other colleges all over the country come here for graduate-training and earn master's or engineer's or doctor's degrees. And so in every major government defense laboratory, in almost every major industrial laboratory, in scores of colleges and universities, Caltech alumni are advancing the fronts of science and engineering and are putting their knowledge to work to advance the welfare of mankind everywhere and to advance the security of their nation.

And as Caltech serves the nation it also serves its own community. Each airplane that comes out of a Southern California factory and flies from Los Angeles to all points on the globe is a better airplane because of knowledge of aerodynamics and aircraft design and structure which came out of Caltech laboratories. When you turn on your water faucet and draw a plentiful supply of pure water you can thank in part a group of Caltech engineers who helped lay out the Metropolitan Water District system and who helped design more efficient pumps to bring water from the Colorado River. When you pay your electric light bill remember that it would have been at least a little bit larger but for the work of the Caltech million-volt laboratory which helped make possible and economical the transmission of electric power over great distances. And some fine day a few years hence when you sniff the fine air of Southern California and find that smog is no longer the ugly irritant it once was, give a little prayer of thanks to a couple of Caltech professors whose ingenious work uncovered the chemical nature of the specific ingredients of smog which made it so unpleasant and so damaging to plants and animals and men.

Second to none

Yes, Caltech has come a long way since the day sixty years ago when Father Throop established in what was then a little town of 5,000 inhabitants a little school of mechanical arts. It has come a long way since that day in 1910 when President Scherer, in dedicating the new campus on California Street, said bravely to the entire student body of 40 students that Throop Polytechnic Institute was then embarked on a program aimed to make it a college of science second to none in the country. Brave words, indeed. And there must have been many who smiled and shook their heads at this boastful bit of academic fantasy. But it was not fantasy but prophecy. For already in 1910 President Scherer had enlisted the vigorous and farsighted interest of George Hale and those who knew George Hale knew he was a man who made his visions come true.

Caltech owes much to George Hale. It owes much to many another citizen of Pasadena and Southern California. It owes much to this entire community, for it is your institution. You, the citizens of this area, created it. You, the citizens of this area, support it. It will go on to greater achievements in exact proportion to your continued confidence and support.

THE WORLD'S WORST CORN CROP

Dr. Ernest G. Anderson, Professor of Genetics in charge of Caltech's Experimental Farm, records data on a dwarf descendant of corn seed exposed in the Bikini bomb test.

Corn from seeds exposed in the atom bomb tests helps Caltech biologists study the effects of radiation on plants and humans

At their eight-acre experimental farm in Arcadia, California, Caltech biologists have produced one of the world's weirdest corn crops. They have grown dwarf corn just a few inches high, plants without silks or kernels, plants with intricately twisted leaves and no ears, plants that wither in the noonday sun, and plants that give off a ghostly blue glow under ultraviolet light.

Most of these freak plants are descendants of seeds which were exposed in the Bikini atom bomb test in 1946 or in the Eniwetok test of 1948. They are invaluable in fundamental studies of heredity and transmitted traits, but the Caltech biologists are also using them to study the effects of radiation on food crops, on other plants and—indirectly—on human beings.

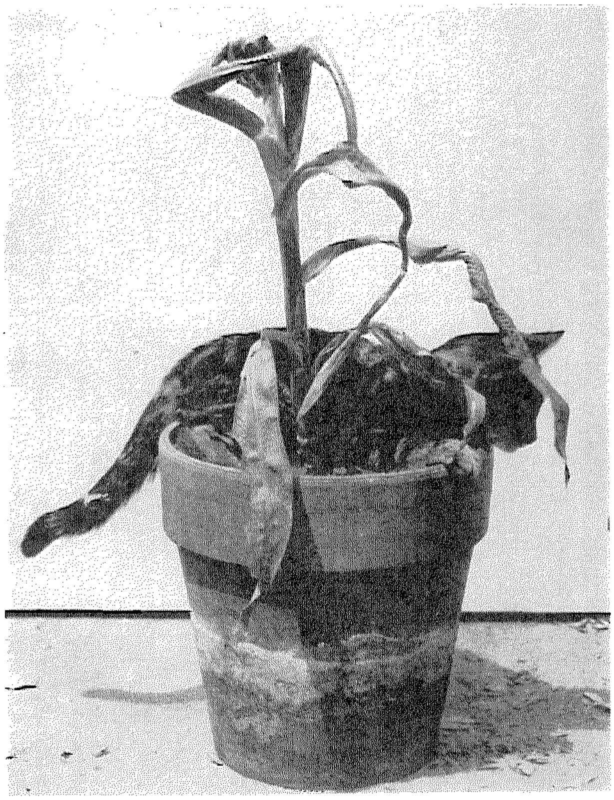
To measure the biological effect of an atom bomb explosion, Caltech researchers exposed normal corn samples to measured doses of X-rays. By comparing these with similar corn material from Bikini and Eniwetok it was possible to express bomb effect in terms of the X-ray dosage needed to produce an equivalent effect.

One Bikini sample, for example, showed an effect about equal to that produced by 15,000 roentgen units of X-radiation. (According to the Atomic Energy Commission's publication on *The Effects of Atomic Weapons*, from 3 to 300 units might be expected to double the normal gene mutation rate in man.)

To determine the frequency of chromosome damage in this Bikini sample, Caltech researchers studied the lateral branches of the corn tassels for evidence of semi-sterile pollen—a condition in which half the pollen, or male germ cells, is sterile.

About 31.5 per cent of the branches examined had semi-sterile pollen. Since this is a direct measure of the extent of gross chromosomal damage in the reproductive tissue, it means that 31.5 per cent of the structures which were potential germ cells carried gross chromosomal abnormalities induced by the radiation.

Some types of these abnormalities cannot be transmitted to the next generation. Others are transmitted to one-half of the offspring. If transmissible and non-transmissible alterations were equally frequent, about 4.7 per cent of the semi-sterile plants would be expected among the offspring. In actual fact, about 4 per cent were obtained—indicating that somewhat less than half of the chromosome alterations were transmissible.



The Experimental Farm's pet kitten furnishes a scale in this picture of an Eniwetok descendant which grows with tightly twisted leaves to a full height of only two feet.

In other words, among the plants grown from seeds exposed to the equivalent of 15,000 r, about 4 per cent of the pollen cells may be expected to transmit semi-sterility to future generations.

All in all, Caltech researchers have found hundreds of mutations in the progeny of seeds exposed at Bikini, and more than a thousand in descendants of seeds irradiated in the Eniwetok test. So many were discovered, in fact, that only the more interesting variations are being studied intensively.

The seeds exposed at Bikini, however, were commercial varieties in which many mutants might have occurred naturally. Careful analysis and selection reduced the number of mutations positively identified as radiation-induced in the Bikini "crop" to 60. This sifting was not necessary in the Eniwetok crop, since all the seeds exposed there were taken from stocks at the Caltech Experimental Farm which were known to be free of mutations and to have constant characteristics throughout.

The principal effect in the mutants as a group—in 46 of the 60 positively identified Bikini mutations, for example—was noted on chlorophyll, the green coloring matter of the plant. Many of these mutants showed a mottling or mosaic of normal green with abnormally pale green, yellow or colorless areas, and some were albinos.

The remainder ran the gamut of known mutations and added many more. Virtually everything described previously as a mutation has been picked up in the bomb-exposed material.

In one rather extreme type the seeds germinate prematurely on the ears. Ordinarily, a seed forms on an ear, matures, dries and germinates when it is planted in soil. But in some mutants one in four seeds is abnormal, germinates on the ear, and one hundred or more little corn plants may be grown directly from the ear.

Another type shows its abnormality only by fluorescing in ultraviolet light.

Paper strip chromatography used in studying the type known as Blue fluorescent-1 (found in Bikini progeny) indicated that one of the substances causing the glow under "black light" was anthranilic acid. Another chemical which the researchers found was a major constituent, has not yet been identified. They have learned, however, that it is converted into anthranilic acid by treatment with acid or alkali.

Six more blue fluorescent mutants are known—from Eniwetok and gamma-ray progeny. Three of these are of the first type (Bikini), all showing similar spots on chromatograms. Chromatograms of the other three blue fluorescent mutants showed fluorescent spots different from the first type. Little more is known about these, except that their blue glow apparently is not due to anthranilic acid.

Some of the seeds from A-bomb tests never grow. These evidently were exposed too close to the blast center. The distances from the bomb explosion center at which the seeds were exposed have never been announced by the Atomic Energy Commission. The Caltech findings are reported by lot number as supplied by AEC.

Some seeds start their growth in the soil but lack strength to push through the surface. Some extend only three or four inches above ground at full growth, while others grow naturally and reach maturity—only to have their progeny exhibit peculiar characteristics.

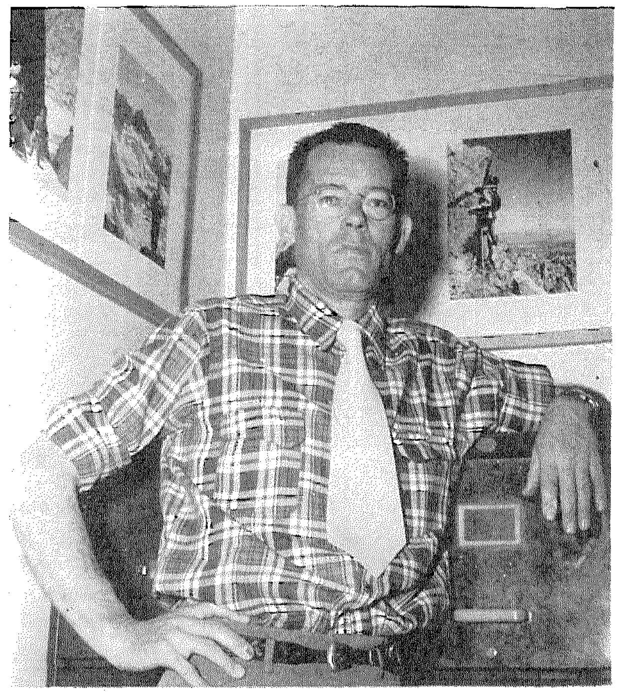
Further studies are being made in virtually all phases of this radiation genetics project at Caltech. Though the research is not designed to produce immediate practical applications, its results are potentially of great value.

"Because of the possible importance of the subject for the future of the human race," says the AEC's *Effects of Atomic Weapons*, "no discussion of radiation injury would be complete without consideration of the genetic effects."

The Caltech findings are helping to close what the AEC publication calls "the large number of gaps in our knowledge which make it hard to arrive at meaningful practical recommendations."

The work is being supported by the Atomic Energy Commission operating through the Office of Naval Research. Dr. Ernest G. Anderson, Professor of Genetics in charge of the Experimental Farm, heads up the project. His colleagues include Dr. Albert E. Longley, Research Associate in Biology, and Drs. E. E. Dale and Howard J. Teas, Research Fellows in Biology.

JAMES BONNER



JAMES BONNER, Professor of Biology at the Institute, is one of the country's outstanding biochemists and plant physiologists. It was, however, by the merest chance that Bonner decided to go into the field of plant physiology at all.

When he graduated from the University of Utah in 1931 with a B.S. in chemistry, Bonner had his choice of a graduate fellowship in chemistry at the University of California, or one in biology at Caltech. The deciding factor in favor of Caltech was the memory of a particularly pleasant year spent here as a college junior in 1929-30. Bonner's father, head of the Chemistry Department at the University of Utah, took a sabbatical year in 1929-30. When he decided to spend it working in the Caltech laboratory of one of his old students, Don Yost, the two oldest Bonner boys came along with him as scholarship students at the Institute.

James Bonner arrived in Pasadena on a Sunday to start his graduate work. Though he had chosen to work in the field of biology, he had no clear idea of what he wanted to do in that field, and he headed immediately for the Caltech campus, impatient to talk over his problem with someone in the Biology Division.

The Biology building was locked, but Bonner saw signs of activity in one of the basement labs and pounded on the window. K. V. Thimann (now Professor of Plant Physiology at Harvard) and the late Herman E. Dolk, first Professor of Plant Physiology at Caltech, were hard at work in the lab. They stopped to let Bonner in. Then, since they were the only people in the building, Bonner sat on a stool in their lab, looking on, as they went ahead enthusiastically with their efforts to isolate a new plant growth hormone—a chemical substance produced in the growing tips of plants which is essential to the growth of the stem, flower stalks and other parts of a plant.

When Thimann and Dolk knocked off work for the day they invited Bonner home to dinner with them. By the end of the evening it was obvious to the new graduate student that there was no more exciting, stimulating or challenging field of biology than plant physiology.

Probably a good many other distinguished careers in science have been launched by just such unscientific methods.

There was, though, nothing capricious about Bonner's decision to work in the field of plant physiology. He was trained in chemistry and interested in biology, and this was an ideal combination of the two—a biological subject which could be approached from a chemical standpoint.

James Bonner got his Ph.D. in 1934. He was the first graduate student to get a degree in plant physiology at Caltech. In that same year he went as a National Research Council Fellow to Holland and Switzerland.

In 1935 he returned to Caltech, and he has been on the faculty here ever since. His research, which has already resulted in the publication of well over 100 papers, has ranged over the whole field of plant physiology. He was in on the beginning of the Caltech research on plant growth hormones which led to the isolation of the growth substance, indoleacetic acid or auxin. This and related active substances are now produced synthetically and used universally to control many varied aspects of plant growth.

His work on growth hormones led next to a study of the role played by vitamins in plants. With A. J. Haagen-Smit, Professor of Bio-organic Chemistry at the Institute, and James English, Jr., now Professor of Chemistry at Yale University, Bonner then began a study of the substances given off by injured tissue that have to do with wound healing in plants. This work led to the chemical isolation of a wound hormone in pure form. This substance, which the Caltech group named traumatic acid, is also now produced synthetically.

In 1938 Bonner began an investigation of what makes plants flower—an investigation which is still going on and which has resulted in methods for the regulation of flowering in some kinds of plants.

During the war he was engaged in a study, for the

Emergency Rubber Project of the United States Department of Agriculture, of natural rubber production. The work involved basic research on the chemistry and physiology of rubber production in the rubber forming plant, guayule, which was shown to be a practicable source of natural rubber.

In addition to these projects, most of which are still continuing, Bonner has engaged in general investigations of proteins, enzymes and viruses in plants.

One of his major continuing projects, however, is the study of plant sociology. This is a logical extension of his original work on growth hormones, which, simply, are substances produced in one part of a plant which tell other parts what to do. Bonner's specific interest in plant sociology is in the chemical substances produced by one plant which tell another plant what to do.

Working with Reed Gray (now Biochemist with the Pineapple Research Institute of Honolulu) Bonner set out to discover why a low desert plant known as brittle bush always grew with no neighboring plants around it —and discovered that its leaves gave off a chemical which inhibited the growth of nearby plants. By its toxic action the plant helped determine what other plants would grow in association with it—and assured itself of adequate food and water.

Not only did this work result in further evidence that the sociology of plants is chemical, as opposed to that of animals, and man—which is psychological—but it resulted in the isolation of the substance in the leaves of the brittle bush which inhibited the growth of other plants. Gray and Bonner produced it synthetically and discovered it could be used successfully as a selective weed-killer.

If there was a certain element of chance in Bonner's becoming a plant physiologist, there was never any question of his becoming anything but a scientist.

James was the oldest of the seven Bonner children. Both his father and mother were chemists. Not until the children reached school age and went out into the world did they know of such things as sugar, salt and water. In the Bonner household things were called by their right names, and what they asked to have passed at the dinner table was sucrose, sodium chloride and H_2O. As soon as each of the children got to be about six or seven years old he began to be taken regularly to his father's chemistry laboratory at the University of Utah, where he was allowed to putter around, wash test tubes and generally soak up the atmosphere. Naturally, then, the Bonner children grew up to believe that what people do in the world is work in laboratories. Most of them have grown up to do just exactly that.

James has been Professor of Biology at Caltech since 1946. His wife, Harriet, is herself a Ph.D. (mathematics). They have two children—a girl, Joey, who's 3, and James, 1.

Lyman, the next to the eldest Bonner, got his Ph.D. in Chemistry at Caltech in 1935, taught at Duke University, and is now Technical Director of the Allegheny Ballistics Laboratory.

Priscilla, the only Bonner girl, missed out on Caltech but got an M.S. in biochemistry from the University of Illinois. She is married to an organic chemist, James Horton, who is Associate Professor at the University of Utah.

David got his Ph.D. at Caltech in 1940. He's now Associate Professor of Microbiology at Yale.

Robert was a graduate student first at Brown University and then at the University of Wisconsin. After a short time at this, however, he had to confess that he got very little pleasure out of life in a laboratory—in fact he thought it was downright dirty work. The rebel is now an applied mathematician, working for the Carter Oil Company in Tulsa, Oklahoma.

Walter, who got his Ph.D. at Caltech in 1946, went first to Harvard and has now been in England for three years as a biochemist at the Molteno Institute of Cambridge University.

Francis got *his* Ph.D. from Yale in 1944 and is now Assistant Professor of Chemistry at Brooklyn College.

Two sides of the family

Of the six brothers, three (James, David and Walter) are biochemists of one kind or another, and three (Lyman, Robert and Francis) are physical chemists—or rather, two of them are physical chemists and the third is the renegade mathematician. Though the whole family rarely manages to get together anymore, the three biochemist brothers remain fairly close and see a good deal of each other, as do the physical chemist Bonners.

The two family groups have other distinctive characteristics—to the point where they would seem to be a psychologist's delight. The biochemist Bonners have always been terrible spellers, for instance, while the physical chemists have never had any trouble in this department. The biochemists are all average-sized men; the physical chemists are all roughly six feet in height. The biochemists are avid skiers and mountain-climbers; the physical chemists are sedentary.

Among the biochemists, James is by far the *most* avid skier and mountain-climber. He still remembers Utah as an ideal place to live because he could put on his skis at the kitchen door and be gone all day without having to take them off until he got home. And mountain-climbing, today, often occupies as much of his time as his plant research. In fact, he's almost as proud of the fact that he has been elected to the American Alpine Club, served on the executive committee of the Southern California Chapter of the Sierra Club, and (in 1948) was chairman of the club's Rock Climbing Section—as he is of his numerous scientific honors. Specifically, these include the vice-presidency of the Western Society of Naturalists (1946), vice presidency (1947) and presidency (1949) of the American Society of Plant Physiologists, chairmanship of the Physiological Section of the Botanical Society of America (1949), and election to the National Academy of Sciences in 1950.

TYPHOON

A Report from the Pacific

by LEWIS L. GRIMM

Lewis L. Grimm '44 is Executive Officer of the U.S.S. Gloucester, a destroyer escort in the Pacific. The following account is an extract from one of his letters, written while his ship was operating off Sasebo, Japan, in October, 1951.

On October 14th, when the typhoon was starting to blow, I had no idea what was to happen before the night was over.

I went to bed about 2200 and was just going to sleep when General Quarters sounded and the word was passed over the public address system to "Go to your abandon ship stations. Collision is imminent."

I climbed out of my bed and struggled into my foul weather gear and life jacket. While I was wrestling with my life jacket, word was passed to "Stand by for collision forward. All hands to their abandon ship stations." Of course, my stateroom is the one that is furthest forward.

I hurried outside and up to the bridge, and there about 50 yards in front of us was the *Bryce Canyon,* a large tender who had broken her mooring and was being blown right toward us. The Captain was trying to maneuver the ship by twisting it so that the bow of our ship would be pointed toward the *Bryce Canyon* when she hit us. There was a tug trying to push her, but it wasn't doing too well. When the *Bryce Canyon* was about 30 feet away (which is awfully close for a ship that size) her engines took hold and she slowly pulled away from us. Before long the Captain of the *Canyon* had her anchored near her buoy and everything was calmed down (except the water and wind).

I went back down to the wardroom and was waiting for some of the officers to drink their coffee while we visited, when the word came over the P.A., "Stand by for collision."

I dashed back to the bridge, and there, bearing down on us, was a huge floating crane that had broken loose from the pier at the beach. She had no power and was headed right for us. Fortunately, the tugs that had been there to help the *Bryce Canyon* were only about 100 yards away, and they got the crane under control and back to the pier in short order.

By the time I returned to my room I was soaking wet, for despite the fact that I had on foul weather gear, the 60-80 knot winds had blown the water in around my neck and sleeves and soaked me. I had just gotten out of my wet clothes and was going to take a warm shower, and then try to get some sleep, when there was a loud snapping noise and a terrific shudder through the ship, and the general alarm started sounding again.

I jumped into some dry clothes, put on my foul weather gear and headed for the bridge. Everything was confusion, for we had broken loose from the buoy and were drifting toward an English destroyer that was anchored astern of us. We managed to get the ship under control and though the space to maneuver was small we soon had our ship back by the buoy.

We dropped the anchor and then the Captain slowed down the engines to see if the anchor would hold. It didn't, and there was an exciting hour while we dragged the anchor all over the harbor, just missing the *Bryce Canyon,* the English destroyer, the floating crane, and the land alongside the channel.

The poor English destroyer was quite upset. She kept thinking we were going to ram her, and I'll admit she had good reason to worry, for at least five times we nearly lost complete control and drifted to within 50 yards of her.

The English "can" sent us quite a few messages by blinker light. The night before, when the wind changed direction, she sent us a message, "Are you drifting?" We sent back "No." The trouble was that when the wind changed direction all the ships in the harbor started to swing around their buoys to line up with the new direction of the wind. The *Gloucester,* however, swings the opposite direction from the way it should, and the English destroyer thought we had broken our moorings.

After we had just missed the English ship for the third time she sent over a message that there was plenty of room to anchor on her port side. I don't know how our message affected their Captain, for we sent back, "We are anchored now." Of course we were still dragging our anchor all over the northwest corner of the bay. Earlier in the evening the strain had broken our anchor windlass and while we could lower the anchors "by gravity" we could not raise them up again. Therefore, we had no choice but to plow up the bottom of the bay. We finally maneuvered the ship into position, and by easing the strain on the anchor by using the ship's engines we were able to stay there.

The Captain wanted to drop the starboard anchor too, but we were in a bit of a bind there. You only have two anchors, and two anchor chains, so when we moored to the buoy we used the starboard anchor chain. This is easy enough to do, for you simply put an iron bar through the anchor chain where it goes through the deck, and then let the anchor out until the bar reaches the hole in the deck. The bar, which reaches across the hole like a cuff link, keeps the chain from going any further. Then you break the chain between the hole in the deck and the windlass and run this piece of the anchor chain that remains on the ship out through the bullnose of the ship to the buoy.

Dropping the anchor

All we had to do now was pull the chain back through the bullnose, fasten it to the starboard anchor, knock the bar out of the chain, and the anchor would drop. Our first problem was the fact that the chain that was hanging through the bullnose—15 fathoms, or 90 feet of it—was wrapped around the port anchor chain, and we couldn't get it loose. Of course the 80-mile-an-hour winds across the deck were no help either. When we saw we couldn't get the chain loose from the port anchor, we broke the chain again and then tried to connect this chain to the starboard anchor.

I went down to the deck where my room was and had just taken off my life jacket when someone said, "Look—there goes that crane again." I looked out the door and there was the crane, gliding by, about 50 yards away. I slipped into my life jacket and headed outside. Then I discovered it wasn't the crane that was moving—it was *us*.

When I got to the bridge I found we'd lost the anchor and 90 fathoms of chain and now we were steaming around trying to keep in the area of our buoy. Again we steamed close to the British "can" and once when we lost control of the ship, went within about 50 feet of the beach.

We must have steamed around for about an hour when we received another message from the destroyer, "Are you planning to stay underway all night?" The Captain sent back, "I haven't decided yet."

Everyone was dead tired, so the Captain sent a message for assistance. He decided he'd try to get the ship back to the buoy and then run our chain over and shackle it to the buoy.

But the shackle had broken, and we didn't have any on board large enough to hold.

The Captain then sent a message to the Officer in Charge, explaining our situation and asking if he had a shackle. In a few minutes the two tugs came out from the inner harbor and were alongside. I went down to the pilothouse to inform the Captain that the tugs had orders to take us into the inner harbor and tie us up to the dock. The Captain didn't want to do this.

"Mr. Grimm," he said, "take the conn while I go outside and talk to the tugs," and he opened the door and out he went. This was all right, except that I had never had control of a ship when there wasn't a lot of room in which to maneuver. I looked out and my heart came right up into my throat. We were going straight ahead, and about 200 feet in front of us was the floating crane. Fortunately I recovered rapidly, gave back one-third on the port engine, stopped the starboard engine, then backed two-thirds on the port engine, and when the ship started to swing, I backed two-thirds on all engines and the ship started moving away from the crane.

I was surprised that the ship handled as well as she did, for the wind was doing better than 60 miles per hour. I was starting to steam around in our little circle when the Captain came back into the pilot house and said that the tugs wouldn't try to put the chain over the buoy, and he wasn't going to try to take his ship through the narrow entrance into the inner harbor. He reasoned that since he had been steaming, more or less, for several hours already and hadn't hit anything, he would rather take his chances going ahead.

There was a little confusion by this time, for the two tugs had fastened on to the ship and were trying to push us through the entrance into the inner harbor. The Captain became quite expressive in telling the tugs to get away from his ship.

As soon as the Talker told the Captain that the tugs were clear of the ship—meaning that the lines were cast off—the Captain ordered all engines ahead two-thirds. The wind had blown us around so we were no longer headed toward the entrance to the inner harbor, and one of the tugs was about two feet in front of us on a course perpendicular to ours. Fortunately we were going quite slowly when we hit the tug, so that we didn't do very much damage.

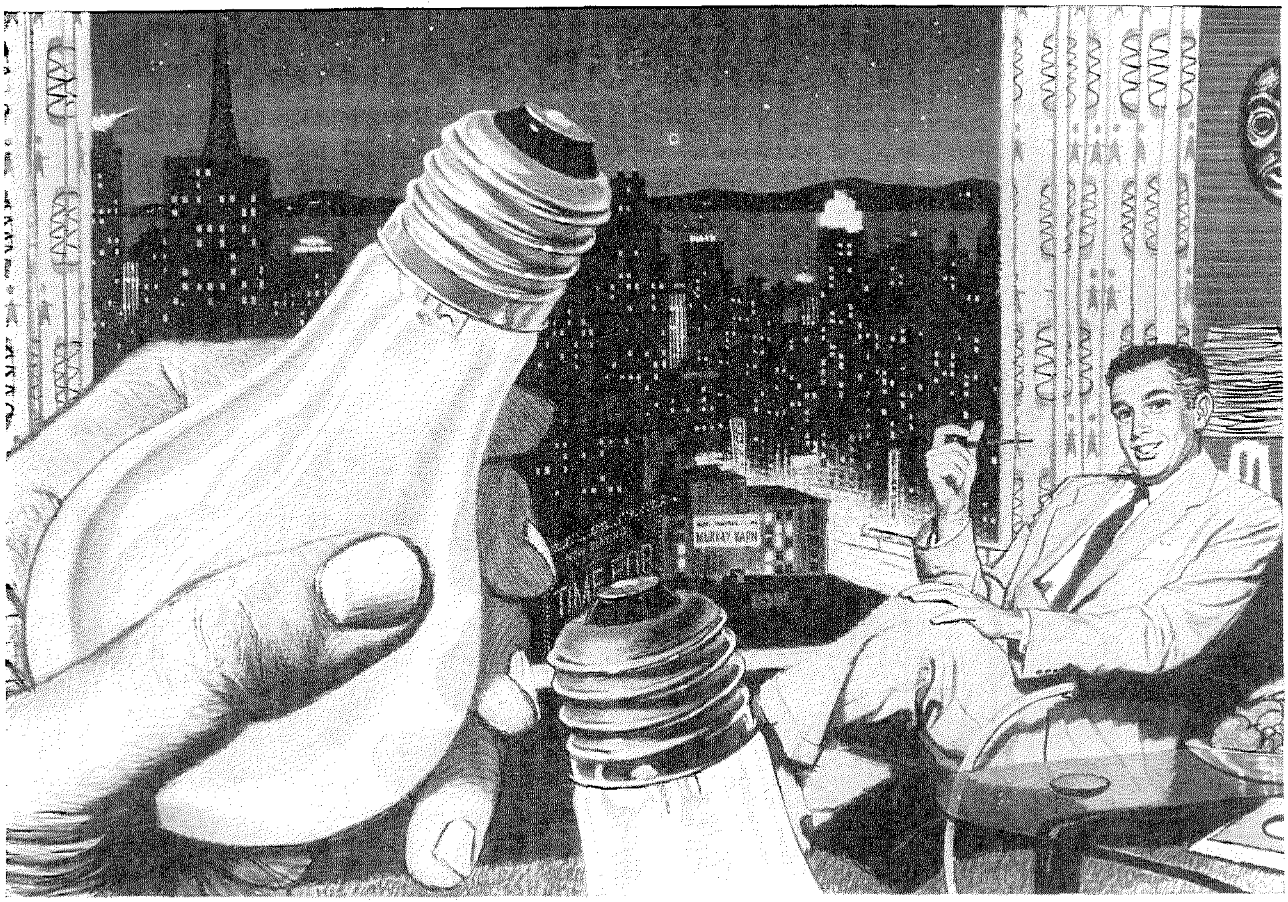
The wind slows down

I was looking forward to a long stay on the bridge when we noticed that the wind was slowing down. It is almost unbelievable, the speed with which the velocity of the wind decreases. The First Lieutenant informed us that he was ready to let go the starboard anchor, so we ran the ship to a favorable position near our buoy and dropped it. The wind had died down enough so the anchor held the ship in position, and we were soon back to near normal.

Of course, it was getting late by this time—about 0600 in the morning. It was a group of soaked and dead-tired officers and men who hit the sack, and we didn't bother to hold reveille for all hands at 0630 as we were supposed to.

The next afternoon they sent a crane out to help us get our starboard anchor up. The crane would fasten on to the anchor near the waterline, and lift it up above our deck, and then the men would pull the chain in a few feet. They kept this process up until 60 fathoms of chain were all on board, and then fastened what was left of our port anchor chain to the buoy.

Early the next morning we were underway to escort a ship up to the battle line near the 38th parallel on the east coast.



Small Change adds up to Millions

Perhaps you've noticed that lamp bases, traditionally made of brass, now are being made of aluminum. There's a story behind this change and it tells a lot about the kind of jobs going on at Alcoa.

It started several years ago when engineers of two leading lamp manufacturers agreed with our suggestion that bases of aluminum would cost less. "But will they be as good . . . will we have to revise our methods?" they asked.

The potential savings, a few mills per lamp times the 830 million sold each year, made finding the answers worth-while. Together we started two long-range research projects. One, to test aluminum alloys in the weather, fumes and years of standing idle that lamps must endure. The other, to find the alloy that would take five progressive draws, then thread rolling and finally, the high temperature of the red-hot glass that is poured in the base.

We tested samples, changed alloys, varied tempers, rolled different thicknesses. Lamp manufacturers tried each, until one met all requirements. Our development men worked long hours to get the right solder and flux to join the side wire to the base. Adapted them to the high-speed, lamp-making machines.

All this time, the manufacturers had aluminum bases installed in seacoast and industrial atmospheres. Our laboratories ran other tests on lit and unlit lamps under corrosive conditions. After 1½ years the reports came in: Aluminum bases measured up in every respect: conductivity, corrosion resistance, ease of installation and removal.

This is typical of the research and development jobs now underway at Alcoa. And others are waiting for the men with the skill and imagination to tackle them. ALUMINUM COMPANY OF AMERICA, 1825 Gulf Building, Pittsburgh 19, Pennsylvania.

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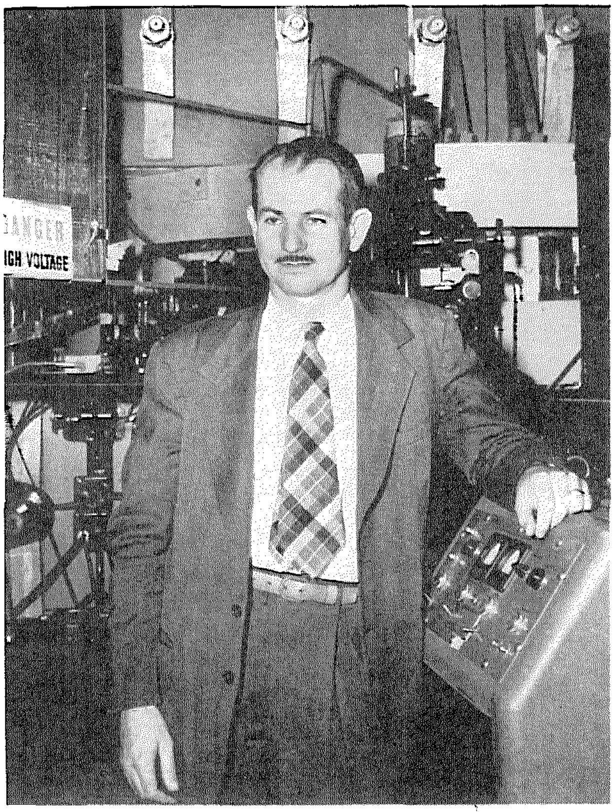


Edwin M. McMillan

THE MONTH AT CALTECH

Nobel Prizewinner

Edwin M. McMillan, co-winner of the 1951 Nobel Prize for Chemistry, is the fourth Caltech scientist to be awarded this highest of all scientific honors. The others: R. A. Millikan, who received the award in physics in 1923; Thomas Hunt Morgan, honored in 1933 for his research in heredity; and Carl Anderson, whose discovery of the positron won him a physics award in 1936.

Dr. McMillan graduated from Caltech in 1928, received his M.S. here in 1929, and his Ph.D. from Princeton in 1932. In that same year he went to the University of California at Berkeley as a National Research Fellow. He has been on the faculty at Cal ever since, and has been Professor of Physics there since 1946.

Dr. McMillan shares this year's Nobel Chemistry Award with his colleague at the University of California, Dr. Glenn T. Seaborg, Professor of Chemistry—for their joint discoveries of six new radioactive elements used in the development of atomic energy.

There were 92 basic elements when the physicist McMillan and the chemist Seaborg began their work. McMillan then produced a 93rd element, the first one heavier than uranium, which he christened neptunium (Neptune being the planet immediately beyond Uranus in the heavens). He was working toward the creation of element 94, plutonium, when he was called to the Massachusetts Institute of Technology as one of the organizers of the work on radar in 1940.

Seaborg went ahead with McMillan's research project and within a few months he and his associates produced plutonium, which proved to be a vital element in the construction of the atomic bomb. While working on the atom bomb project during the war, and after his return to the University of California, Seaborg produced, one after another, elements 95 (americium), 96 (curium), 97 (berkelium) and 98 (californium).

During the war Dr. McMillan not only worked on microwave radar, but assisted in the development of sonar at the Navy Radio and Sound Laboratory in San Diego, California, and later joined the Los Alamos Scientific Laboratory. McMillan helped Prof. J. Robert Oppenheimer organize the lab for the development of the atomic bomb. He was in charge of early development of the Hiroshima bomb and later worked on the Nagasaki type bomb. He returned to Berkeley in 1945.

In addition to the work which won him the Nobel award, Dr. McMillan is also responsible for the theory of phase-stability, which has made possible the construction of powerful new types of particle accelerators to create matter out of energy—the synchrotron, synchrocyclotron, cosmotron and bevatron.

McMillan and Seaborg are to receive their $32,000 award from King Gustav Adolf in Stockholm on December 10, the anniversary of the death of Alfred E. Nobel. It's the first time that a single American institution has produced two Nobel prizewinners in one year, and it

CONTINUED ON PAGE 26

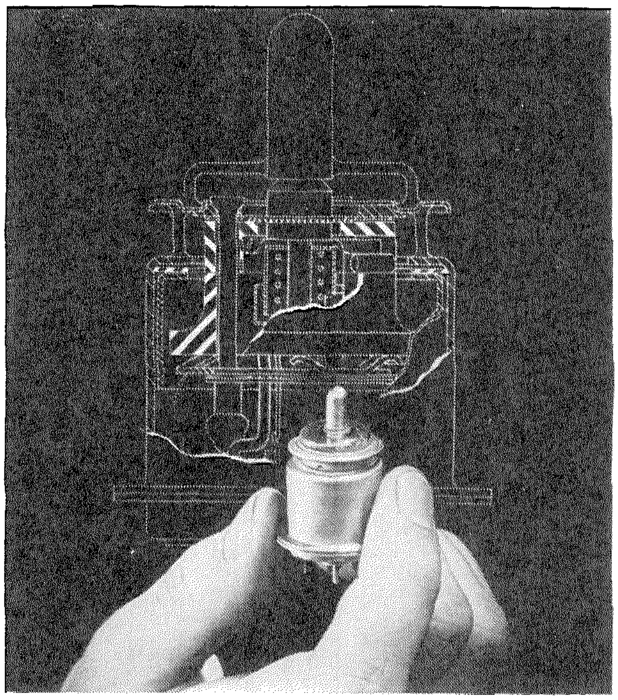
THIS MIDGET TUBE WAS A MIGHTY CHALLENGE

It had Bell Telephone engineers scratching their heads.

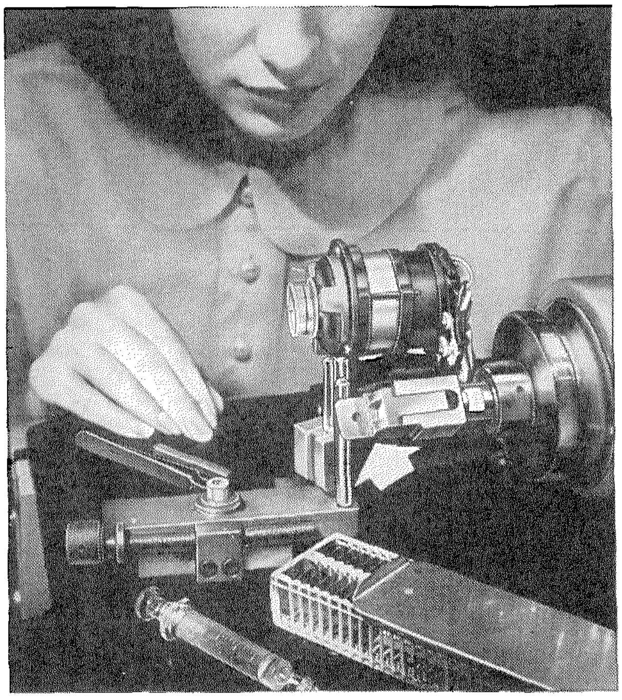
A new kind of electron tube was needed for coast-to-coast *Radio-Relay*. It had to amplify a wide band of super-high-frequency signals. It had to relay them, without distortion, every thirty miles across the country.

That meant splitting hairs. For the working elements of the new tube would have to be five times closer together than in any other tube. And that's mighty close — 6/10 mil between grid and cathode; grid wires 1/3 mil thick, and wound a thousand to an inch.

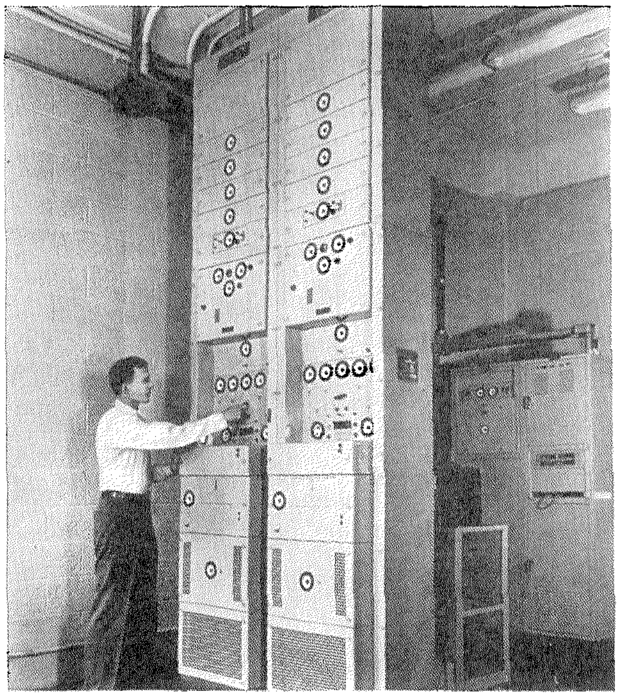
What's more, the tube had to be designed for assembly-line production, then installed and maintained, and its performance on the job analyzed.



The walnut-size midget was developed and the first samples were made by scientists in the Bell Telephone Laboratories. It was a joint project, involving electrical, mechanical and chemical engineers, and skilled ceramic, metallurgical and other technicians.



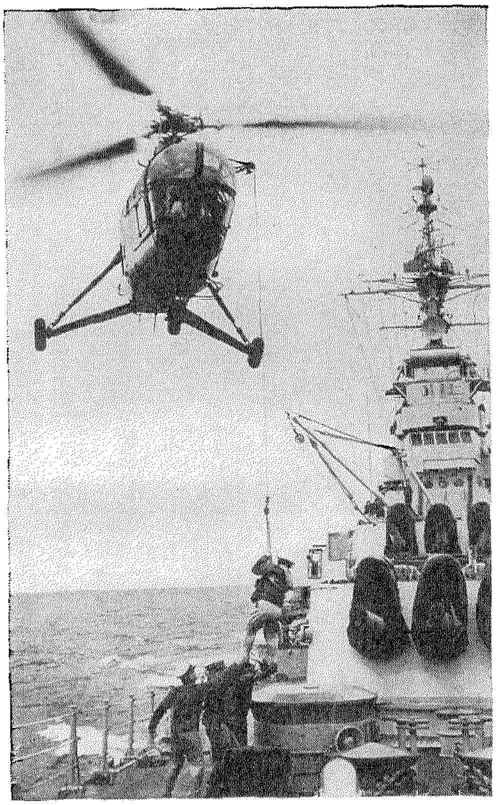
Quantity production of the (416A) tube was a job for Western Electric, the manufacturing unit of the Bell System. Work had to be done under microscopes. Western's engineers designed new equipment, worked out details of assembly, devised ways to develop skillful workers, simplify operations, keep assembly areas surgically clean.



Engineers in the operating companies and A. T. & T.'s Long Lines Department continually study the performance of the "Mighty Midget" as it plays its part in speeding telephone calls and television programs across the nation. From their studies will come more challenging problems for—and more solutions from—Bell System engineers.

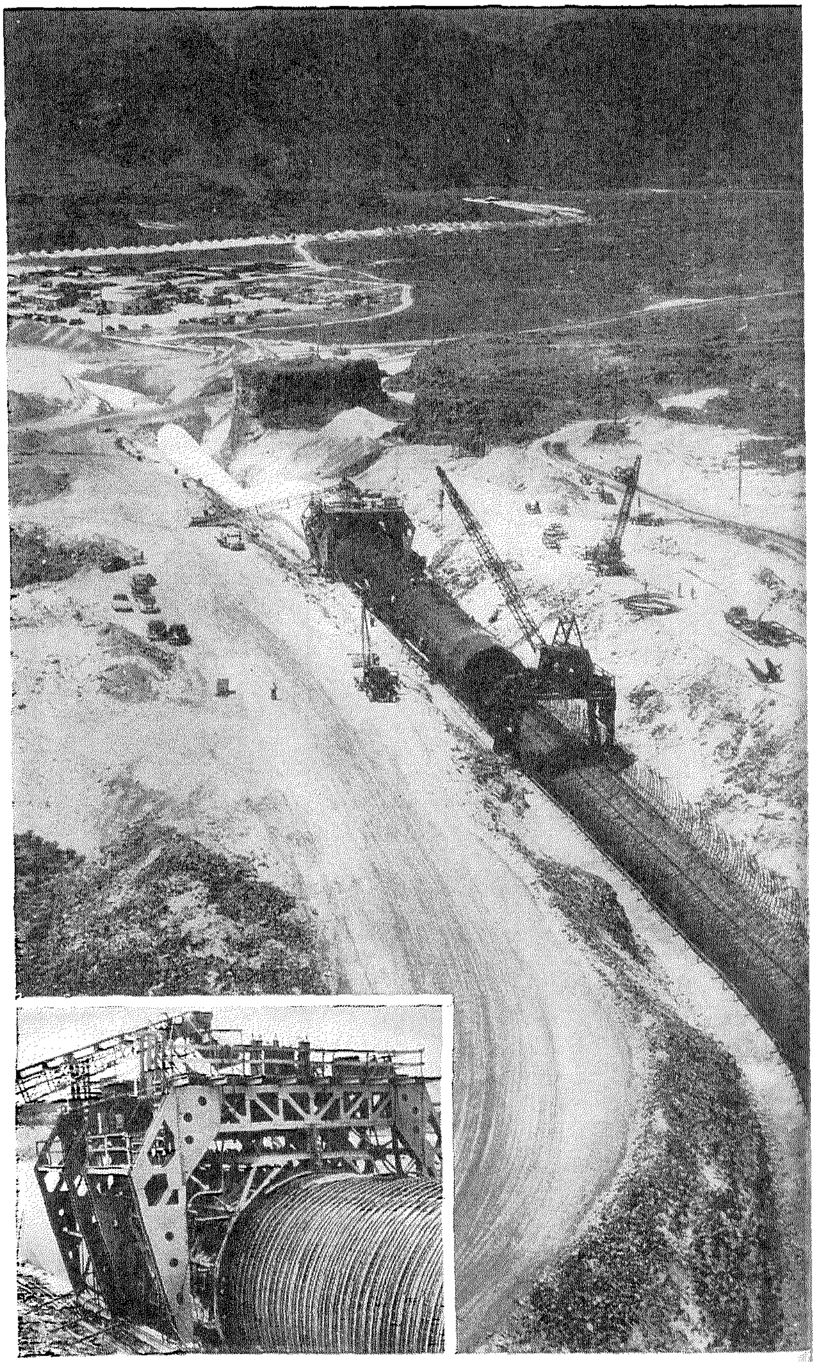
BELL TELEPHONE SYSTEM

Only STEEL can do



MISSION OF MERCY. Here, a Naval medical officer is being hoisted aboard a helicopter to bring quick medical aid to an injured sailor on another ship. All-out defense requires vast quantities of steel. And U.S. Steel's capacity, far larger now than ever before, is being still further expanded to help meet both defense and everyday needs.

WHEN TIN ISN'T TIN. This young man's baby food comes to him perfectly protected against contamination by airtight "tin" cans. But those tin cans are really *steel* cans . . . about 97% steel, with a very thin coating of tin. And U.S. Steel makes thousands of tons of tin plate every year to be used in forming billions of cans to safeguard food, oil, paint, and other items.



SIPHON WITH A STEEL THROAT. Extending around the north end of Soap Lake in the Grand Coulee area, this huge siphon, more than 22 feet in diameter, will carry irrigation water from an elevation of 1320 feet down into a 215-foot dip in the land's profile, and up again to an elevation of 1301 feet. The siphon is steel-lined concrete pipe. The 3400 tons of steel plate used to fabricate the liner sections were supplied by U.S. Steel, while the outside traveler and form (inset) and the inside traveler and collapsible ribs, were especially fabricated by U.S. Steel for the casting of this large conduit.

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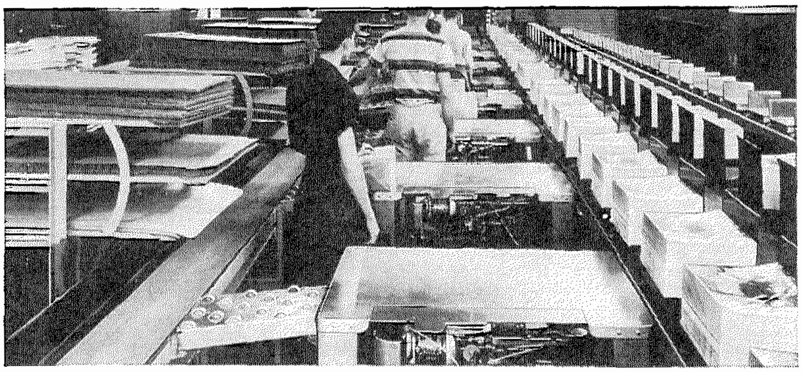
so many jobs so well...

EASY ON THE BACK. When it comes to shoveling snow, you'll agree that this machine is a great improvement over the old hand shovel. Just as U·S S COR-TEN Steel, of which it is made, is a great improvement, for many purposes, over ordinary steel. For COR-TEN permits equipment like this to be built *lighter*, and yet to possess the great strength and rugged resistance to abrasion and corrosion essential for satisfactory performance. Only steel can do so many jobs so well.



MODERN MAILING ROOM. Ever wonder how all those millions of magazines that are printed every month in America are packaged for shipment? Many of them are tied into wrapped bundles with Gerrard Round Steel Strapping, made by U.S. Steel—on Gerrard Model Q semi-automatic tying machines like these.

FACTS YOU SHOULD KNOW ABOUT STEEL

Steel costs less than every other metal in the world. It is cheaper per pound than the cheapest material from which clothing is made. It is cheaper than the lumber that goes into your home. It is even cheaper than the pulp upon which your daily newspaper is printed.

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means that the University of California's Berkeley campus now has six Nobel winners. The four others: E. O. Lawrence, William F. Giaque, Wendell M. Stanley, and John H. Northrup.

Geochemist

PROFESSOR HARRISON S. BROWN of the Institute for Nuclear Studies at the University of Chicago will join the Caltech faculty about December 1 as Professor of Geochemistry in the Division of the Geological Sciences.

Professor Brown's contributions to scientific progress won him the $1,000 Prize of the American Association for the Advancement of Science in 1947 for his work on meteorites. At the American Chemical Society Diamond Jubilee meeting this fall he was announced as recipient of the $1,000 ACS Award in Pure Chemistry to be presented next spring.

His scientific contributions are all the more remarkable because many of the results of his work from 1942 to 1946 have not yet been published—and may not be for some time. During that period he worked first as a Research Associate on the University of Chicago Plutonium Project and then as Assistant Director of Chemistry at the Clinton Laboratories, Oak Ridge, Tennessee. His contributions here were fundamental to the plutonium process developed for the Hanford, Washington, atomic project.

Brown's main interests have been in problems of the chemical composition of the universe and the planets—which involves work in the fields of chemistry, astronomy and geology. His war duties, however, caused him to suspend this research until 1946, when he went to the Institute for Nuclear Studies and the Department of Chemistry at Chicago as an Assistant Professor. He became an Associate Professor in 1948.

A native of Sheridan, Wyoming, where he was born September 26, 1917, he moved to San Francisco at the age of ten. In 1938 he received the Bachelor of Science degree in chemistry at the University of California. He was awarded the Ph.D. degree in chemistry at the Johns Hopkins University in 1941, after serving his last year in graduate work there as a DuPont Predoctoral Fellow. He then spent a year at Johns Hopkins as an Instructor of Chemistry before taking up his war work. His research at Johns Hopkins concerned the chemistry of the fluorine compounds which were to become important in manufacture of the atomic bomb.

His war work gave him a vital interest in the social problems created by the bomb. Since 1947 he has been Executive Vice Chairman and Trustee of the Emergency Committee of the Atomic Scientists. His book, *Must Destruction Be Our Destiny?* was published the year before. He was co-author of *Years of the Moderns*, published in 1949, and is editing, for the Rockefeller Foundation, the *International Compilation of Meteorites and Their Properties*, to be published in three volumes in 1953.

Harrison Brown

He also has published some 30 scientific papers in the fields of mass spectroscopy, thermal diffusion, fluorine and plutonium chemistry, meteorites, geochemistry and planet structure.

He is a member of the American Chemical Society, American Physical Society, American Meteoritical Association, American Astronomical Society, American Association for the Advancement of Science, Sigma Xi and Phi Beta Kappa.

Postwar research

In the comparatively brief span since Professor Brown returned from his war endeavors to basic scientific research he has laid a theoretical background for relating the composition of meteorites to the earth, other planets and the sun. He has found that the planets of our solar system were formed by condensation at relatively low temperatures from a medium chemically similar to the sun and other stars. A single cosmic catastrophe millions of years ago accounts for all the meteorites which have struck the earth, he believes. In this research Professor Brown has contributed fundamental facts for consideration in any theory attempting to explain the origin of the earth—perhaps our most fundamental geologic problem—and of the entire solar system as well.

"Professor Brown is one of the most brilliant young workers in the field of geochemistry in this country," says Dr. DuBridge. "We feel that his high qualifications as a physical chemist coupled with his keen interest in the geological aspects of this field will bring about a more intimate tie between the earth sciences and the work of our physics and chemistry divisions. This is in keeping with the Caltech tradition that cooperation

CONTINUED ON PAGE 28

German crowd, part of the 1,250,000 from East and West Berlin, sees a typical RCA television program.

"Freedom's window in the Iron Curtain"

You've read the story of last summer's TV demonstrations in Berlin. It attracted a million and a quarter Germans – including thousands who slipped through the Iron Curtain to see Western progress at work.

Behind this is another story: How RCA engineers and technicians broke all records in setting up these Berlin facilities. The project called for a TV station and studio, a lofty batwing antenna, and the installation of 110 television receivers at strategic points. Such a program would normally take several months to complete. It was installed and put to work by RCA in a record-breaking 85 hours!

Programs witnessed by Berliners included live talent shows, sports events, news commentaries, and dramatizations of the Marshall Plan. Observers pronounced reception fully up to American standards – another impressive demonstration of democracy's technical ingenuity and leadership.

* * *

See the latest wonders of radio, television, and electronics at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.

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Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
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World Leader in Radio — First in Television between the various fields of science and engineering provides the most fruitful atmosphere for productive research."

Lewis Medal

PROF. LINUS PAULING has been selected as the first recipient of the Gilbert Newton Lewis Medal of the California Section of the American Chemical Society.

The award commemorates the late Professor Lewis of the University of California, one of America's noted theoretical scientists. It is to be presented to American chemists who have made significant contributions to the theoretical aspects of chemistry.

The Lewis Medal was presented to Professor Pauling at the formal dinner meeting of the California Section in Berkeley, November 27.

The first California Section Medal was also awarded at that time to Professor C. H. Li of the University of California. This medal is to be presented annually to a scientist under 40 years of age who has made a major contribution to chemistry while a resident of one of the eleven Western states.

Dr. Li received the award for his contributions to the knowledge of the chemistry of living matter. He is credited with isolating ACTH, the anti-arthritis hormone, and four other hormones of the anterior pituitary gland.

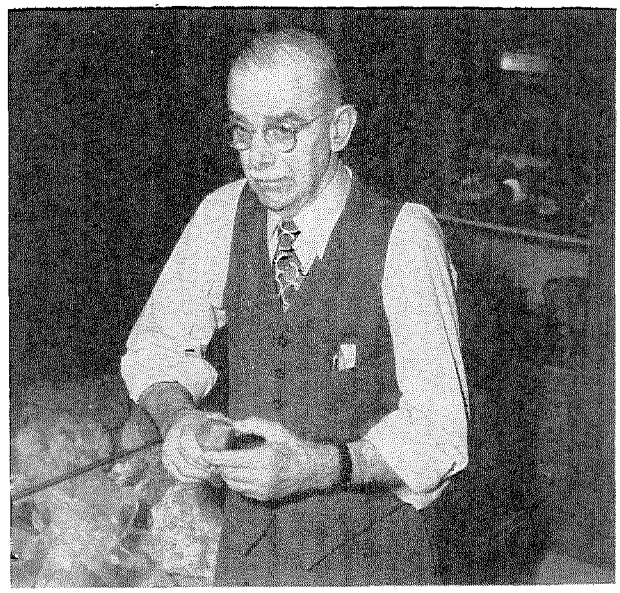
The two awards were established by the Section in celebration of its Golden Anniversary. With a membership exceeding 2,000 it is the fifth largest section of the A.C.S., which has more than 65,000 members and is the world's largest scientific organization. This year is both the Diamond Jubilee year for the Society and the Golden Anniversary year for the California Section.

Geology Collections

THE INSTITUTE'S Geology Division last month acquired the personal library of the late Dr. Chester Stock, who headed the Division until his death last year. The collection consists of about 950 books and some 6,000 reprints of articles on vertebrate paleontology and related fields, including a bound collection of Dr. Stock's 172 published papers.

Dr. Stock started his library when he was a student in 1913. It includes a number of volumes which belonged to the late Prof. John C. Merriam, who taught Dr. Stock at the University of California. The Merriam library was a gift from Prof. Merriam's sons—one of whom, Charles, is Associate Professor of Invertebrate Paleontology at Caltech.

At the same time William C. Oke presented the Geology Division with his extensive mineral collection, consisting of more than 3,000 carefully labeled and catalogued specimens.



William C. Oke, Curator of Mineralogy

Mr. Oke began his mineral collection only 18 years ago, at the age of 50. A typewriter repairman for the Union Oil Company in Los Angeles, he became interested in mineralogy and went to night school to learn more about the subject. He has twice been elected president of the Mineralogical Society of Southern California. Since his retirement from Union Oil three years ago, at the age of 65, Mr. Oke has assisted the Geology Division in caring for its mineral collections, and last summer was named Curator of Mineralogy at the Institute.

The unique Oke collection, which includes many rare minerals from all over the world, will provide the Geology Division with a long-needed reference tool. Mr. Oke intends to add species and varieties to the collection as he acquires them.

Rain and Radar

DR. E. G. BOWEN, physicist member of the Australian Commonwealth Scientific and Research Organization, in a series of lectures delivered at the Institute last month, revealed that Australian scientists had developed a revolutionary new method of rain-making.

Though, in this country, we have concentrated on producing rain by seeding clouds with dry ice or silver iodide, the Australians have been more successful by spraying low clouds with water.

In small-scale experiments, using only a few hundred pounds of water at a time, sprayed from DC-3's, the Australians managed to start rain falling in 15 or 20 minutes which would not otherwise have reached the ground. These experiments have indicated that a single ton of water would yield at least 1,000,000 tons of rain.

The experiments have been on low-hanging clouds—and in Australia 50% of the country's rain comes from

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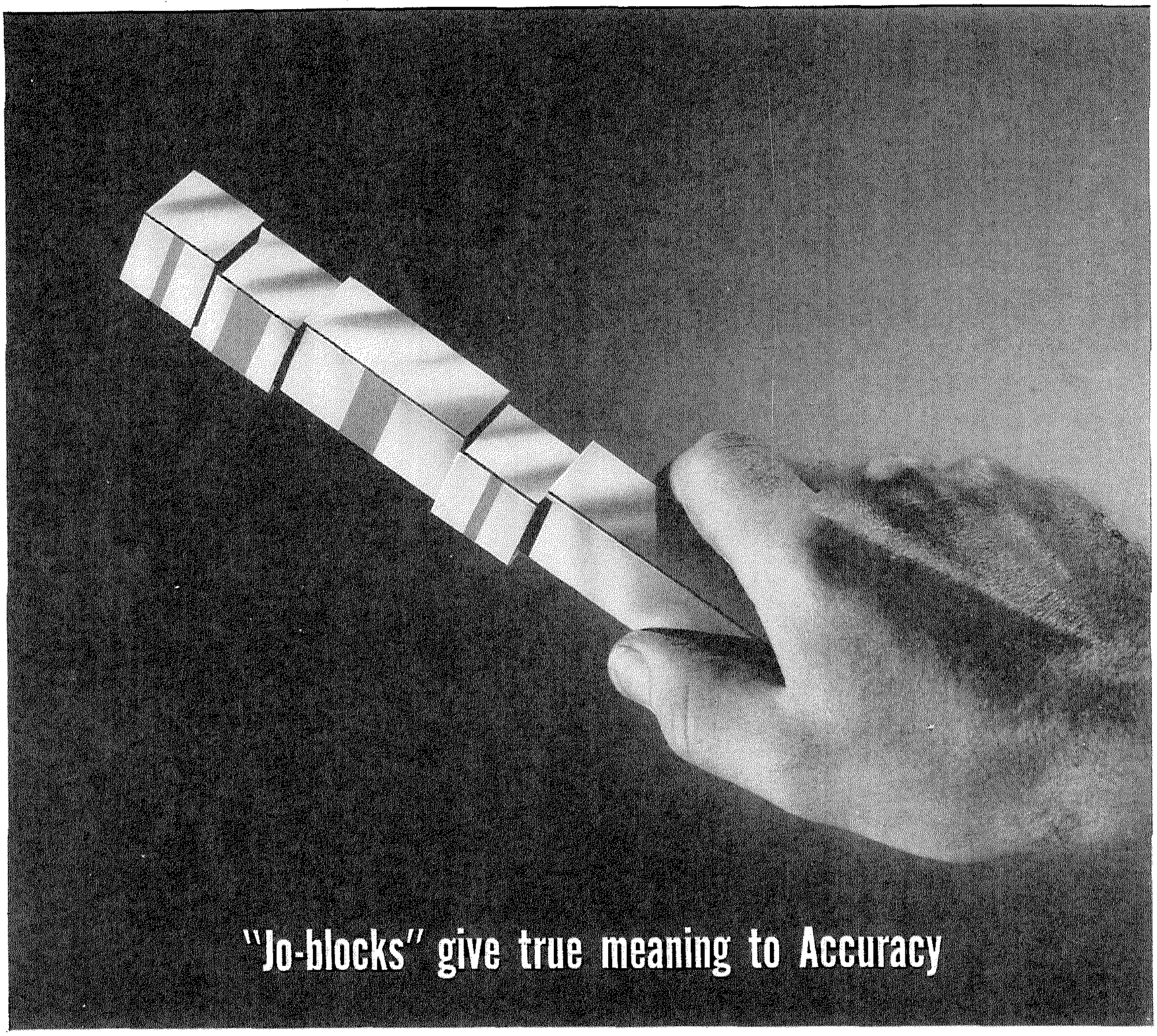

Working within measurements of millionths of an inch is, today, a common practice. This precision mass production in micro-inches is possible only because of "Jo-blocks." With their development, accuracy in terms of precision measurement acquired a new true meaning. These famous gauges are made with such dimensional accuracy that even the small amount of heat generated in handling may cause them to expand and become inaccurate. As the photo shows, the surfaces and tolerances of these blocks are so finite and smooth *that they adhere firmly to each other.*

Did you ever consider how such dimensional accuracy and finish are achieved?

You have but to look to abrasives for your answer. Grinding wheels, coated papers and lapping compounds (all products by CARBORUNDUM) play their part in the production of "Jo-blocks."

The development and application of such abrasive products is a natural for CARBORUNDUM which alone makes all abrasives to supply the proper ones for all industrial requirements of grinding, sanding and finishing. This assures abrasive users an impartial recommendation of the right abrasive in every case. It is a good reason why industrial users look to CARBORUNDUM for the best answer to their abrasive problems.

While the CARBORUNDUM brand enjoys leading recognition in the field of abrasives, other products by CARBORUNDUM are no less important industrially. Among these are super refractories, widely used in both high and low temperature applications, ceramic heating elements and resistors, and deoxidizers.

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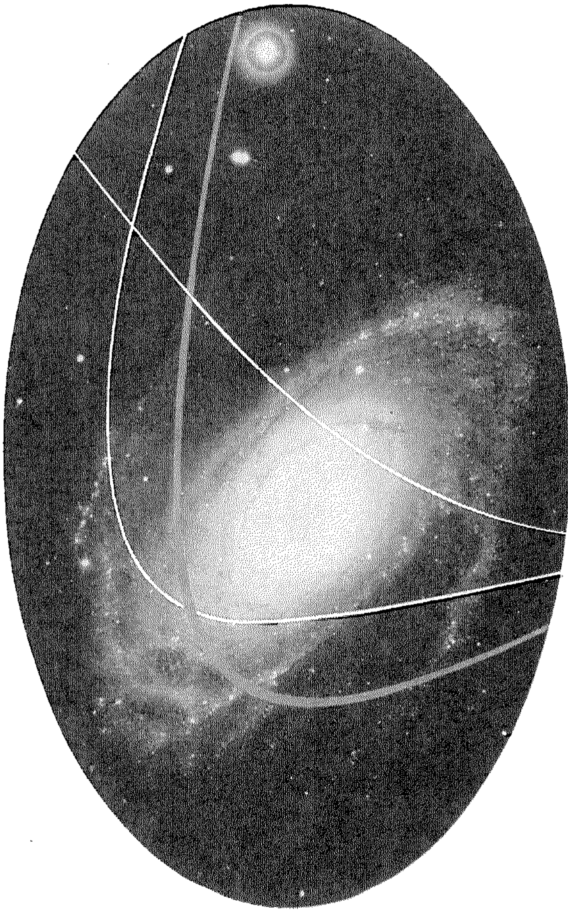
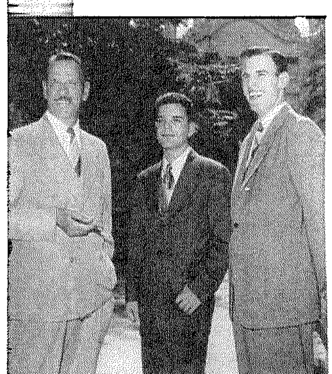


to be always beyond the frontier

Modern industrial research must constantly explore far beyond outposts of the known. For through this tireless reaching past existing scientific frontiers, the impossible of today becomes the reality of tomorrow.

The Howard Hughes Fellowships in Science and Engineering were established at the California Institute of Technology to encourage such creative industrial research and development. Any American citizen is eligible for a Fellowship who qualifies for graduate standing at the Institute for study toward the degree of Doctor of Philosophy with a major in physics or engineering.

Each Fellowship covers a twelve-month period. A portion of it is spent in advanced work in the Research and Development Laboratories of Hughes Aircraft Company. A Fellowship award provides a money gift, salary, and tuition and research expenses.



Dr. Clark Millikan (left) of the California Institute of Technology welcomes to the campus Hughes Fellowship recipients Art Bryson from Illinois and Warren Mathews from New Jersey.

Hughes Fellows Warren Mathews and Art Bryson are shown (left to right) with Dr. Robert R. Bennett and Dr. Allen E. Puckett examining the results of some random noise studies made with use of electronic analog computer in Hughes Research and Development Laboratories.

low clouds. Silver iodide and dry ice proved to be more effective than water in high cumulus clouds, where freezing occurs. In the low clouds, the effect of the sprayed water was to introduce droplets larger than those already suspended in the cloud. The small drops of water attach themselves to the larger ones, which soon become so heavy that they drop to the earth.

The Australians don't plan to go into large-scale rain-making operations until they're positive it is a safe procedure—which means about two more years of basic research.

In all, Dr. Bowen delivered five lectures at the Institute last month. Though two of these were devoted to natural and artificial rain, the others were on "Radio Frequency Radiation from the Sun," "Radio Frequency Radiation from the Galaxy," and "Moon Echoes and Moon Radiation."

Reporting on Australian studies of the radio waves produced by the moon and received continuously on earth, Dr. Bowen revealed that these have given us accurate estimates of the temperatures on the moon. The range is from a high of 158° F. to 145.4° F. below zero, with a mean temperature of 86° below zero.

These temperatures are in line with those obtained in a different way by Dr. Seth B. Nicholson and other researchers at the Mt. Wilson Observatory. These were obtained optically by studying infrared light from the moon.

Australian scientists have also launched a project to bombard the moon with radar waves. In less than a year the researchers hit the moon and received echoes about 25 times. Signals took 2.5 seconds to make the 480,000-mile round trip, which means they went at about the speed of light.

The experiment leaves some doubt as to the possibility of using the moon to reflect messages being sent, say, from Australia to the United States. The echoes received from the moon, in nearly all cases, were extremely blurred. But the technique of bouncing radar waves off of celestial objects might provide an accurate check on our measurements of distance from many of these.

THE BEAVER

A Midautumn Night's Dream

THE WEEK OF OCTOBER 29 to November 2 was filled with more than the usual bustle around the student houses. It was mid-term week, and there was no football game the following weekend. All signs unmistakably pointed toward the coming of the annual Interhouse Dance—even including the traditional rumors about the photographers of *Life* Magazine showing up.

The Interhouse Dance is really five simultaneous dances, one in each of the four houses and one in Throop Club. Every year each house plans its share of the Interhouse Dance around some particular theme or motif. Each has its own decoration, orchestra, dance floor, and refreshments. Couples move around from one house to another, impartially sampling the music and refreshments at each. After this the young lady agrees that the decorations of her escort's house are by far the most original.

A couple beginning at the spot which less than a week before marked the Dabney House courtyard would have found a spectacle rivaling the Grand Canyon in concentrated grandeur and Disney's "Fantasia" in color.

The moonless night hid almost everything but the green luminescent fountain, continuously disgorging itself fifteen feet into the air. A luminescent river without beginning or end flowed along one side of the court, which was filled with pine wood carefully arranged and especially imported for the occasion. The inside of the lounge was peopled with surrealistic creatures peering at the dancers who, in turn, were peering back at them. The mood was heightened by a miniature waterfall on one wall. Intrepid explorers found, by reaching far enough, that the water was real.

Upon leaving the "Black Magic" theme of Dabney, the couple might go to neighboring Blacker House for "A Night in Old Albion." An old English castle was suggested by a moat, drawbridge, and battlement. The court also included "Ye Olde Boar's Head Tavern" (indicating that the boys take their third-year English literature course seriously), and "Ye Olde Kissing Well" (indicating that the boys take their dances seriously). In the lounge, a life-size king in full regalia looked down from his balcony, with the aid of special torch lighting, upon a hall of tapestries and knights in armor.

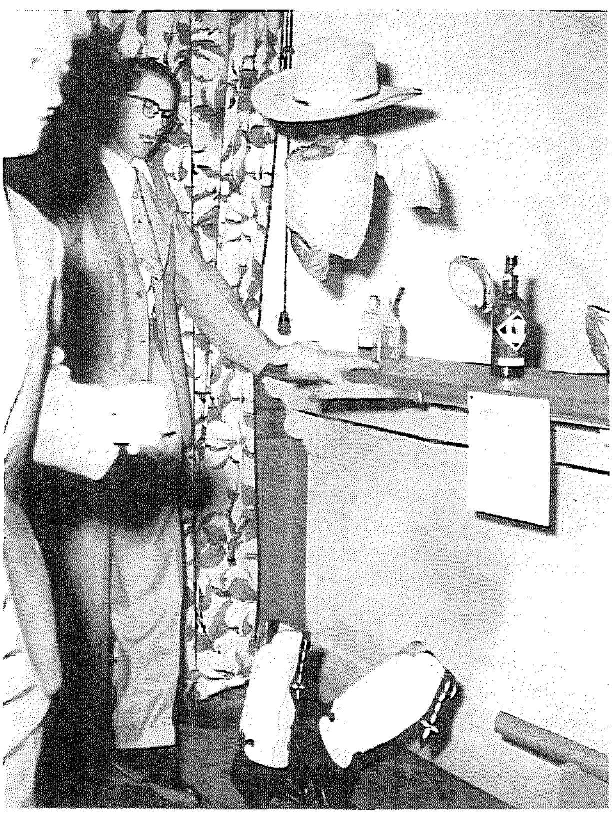
Ricketts under water

Ricketts House was "Twenty Thousand Leagues Under the Sea." Ricketts court, very often dry in real life, became a part of the ocean floor. A large bathysphere sat in the center of the court, along with a dummy clothed in a diving suit. The effect was embellished, as in all the other courts, by expert lighting. The inside of the lounge was covered with extravagantly colored murals depicting imaginative undersea scenes.

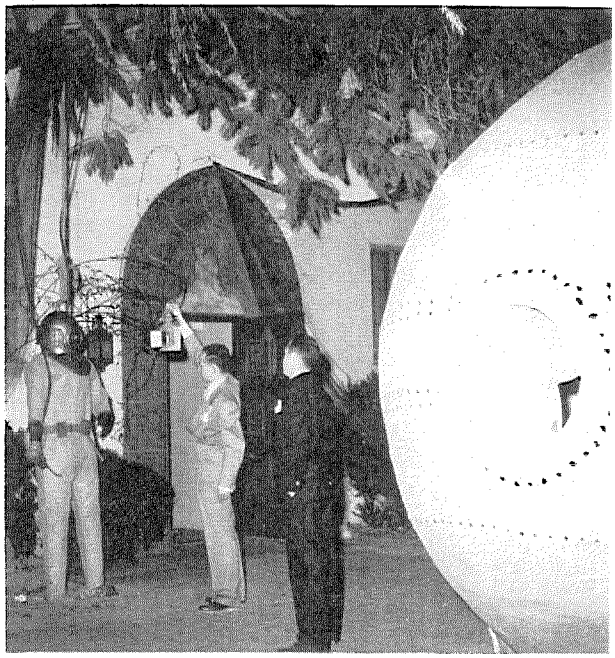
By now the wandering couple must have been almost overwhelmed by grandeur, just as this writer is running

out of Hollywood-type descriptions. Their next stop, Fleming House and its environs, was an accurate reconstruction of "The Old West." The way to the lounge was a typical main street in the old West. The mood here turned to humor, as the shops on either side of the street were aptly named for appropriate faculty members. The lounge itself was a typical western dance hall, according to students who claim to have been in such places at the turn of the century. At any rate, the impression was unmistakably successful. The refreshments in the dining room were served at a real bar, behind which an enormous painting of a nude (painted by local talent and specially commissioned for the event) graced the saloon. Outside, a real stage coach, a body hanging from a tree by the neck, and a humorous cemetery added a mixed atmosphere.

The theme for Throop Club's decorations was a fitting epithet for the entire dance to many of those in all the houses who put in so much work: "The Lost Weekend." The sophisticated motif used theatrical expressionism in depicting a bar as a drunk would see it. This gave one the opportunity to appreciate the D. T.'s without drinking. As in all the other houses, the drinks were non-alcoholic, despite the fact that they were served from what may have been bars. Master stroke of the decorations in Throop was the huge champagne glass with live but proper girls inside.



Phantom cowboy at the Old West bar in Fleming House



Twenty thousand leagues under the sea in Ricketts House

Amid these varied backgrounds boy-girl relationships were understandably mellowed, student-faculty relations were advanced through the many faculty members and their wives who were present, and alumni acquaintances were renewed by the reappearance of many who had worked on the Interhouse Dances of more than a few years back.

The entire dance cost an estimated $1000. This is only $200 per house, including the fee for a high quality orchestra, which can easily run about $150. This averages about $2 per man, which nowadays is indeed inexpensive for a date.

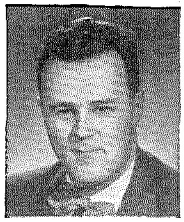
Football Season

Caltech officials rested easily while throughout the country football coaches and college presidents walked the tightrope between pressure for winning football on the one hand, and embarrassing questions, on the other hand, from many sources, even including Congress, concerning overemphasis of football. Meanwhile the Beavers finished their most successful football season in recent years:

	Opponents	*Caltech*
La Verne	26	0
Arizona State	14	28
Redlands	13	27
Pomona	27	25
Whittier	20	13
Occidental	27	13
Cal Poly	42	7

The win over Redlands was our first conference victory in football since 1946. Also, the Arizona State-Redlands two-game winning streak was the first such streak Tech has had in a long time. Few people can remember how long.

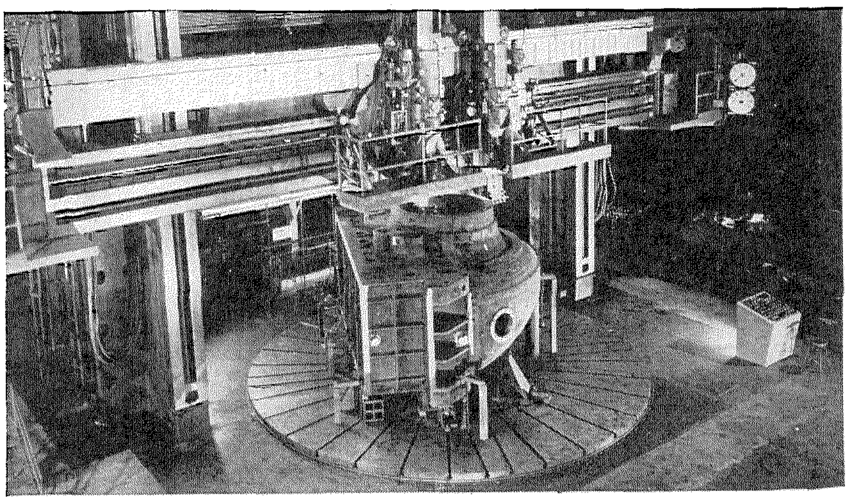
Behind Every Success There's
PLANNING



H. V. FULLER

by H. V. FULLER, *Supt. Time Study and Planning Dept.*
General Machinery Division, ALLIS-CHALMERS MANUFACTURING COMPANY (*Graduate Training Course 1939*)

PLANNING is an important part of manufacturing machinery—and of building a career, too. This planning, however, must be based on information and experience. You don't always have all the facts about industry that you need at the time you leave engineering school and start planning your own future. At least, that's the way it was with me when I got my degree in Mechanical Engineering at University of Wisconsin in 1936.



New 30-ft. boring mill now operating in Allis-Chalmers' West Allis shops. It supplements older, slower 40 ft. mill, and greatly increases capacity on big, heavy work. Both mills are scheduled practically around the clock, seven days a week.

I took a job with a big manufacturer, but within a year the work I was doing ended, and my employers referred me to the Allis-Chalmers Graduate Training Course. I enrolled in 1937—and then my knowledge of industry really began to grow. There was the usual round of the plant—shops, offices, various departments—where I saw a wide range of work at first hand. I worked with steam turbines, pump testing, and on the electrical test floor. About half way through the two-year course I got really interested in the manufacturing side of the business. After four months of plant layout work I went to the Time Study and Planning Department, and finished out my course there in 1939. In 1945 I became Superintendent.

This Is the Starting Point

In this department we really start the manufacturing operation. We're given the engineering drawings and material specifications. And from this data we plan the sequence of manufacturing operations—determine the equipment and tooling required, and set up time standards for each operation.

You can get some idea of the volume of work from the fact that our West Allis Machinery Division shops ship an average of eight million pounds of finished machinery per month—representing a range of products from small V-belt sheaves to massive crushers, steam and hydraulic turbo-generating units, cement kilns, sewage pumps, motors, flour mills, and power transformers.

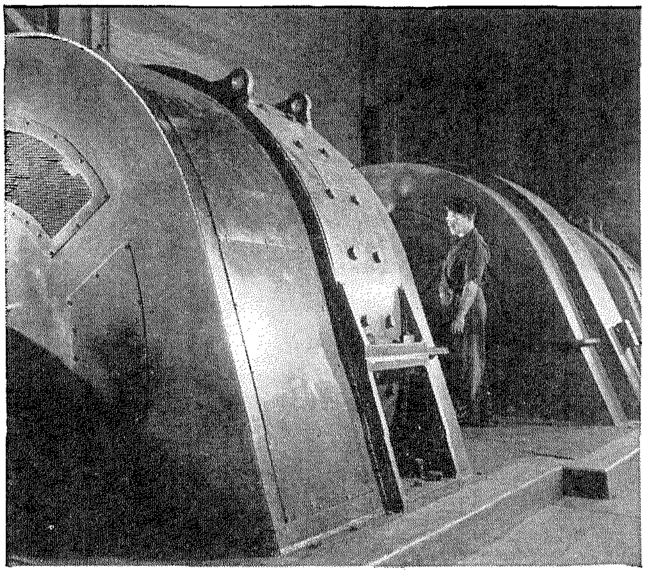
Look Before You Decide

As a Graduate Training Course engineer here you may become interested in manufacturing. There's a great need for trained engineers in this work. Or, you may find your interest lies in some other field—designing, research, sales, personnel, service and erection. In any case, the Graduate Training Course gives you a chance to look them all over, gain practical first-hand experience, plan your career on a sound basis of knowledge.

Do Your Own Planning

The course is flexible—you help plan it yourself and can change it as new interests or opportunities develop. There's no other spot in industry that offers such a wide range of experience—so many choices for a career.

If you want to get further details as to qualifications, salary and operation of the course, get in touch with any Allis-Chalmers district office. Probably the manager was a G T C himself. Or, write for literature.



One of the three 6000 kw 3-machine Allis-Chalmers motor-generator sets in large Eastern steel mill. These units provide direct current for motors driving 68-inch hot strip mill.

ALLIS-CHALMERS *Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin*

ALUMNI NEWS

Boyd to Kennecott

On October 16, James Boyd '27 resigned as Director of the United States Bureau of Mines to join the executive staff of the Kennecott Copper Corporation. Kennecott is the world's largest copper producer and has copper mining activities in Utah, Nevada, New Mexico and Chile; titanium mines in Canada; gold mines in the Orange Free State; and several other mining and manufacturing operations. Primarily, Boyd's new job at Kennecott is to assist the president of the corporation—working under the general direction of the vice-president in charge of exploration—in selecting projects arising from the company's own exploration activities and those that come to the company from the outside, and in planning the company's expansion activities.

After his graduation from Caltech in 1927, Jim Boyd spent two and a half years in the mining geophysical business in Canada and in most of the western states. He received his M.S. from the Colorado School of Mines in 1932, and his Ph.D. in 1934. From 1929 to 1941 he was variously Instructor, Assistant Professor and Associate Professor in Geology at the school, and carried on a consulting practice during the summer months. He also ran small mines in Colorado and did some work for the oil industry. In 1941 he was called into the Army, and served with the Office of the Undersecretary of War and the Army Service Forces, primarily as the Army's member of the War Production Board's Requirements Committee. Later, as Executive Officer to General Lucius D. Clay, he went to Germany early in 1945 to take charge of the Industrial Division in the Office of the Military Government. In 1946 he returned to the Colorado School of Mines as Dean of the Faculty. Shortly thereafter he went to the Office of the Secretary of the Interior as his Mineral Advisor, and was appointed Director of the Bureau of Mines in August, 1947. During 1950 and 1951 he was simultaneously the Defense Minerals Administrator.

Smits in Iran

Howard G. Smits '31, M.S. '33, President of Pacific Iron and Steel Company in Los Angeles, took a round-the-world trip last spring, with Mrs. Smits, in connection with work his company is doing in the Far East. After his return this summer Howard got off a long letter to California Senator Richard M. Nixon, giving him some impressions of some of the places he visited—in particular, Iran, where Howard had the good fortune to travel about 1500 miles by auto and to talk to a number of people.

We quote, herewith, some of the highlights from this colorful and informative letter:

"The Iranians distinctly hate the Russians, and have very good historical reasons for doing so. They have nothing but contempt for Russian methods and do not

CONTINUED ON PAGE 38

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Robert P. Sharp '34

VICE-PRESIDENT
John E. Sherborne '34

SECRETARY
Donald S. Clark '29

TREASURER
Henry R. Freeman '25

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Donald C. Tillman '45	William O. Wetmore '37

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The San Francisco Chapter meets for lunch at the Fraternity Club, 345 Bush St., every Thursday.

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830 World Center Building

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Arthur A. Sauer, Consulting Structural Engineer,
2203 13th St.

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Armour Research Foundation, 35 W. 33rd St.

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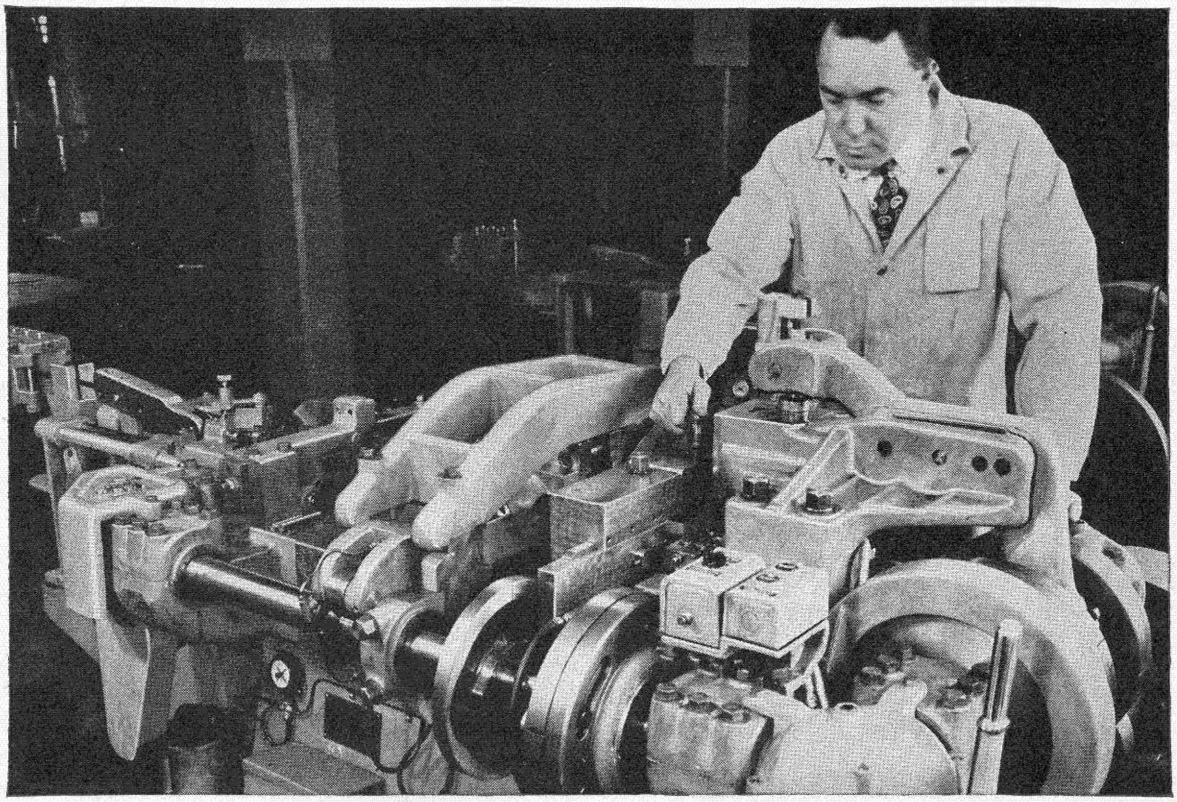
Illinois Institute of Technology, 3300 S. Federal St.

SECRETARY-TREASURER Harrison Lingle '43
Cherry Burrell Corp., 427 W. Randolph St.

FLAT SPRING STEEL



Manufacturers count on Roebling for absolutely uniform quality

FOR FLAPPER VALVES, shoe shanks, measuring tapes! For steel rules, curtain springs, snap springs, lock springs, drop wires, sinker steel and a thousand and one other exacting uses, Roebling high carbon flat mechanical spring steel is unsurpassed.

Roebling has one of the largest specialty wire mills in America, and our complete facilities for producing flat spring steel give us positive control over every phase of production. The final product is dimensionally and mechanically uniform . . . cuts down machine stoppages . . . minimizes rejects. And Roebling flat spring steel is made in a wide range – annealed, hard rolled untempered; scaleless tempered; tempered and polished, blued or strawed.

Roebling technicians are always glad to help choose the *right* flat spring steel for top efficiency in any given application. John A. Roebling's Sons Company, Trenton 2, N. J.

ROEBLING

Atlanta, 934 Avon Ave ★ ***Boston,*** 51 Sleeper St ★ ***Chicago,*** 5525 W. Roosevelt Rd ★ ***Cincinnati,*** 3253 Fredonia Ave ★ ***Cleveland,*** 701 St. Clair Ave, N.E. ★ ***Denver,*** 4801 Jackson St ★ ***Detroit,*** 915 Fisher Building ★ ***Houston,*** 6216 Navigation Blvd ★ ***Los Angeles,*** 216 S. Alameda St ★ ***New York,*** 19 Rector St ★ ***Odessa, Texas,*** 1920 E. 2nd St ★ ***Philadelphia,*** 230 Vine St ★ ***San Francisco,*** 1740 17th St ● ***Seattle,*** 900 1st Ave, S. ★ ***Tulsa,*** 321 N. Cheyenne St ★ Export Sales Office, ***Trenton, N. J.***

believe that Russia is a paragon of productive ability. It is necessary that Iran carry on trade with Russia, which consists principally of the exchange of Iranian food items for Russian cotton goods. The Persians have always been good bargainers. They will settle their oil dispute with Britain, in spite of Harriman, with each side using tactics peculiar to themselves. They are Nationalists and they believe strongly in their own religion (which, incidentally, has the same roots as our own, namely, the recognition and use of the Old Testament). The people are Western in their thinking when compared to the Hindus, Buddhists, etc.

"I was told repeatedly of the disastrous effects of our giving money. This does not mean the people are uninterested in help. It means the giving of money is a positive evil and retards rather than helps a country. Put simply, the reason for this is that giving money merely causes an 'inflation' in the standard or rate of graft and creates dependence.

Giving—and receiving

"If our Government feels compelled to give, by all means let me urge the Government to give 'things,' not money; and to attempt to give the type of 'things' that cannot be resold. For example, Iran desperately needs roads. We would generate enormous good will should we go into Iran and actually build these roads. However, if our Government attempts to do the actual construction, I am sure the results will be disappointing. If, on the other hand, a contract is let by our Government to an American contractor under competitive bidding with no restrictions tied to him as to whom or what he shall pay, and if our Government assumes its normal role of inspection for quality and performance of contract, you will witness amazing results.

"The Voice of America is ignored. However, radio sets are common even among the poorest of the people. They have a surprising way of getting the facts without the benefit of our colored and often pointless Voice of America.

"The Iranians understand the word 'power' and the meaning of 'law and order.' Further, they have a fundamental knowledge of the power of 'trade.' They understand that these are the factors which govern the course of the world and the peoples therein. From many of the strange utterances and behaviors of the State Department, it would seem that we have rather lost touch with these fundamentals in working with the world.

"Briefly, as we progressed eastward through Kashmir, India, Thailand and Indonesia, there was evident a progressive deterioration in 'law and order' and well-being. Communism is entirely overrated as a force. There are liberal and revolutionary forces at work everywhere, as there have been since the beginning of time. These, how-

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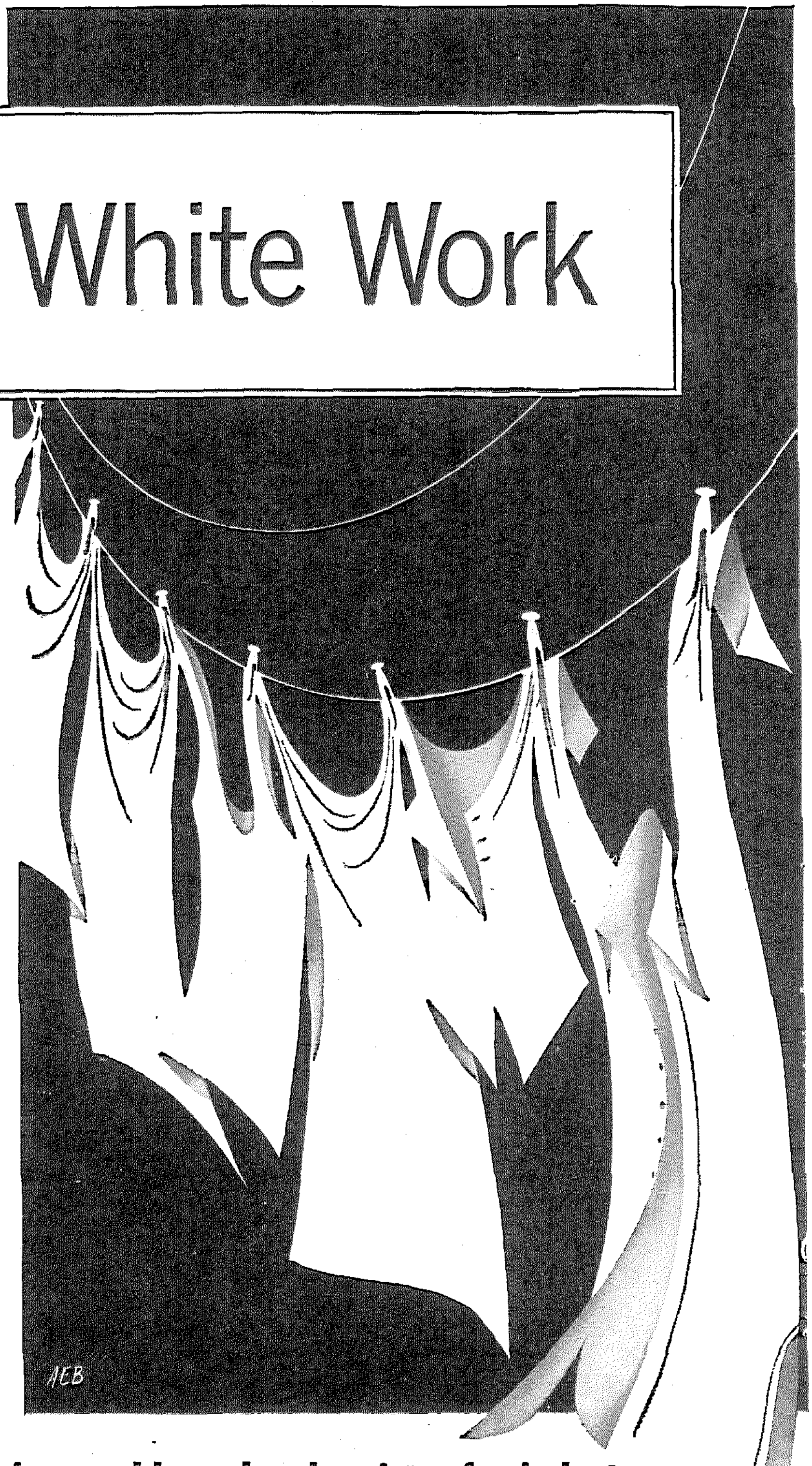
Whiter White Work



CHEMICAL PROBLEM...

. . . laundry detergents to wash clothes whiter without increasing laundering costs.

SOLUTION...

. . . a Hercules cellulose derivative called CMC-CT . . . a special form of cellulose gum. Now a standard ingredient in many leading brands of "soapless soaps," its unique action floats dirt away from the clothes and prevents it from getting back during the wash, thereby improving whiteness.

COLLEGE MEN...

This is but one example of the far-reaching chemical developments in which you could participate at Hercules—in research, production, sales, or staff operations. It suggests the ways Hercules' products serve an ever-broadening range of industries and end-uses.

Hercules' business is solving problems by chemistry for industry...

. . . paint, varnish, lacquer, textiles, paper, rubber, insecticides, adhesives, soaps, detergents, plastics, to name a few, use Hercules synthetic resins, cellulose products, terpene chemicals, rosin and rosin derivatives, chlorinated products, and other chemical processing materials. Hercules explosives serve mining, quarrying, construction, seismograph projects everywhere

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ever, are concerned with the elemental things of a wider distribution of land and a lighter tax burden. These revolutionary forces are *not* concerned with any Government ideologies or social ideologies and are not supported in any material way by Russia.

"Universally, I found an awareness that Russia was in arrears in its commitments, whether they be trade, political help or token arms.

"I can find no reason to believe that Russia is anything but a colossal hoax which our State Department appears to be enormously afraid of."

Sorensen Fellowship

At the annual Alumni Banquet in 1950 (*E&S* June, 1950) Howard Vesper '22 announced the establishment of the Royal W. Sorensen Fellowship in Electrical Engineering. The fellowship was set up by an interested group of alumni in recognition of Dr. Sorensen's retirement at that time. Dr. Sorensen had been on the Institute staff longer than any other member, having become head of Electrical Engineering at Throop Polytechnic Institute in 1910.

There wasn't time to get the fellowship into operation last year, but it has now been set up and Jerome K. Delson was named as the first recipient this fall. The annual stipend for the graduate fellowship has been set at $900 and funds have been collected for approximately three years. The project has been handled thus far by an informal group, including Abe Zarem, M.S. '40, Ph.D. '44, Fred Lindvall, Ph.D. '28, Bob Bowman '26, and Howard Vesper, acting as chairman. Funds were contributed for the most part by alumni in classes graduating prior to 1940, with a considerable portion of the donors being electrical engineers.

Back Numbers

Caltech's student newspaper, the *California Tech*, asks the help of alumni in completing its files of back issues. Still missing:

Vol. 48 No. 30 (The Hot Rivet, 1947)
Vol. 49 No. 1 (October 9, 1947)
Vol. 49 No. 5 (November 6, 1947)

Anyone who has copies of these three issues will do the *California Tech* staff a great service by sending them to Editor Chuck Benjamin in Ricketts House.

ALUMNI CALENDAR
1952

February 9	Dinner Dance
April 12	Seminar Day
June 4	Annual Meeting
Date to come	Family Day

PERSONALS

1915

Earl A. Burt, who is Assistant Road Commissioner of L. A. County, was elected president of the County Engineers Association of California at the organization's annual meeting in Santa Cruz in September.

1917

Sidney R. Searl was elected to membership in the Los Angeles Stock Exchange this fall. He will represent the investment firm of First California Company. He had been a member of the exchange from 1928 to 1944.

1920

Virgil H. Best reports that he is still Chairman of a High School Science Department, and in his 30th year of teaching in the Los Angeles Schools.

1922

R. E. Bear has recently been made Manager, Users Section, of the General Electric Company's Apparatus Department in Los Angeles.

1923

Harold A. Barnett was appointed City Engineer of San Gabriel on February 1, 1951. He is also City Engineer of Gardena and San Marino.

Donald H. Loughridge, Ph.D. '27, formerly Scientific Adviser to the Secretary of the Army, has been appointed Assistant Director of the Atomic Energy Commission Division of Reactor Development. Dr. Loughridge will be chiefly concerned with formulating and effecting policies and practices for the coordination of technical programs at the Argonne National Laboratory.

1924

George Baxter Stone, who was formerly General Manager of Pacific Electrical and Mechanical Company's Los Angeles branch, died on October 25th at a local hospital. He was associated with P.E. and M. for 19 years and wrote extensively for trade publications. He was also prominent in the National Electrical Contractors' Association of Los Angeles.

1926

Arthur B. Allyne is now with the Honolulu Gas Company, Ltd. in Honolulu.

Charles H. Prescott, Jr., Ph.D., died on November 1 from the effects of a laboratory fire and explosion at San Bruno on October 24. Dr. Prescott was wartime head of the chemical section of the University of California Radiation Laboratory.

Fray Hardwick is working at Lockheed's Georgia Division and living in Marietta, Georgia.

1927

Arthur H. Warner, Ph.D., has resigned as Technical Director, Air Force Missile Test Center, Cocoa, Florida, as of November 16th. On December 1 he will become Head of the Scientific Section of the Pasadena Branch of the Office of Naval Research.

1928

Frank W. Bell, M.S. '33, returned to southern California a year ago after an assignment in Houston, Texas. His job with Shell Oil Company is now Area Geologist for Pacific Coast and Rocky Mountain States. He says it's good to be back in southern Cal, after spending nine years on assignments in Sacramento, Bakersfield, and Texas.

Hugh A. Hossack died May 28, 1951 from an illness resulting from high blood pressure. He was Senior Engineer with Pacific Tel and Tel in North Hollywood.

1930

Jack S. Boren, M.S., is Supervising Electrical Engineer for the Ralph M. Parsons Company in Los Angeles.

1931

Edward Uecke, Ex.'31, has been appointed Chief Engineer, Electronics and Recording Division for Capitol Records, Inc. Ed was previously Chief Electronics Engineer for the company. He will now assume executive supervision of all Capitol recording operations.

1934

James W. McRae, M.S., Ph.D. '37, was recently appointed Vice-President of Bell Telephone Labs, Inc. He is in charge of the systems development organization of the laboratory, consisting of systems engineering, transmission development and switching development. Jim first joined the Bell Labs organization in 1937 and rejoined it again in 1945 after his release from the army.

1935

Oliver C. Dunbar writes that he's been promoted to Lt. Colonel in the Regular Army, and has a new daughter, Ann Pritchard, born last February. Working with Olly in the Signal Corps at Fort Monmouth, New Jersey, is Pvt. *James A. Hummel*, '49, who claims he's probably got one of the softest jobs in the Army. Both are living in New Jersey—Olly in a new home in Little Silver, and Jim in Red Bank.

1936

Frank W. Davis has been appointed

assistant chief engineer in charge of research and development at Consolidated Vultee Aircraft Corporation's San Diego Division.

Arthur M. Frost, Plant Engineer at Douglas Aircraft Company, was killed in an explosion of a new drying oven at the Douglas plant in Bell, Calif., on November 5. Art had been associated with the Company for 15 years, and was considered one of its top-flight engineers. Early last year he was appointed chief plant engineer. He and his wife had been living for the past three years in Brentwood.

1938

John R. Baker and his wife announced the arrival of their first son, John Hayward, on September 11. The Bakers moved into a new home last year in Hastings Ranch in Pasadena.

1939

R. K. Collins is now working as a consulting engineer for Westinghouse in Los Angeles. His most important job at present is the 40,000-HP modification at the Southern California Cooperative Wind Tunnel. A recent addition to the Collins family was a daughter, Leanne, born April 2. Their son, Michael, is nine years old.

Major William M. Green was recalled by the Air Force on September 3 and has been assigned to the Special Weapons Command, Kirtland Air Force Base, Albuquerque, New Mexico. His wife and two children are happily settled in a unit of the Wherry Housing Project nearby.

Lt. Frederick C. Hoff was recalled to active duty as Ordnance Production Officer at the Naval Ammunition Depot, Hingham, Massachusetts. He says: "We have been provided delightful quarters on the station in a spacious 8-room house built shortly after the arrival of the Pilgrims, but recently modernized by Navy Public Works into most livable quarters. . . . We are really in wild country. Six miles of travel thru the thickly wooded reservation brings us back to civilization, if you can term Hingham town that. It is great for the kids—David, 8 and Laura, 3—however all will be glad to be back in California in about 17 months."

1940

Frank Dessel, M.S. '43, reports that he has two sons, aged 9 and 5. He recently purchased the San Marino Pharmacy at Mission and Los Robles in San Marino and has already had a lot of Tech graduates drop into the store.

Keith E. Anderson has transferred from his Bureau of Reclamation job as Area Geologist at Kalispell, Montana, to Regional Drainage Engineer at Boise. In addition to doing drainage work, he will serve as grouud-water geologist in the regional office.

Robert W. Grigg reports the birth of a daughter, Virginia Ann, on September 22. This makes it four children for the Griggs—three girls and a boy. Bob is still working for Pacific Telephone and Telegraph, in the Chief Engineer's Department in L. A., but recently he was shifted from the radio field to toll transmission design.

A. Boyd Mewborn, Ph. D., was promoted from Associate Professor to Professor of Mathematics and Mechanics at the U. S. Naval Postgraduate School, Monterey, California. He got out to Honolulu during his 14 days annual training duty as Navigator on the *Mars* with VR-2, N.A.S. Alameda, Cal. He is also being moved up to "Fellow" of the American Association for the Advancement of Science.

Don Loeffler and his wife announce the arrival of their first offspring—a nine-pound, four-ounce boy named James John.

1942

R. T. DeVault is Director of the Aeronautical Laboratory at the University of Southern California. He lists *C. L. Dailey* '41, M.S. '42 as Chief of Research, and *P. O. Johnson* '42 as a Research Associate at the Laboratory. The DeVaults now have three children.

R. A. Cooley, Ph. D., is now in the Research Department of the Western Cartridge Company in East Alton, Illinois.

Frederick K. Bauer is reported to be recovering from a severe attack of polio.

Hugh Baird, M.S. '46, completed five years this fall with C. F. Braun and Company at Alhambra—in their Process Engineering Department. He is currently working on a pair of chemical plants for Dow Chemical Company at Freeport, Texas. Hugh has a daughter who is now in first grade, and a three-and-a-half-year-old son.

1944

Carl Olson is still working at the University of California's Radiation Laboratory as an electronics engineer. The Olsons have a 16-month-old daughter, Candace Lynn.

Harrison W. Sigworth announces the arrival of a third son on October 20th. The two others are now five and two years old, respectively. Harrison is still Research Engineer on Motor Gasolines for the California Research Corporation in Richmond.

1945

William A. Baum, M.S., Ph. D. '50,

joined the staff of the Mount Wilson and Palomar Observatories after completing his graduate study at Caltech. His present research involves photoelectric photometry of stars and nebulae at the prime focus of the 200-inch telescope. The Baums' second daughter was born last May.

William E. Frady has been employed by Hughes Aircraft Company as a Research Engineer for the last two and one-half years. The Fradys have one boy, aged four.

Roy C. Killian transferred last January from the Fleet Air Wing Five Aerological Unit in Miami, Florida, to the Naval Air Facility, Weeksville, Elizabeth City, North Carolina, and is assigned as Aerological Officer. His new station is rapidly becoming the operational center of the entire Navy lighter-than-air program. He graduated with honors last April from the U. S. Naval School (Naval Justice), Newport, Rhode Island. Roy has two daughters, Janis (3½) and Joyce (1½).

1946

Hal McCann writes from Makassar, Indonesia, that he, *Ward Vickers* (V-12) and *Art Teets* '45 are still on a world cruise aboard the schooner *California* (E. & S.—June, 1950). Since their departure in March '49 they have cruised the west coast of Central America and northern South America, all the Pacific Island groups south of the Equator and east of New Guinea, northern Australia, New Guinea, and the eastern part of Indonesia. By January, 1952, he says they plan to have covered the rest of Indonesia, Siam, and be on their way across the Indian Ocean — if they're still afloat! They hope to spend another year and a half sailing and sightseeing before returning to Los Angeles.

Jim Lewis has just started work as a reporter for the San Mateo, Calif., *Times*, after completing two years as reporter for the Chico *Enterprise Record.*

1947

Edwin J. Cowan and his wife have a baby boy, born October 4th in Pasadena, named Robert Leigh.

Joseph Rosener, Jr. married Judy Bogen on July 1 in Pasadena. Judy graduated from U.C.L.A. in '51 and is the daughter of a Caltech alumnus, Robert Bogen '26. The couple returned recently from a belated honeymoon in the Hawaiian Islands. Joe, who is working for Western Lithograph in L. A., received his M.S. from the Stanford Graduate School of Business last March.

Robert H. Utschig is attending the General Motors Dealership Management Training Program at General Motors Institute, Flint, Michigan. He is one of 41 men selected by General Motors divisions to participate in the program.

Roger D. Stock writes that he was married in 1948 and has a year-old son, Roger Jr. He has been at Warren Wilson Junior College in Swannona, Tennessee, since the fall of '47, in charge of physics instruction and the electrical department—in which capacity he has rejuvenated the campus 2300 V Distribution system and designed the wiring and lighting for a new science building.

1948

William H. Shippee was promoted to First Lieutenant on September 20th, and will be going to Germany shortly with his Company (the 330th Chemical Maintenance). He will be there until eligible for discharge—in eight to eleven months, he hopes.

Julius Bendet, M.S., after leaving Caltech, became a Visiting Assistant Professor of Aeronautical Engineering for one year at the U.S.C. College of Aeronautics in Santa Maria. Back in Los Angeles now, he's a Lecturer in Mathematics at U.S.C. while working for a Ph.D. in Math. He and his wife have "a husky three-year-old son."

1949

Arturo Maimoni, M.S., is now working for his Ph.D. degree in Chemical Engineering at the University of California.

Arthur E. Bryson, Jr., M.S., Ph. D. '51, is now employed in the Missile Aerodynamics Department of Hughes Aircraft's Research and Development Laboratories.

Carlton L. McWilliams, M.S., is an Aeronautical Research Engineer at the Air Force Flight Test Center in Edwards, Calif. He's in charge of the Deceleration Track Section of the Experimental Track Branch.

Fred C. Schneider, after spending a training period of a year and a half covering all phases of oil production with the Shell Oil Company, was transferred to Shell Development, in Emeryville, Calif., where his work is now purely research and experiment in field production problems. During the last year he has produced two successful inventions, and patents have been applied for. Fred's most active pastime these days is folk dancing, and he must be pretty good at it because he belongs to an exhibition group which has performed in a couple of concert series as well as in a number of USO shows.

Lt. William R. Muehlberger, M.S. '49, was recalled to active duty in the Marine Corps last December and sent to Port Hueneme to attend the Civil Engineer Corps Officers School from February to June. There he met *Dennis Long* '49, USNR, going through the same course. On returning to Camp Pendleton, in Oceanside, Bill was transferred to the Office of Ground Water Resources to do ground water geology. He hopes to be released next April.

1950

Robert D. Clark, M.S., announced the birth of a second son, Bruce, on July 28th. The Clarks' first, Mark, is now three years old. Bob is a development engineer with Union Oil, lives in Long Beach.

William H. Proud is now working in the Systems Research section of the Hughes Aircraft Research and Development Labs, Radar Department. In the same section is *Harold Hance* '39—and *Norm Enenstein,* M.S. '47, Ph.D. '49, was in the section until recently too.

Pete Howell, after spending the summer at the Naval Ordnance Test Station at China Lake, is back again at the University of Minnesota working on his Ph. D. in chemistry. Pete lists *Dick Knipe, John Green, Werner Riesenfeld, Ralph Lutwack,* and *Charles Steese* as others of the class of '50 who inhabited the "Goat Shack" for the summer at Inyokern. *Don Moore* '50, aud his wife Pat were also at the Test Station.

Jay Montgomery announces the birth of a son, Kenneth Allen, on September 25, in Whittier.

Jack Willis is with Douglas Aircraft in Santa Monica, doing design work on hydraulic guidance components for guided missiles. He lists *Stan Van Voorhees* '38, *Bob Waters,* M.S. '50, *Dirck Hartmann* '50, *J. P. McLaughlin* '32, and *Roland Saye* '43 as other Caltech men at Douglas.

1951

Leo L. Baggerly married Jean Bickford (Oxy '50) on June 9th. He started graduate work in physics at Caltech this fall.

Llewellyn H. Jones, Ph. D., is working in the Chemistry and Metallurgy Division of the Los Alamos Scientific Laboratory.

R. E. Bible and *H. T. Brackett,* M.S., have joined the engineering department of the Chance Vought Aircraft Division, United Aircraft Corporation, in Dallas, Texas.

Larry Dyer is a chemical assistant in the Metallurgy Division at the Oak Ridge National Laboratory.

Roland Berner and Janet Dorothy Munro of San Marino were married in September. They're now living in Seattle, Washington.

Francis James Petracek, M.S., was married to Carole Mae Kroll on September 15th. They are living in Santa Monica and he's working as a research chemist.

LOST ALUMNI

The Institute has no record of the present addresses of the men whose names appear in the list below. If you find your own name here—or that of someone you know—please drop a card, giving the current address, to the Alumni Office, C.I.T., 1201 E. Calif. St., Pasadena 4.

1906
Norton, Frank E.

1911
Lewis, Stanley M.

1912
Humphrey, Norman E.

1913
Hovey, Chester R.

1914
Newton, Walter L.

1917
Mosher, Ezra D.

1918
Pease, Francis M.

1920
Hoenshell, Howard D.
Hounsell, Theron C.
Mosher, Frank R.

1921
Arnold, Jesse
Hood, John H.

1922
Bruce, Robert M.
Cox, Edwin P.
Wesseler, Martin J.

1923
Little, Fred G.
Owens, Clarence R.
Skinner, Richmond H.

1924
Carr, John
Lovering, Frank R.
McKaig, Archibald
Miller, Palmer
Wolochow, David

1925
Dent, William U.
McProud, C. Gilbert
Miller, Leo M.
Smith, Dwight O.

1926
Barnes, Orrin H.
Chang, Hung-Yuan
Foster, Alfred
Hastings, James W.
Huang, Jen Chieh
Jaffray, George R.
Keech, Douglas W.
Paulas, George L.
Remington, Harry L.
Schabarum, Bruno R.
Schueler, Alfred E.
Ward, Edward C.
Yang, Kai Jim

1927
Gilliland, Ted R.
Kaye, George R.
Langer, R. Meyer
Peterson, Frank F.

1928
Chou, P'ei-Yuan
Clark, Alexander
Eastman, Luther J.
Martin, Francis C.
Morgan, Stanley C.
Shaffer, Carmun C.
Shepley, Bertie H., Jr.

1929
Briggs, Thomas H., Jr.
Elder, John D.
Lynn, Laurence E.
Murdoch, Philip
Nagashi, Masahiro
Nelson, Julius
Noland, Thos. J., Jr.
Olman, Samuel
Rapp, John C.
Robinson, True W.
Sandberg, Edward C.

1930
Allison, Donald K.
Brandon, Hugo
Chao, Chung-Yao
Ellis, Eugene
Forney, Morgan T.
Fracker, Henry
Grant, Edmund
Groch, Fred
Imus, Henry
Janssen, Philip
Kelley, William
Leppert, Melvin L.
Moyers, Frank
Murphy, Franklin M.
Posner, Ezra C.
Russell, Lloyd
Schubauer, Galen B.
Suzuki, Katsunoshin
West, Stewart
White, Dudley
Wilkinson, Walter D., Jr.
Zahn, Franklin, Jr.

1931
Anderson, Maynard M.
Green, Lowell F.
Hall, Marvin W.
Ho, Tseng-Loh
Mattison, Harry
Newby, Oscar M.
Stein, Myer S.
Voak, Alfred S.
Webb, Glenn M.
Weise, Carl A.
West, William T.
Woo, Sho-Chow
Yoshoka, Carl K.

1932
Bleakney, William M.
Brown, Rupert A.
Gregory, Jackson, Jr.
Harsh, Charles M.
Huntley, Walter P.
Martin, R. S.
Patterson, J. W.
Schroder, L. D.
Shuler, William R.
Thomas, Richard N.

1933
Andes, Ammon S.
Applegate, Lindsay M.
Ayers, John K.
Davis, Edwin N.
DeLaubenfels, C.
De Milita, Joseph
Hsu, Chuen Chang
Kemmer, Paul H.
Kendall, Robert C.
Kitusda, Kaname
Koch, Albert
Lamel, Arthur
Larsen, William A.
Lockhart, E. Ray
Lyons, Ernest H., Jr.
Magden, John
Michal, Edwin B.
Murdock, Keith
Newmeyer, W. L., Jr.
Pauly, William C.
Plank, Dick A.
Rice, Winston H.
Schlechter, Arthur H.
Scholtz, Walter
Shappell, Maple D.
Skaredoff, Nikolas
Smith, Warren H.
Spicer, Charles B.

1934
Charters, Alexander
Chawner, William D.
Harshberger, John D.
Judson, Jack
Liu, Yun Pu Liu
Lutes, David W.
Marmont, George H.
Newcombe, Dennis A.
Radford, James C.
Rassieur, W. T.
Sargent, Marston C.
Skinner, Davis A.
Sunderland, Robert C.
Vosseller, A. B.
White, Charles
Willard, Kenneth A.
Wong, Kai

1935
Antz, Hans M.
Beakley, Wallace M.
Becker, Leon
Deahl, Thomas J.
Ehrenberg, Gustave, Jr.
Gelzer, John R.
Gross, Siegfried T.
Harney, Patrick J. D.
Jackson, Oscar B.
Karp, Nathan
King, Fred C., Jr.
Koons, Harry M.
Lehmicke, David J.
McCoy Howard M.
McNeal, Don
Mathews, Elmo S.
Obatake, Tanemi
Rivas, Dagoberto
Schwartz, Jack W.
Scott, Claude T.
Simmons, Norwood L., Jr.

1936
Bassett, Harold H.
Bolster, Calvin M.

Borys, Edmund
Brink, Frank
Chu, Djen-Yuen
Creal, Albert
Fahrner, Ted
Fleming, Morton, Jr.
Gardner, Robert
Hartlein, Robert L.
Johnson, Leon W.
Kasnicka, Edward J.
Kelch, Maxwell
Kurihara, Hisayuke
Lovett, Benjamin
McKillip, John C. S.
McLeish, Charles W.
Oberholtzer, Wm., Jr.
Ohashi, George Y.
Onaka, Takeji
Stern, Benjamin
Strange, Hubert E.
Uhrig, Leonard F.
Van Riper, Dale H.
Watt, Chauncey W.
Weber, Bruce T.
Zimmerman, Don Z.

1937

Bell, Willard
Bennett, Foster C.
Butterworth, Wesley
Cheng, Ju-Yung
Church, Harry V., Jr.
Dykes, J. Christopher
Easton, Anthony
Fan, Hsu Tsi
Gevecker, Vernon A.
Hatcher, John G.
Maginnis, Jack
Miller, Shirley S.
Moore, Charles K.
Munier, Alfred E.
Murphy, Joseph N.
Nojima, Noble
Odell, Raymond H.
Offeman, Richard E.
Park, Noel R.
Parry, H. Dean
Penn, William L., Jr.
Price, Edward T., Jr.
Quinn, Eugene H.
Rechif, Frank A.
Rinehart, John S.
Schomhel, Leonard F.
Servet, Abdurahim
Shaw, Thomas N.
Shuler, Ellis W.
Yuan, Shao Wen

1938

Cowie, Roger H.
Davidson, Robert C.
Elliott, Bruce C.
Evans, Harry D.
Gershzohn, Morris
Goodman, Hyman D.
Greenwood, Marvin H.
Hughey, Albert H.
Jack, Samuel S.
Jetter, Ulrich
Kanemitsu, Sunao
Kazan, Benjamin
Lowe, Frank C.
Moorman, Thomas S.
Nysewander, Cecil W.
Ofsthun, Sidney A.
Okun, Daniel A.
Osborn, George H.
Osborne, Darrell W.
Parrish, John B.
Rynearson, Garn A.
Schoech, William A.
Scoles, Albert B.
Stone, William S.
Thomas, Robert C.
Tilker, Paul O.
Tsao, Chi-Cheng
Wang, Hsih-Heng
Wang, Tsun-Kuei
Watson, James W.

1939

Askawa, George
Bishop, Richard
Burns, Martin C.
Carter, Robert T.
Coates, Leonidas D.
Crawford, William D.
DeLong, James H.
Hendry, Noel W.
Hepner, Franklin R.
Hsueh, Chao-Wang
Jones, Winthrop G.
Liang, Carr Chia-Chang
Mouat, Thomas W., Jr.
Neal, Wilson H.
Robertson, Francis A.
Smith, Max F.
Streckewald, Paul B.
Tatom, John F.
Widmer, Robert H.
Zukerman, Lester G.

1940

Akman, M. S.
Anderson, O'Dean
Batu, Buhtar
Braithwaite, J. W.
Brewer, Leo
Espy, W. Dawkins
Gentner, William E.
Green, William J.
Guillou, Alfred V.
Hartman, Edwin P.
Helfer, Robert
Hohwiesner, Henry, Jr.
Holloway, John M.
Horne, Riley C., Jr.
Howell, William J.
Kemp, Leroy J.
King, James L.
Lewis, William D.
Marwuardt, Roy E.
Nagle, Darragh E.
Olney, Frank
Pai, Shih-I
Paul, Ralph G.
Stowell, Ellery C., Jr.
Tao, Shih Chen
Thompson, Ross D. F.
Vetter, Warren H.
Wang, Tsung-Su
Wild, John M.

1941

Bruce, Sydney C.
Buchzik, Charles M.
Caldwell, Norman H.
Carlmark, Carl W.
Clark, Morris R.
Crowson, Delmar L.
Damberg, Carl F.
Durrenberger, Robert W.
Ellsworth, Richard E.
Dieter, Darrell W.
Easley, Samuel J.
Feeley, John M.
Fellers, Walter E.
Gould, Martin
Green, Jerome
Guerin, Jack T.
Hamway, Daniel S.
Hight, Charles T.
Lakos, Eugene A.
Lewis, Lloyd A.
Miller, Joseph A.
Moore, Charles L.
Peters, Ralph
Porush, Isadore I.
Ryan, Frank R.
Shelton, Edward E.
Standridge, Clyde T.
Richardson, John M.
Stickler, Robert F.
Swart, Leland
Taylor, D. Francis
Terhune, Charles, Jr.
Tiemann, Cordes F.
Truesdell, C. A.
Tyra, Thomas D.
Vartikian, Onick
Weiss, Joseph
White, John R.
Whitfield, Hervey H.
Yui, En-Ying

1942

Bebe, Mehmet F.
Callaway, William F.
Chastain, John A.
Gayer, Martin R.
Go, Chong-Hu
Goldin, Robert
Grossberg, Allan
Horne, Othniel
Levin, Daniel
MacKenzie, Robert E.
McDaniel, Gene W.
Martinez, Victor H.
Muratzade, Enver
Pollycove, Myron
Proctor, Warren G.
Tovell, Walter M.

1943

Bacon, John W., Jr.
Bridgland, E. P.
Edelman, Leonard B.
Fiul, Abraham
Flavell, Edgar W.
Johns, Robert R.
Jones, W. Lawson
Kane, Richard F.
Labanauskas, Paul J.
Levine, Robert P.
Ling, Shih-Sang Ling
McCourbrey, Arthur O.
Mampell, Klaus
Newton, Everett C.
Patterson, Ernest L.
Rambo, Lewis W.
Sweeney, W. E.
Vicente, Ernesto
Yung, Chiang H.

1944

Abrams, Leonard S.
Alpan, Rasit H.
Barfield, Howard P.
Baronowski, J. J.
Beek, Barton B.
Bell, William E.
Birlik, Ertugrul
Boehnlein, Chas. T.
Burch, Joseph E.
Chambers, Lester S.
Chang, Howard H. C.
Cox, Charles S.
Dameson, Louis G.
Debevoise, John M.
Estrada, Meuk S.
Feblowiez, Ernst
Fu, Ch'eng Yi
Geisberg, R. L.
Goldsmith, Edward A.
Gray, James B.
Harbottle, Garman
Hasert, Chester N.
Harrison, Charles P.
Heinz, John A.
Hu, Ning
Huggins, John C.
Hurst, Stephen D.
Johnson, William M.
Kern, Jack C., Jr.
Maier, Mark P.
McCasland, Gifford
Mapel, Robert W.
Parker, Theodore B.
Phipps, Robert P.
Seiler, Dayton D.
Shults, Mayo G.
Stanford, Harry W.
Stein, Roberto L.
Sunalp, Halit
Sullivan, Richard B.
Tanyildiz, Streyya R.
Timm, Wayne C.
Titzler, Henry N.
Trimble, William M.
Writt, John J.
Yik, George
Yoho, Lewis W.
Yungul, Sulhi

1945

Ari, Victor A.
Bozarth, Charles W.
Bunze, Harry F.
Burns, William R.
Carlson, Harry W.
Carter, Truland H.
Cato, Glenn A.
Jenkins, Robert P.
Knox, Robert V.
Krause, Jack D.
Lien, Wallace A.
McElhannon, Marshall E.
Magneson, Norman J.
Maloney, John W.
Nesbitt, Mason W.
Pooler, Louis G.
Ridley, Jackie L.
Scarbrough, A. D.
Taylor, Edward C., Jr.
Trout, R. G.
Werme, John V.
Wiedow, Carl P.

1946

Anderson, John B.
Andrews, Clyde C.
Brinkhous, Harvey H.
Bromley, Edmund, Jr.
Burger, Glenn W.
Clapp, Roger W.
Conradt, Robert H.
Downs, Bertram W., Jr.
Drake, James F.
Dyson, Jerome P.
Ellis, Douglas S.
Esner, David R.
Fagan, Peter
Gill, George S.
Hoffman, Charles C.
Huang, Tsung Hsiung
Ingram, Wilbur A.
KeYuan Chen
Lambertus, Harold
Lewis, Frederick W.
Lowery, Byron O.
McCann, Hal D.
Miller, Jack N.
Monteath, E. B.
O'Meara, Donald J.
Parker, James F.
Pentney, Robert W.
Reece, Robert H.
Russell, Charles R.
Simmons, George F.
Smith, Harvey F.

LOST ALUMNI CONTINUED

Stookey, William C.
Tung, Yu-Sing
Uberoi, Mahinder S.
Webb, Milton G.
Webber, Carroll A., Jr.
Weisenberg, J. O.
Weitzenfeld, Daniel K.
Williams, Ralph C.

1947

Atencio, Adolfo J.
Bellew, William R.
Clarke, Fredric B.
Craven, John P.
Das, Subodh C.
Fossier, Mike W.
Fusfeld, Robert D.
Garrison, Edward W.
Heidt, Herman
Huang, Ea-Qua
Hutcheson, Paul T.
Kelley, George G.
King, Emmett T.
Leo, Fiorello R.
Lesko, James S.
Lim, Vicente H., Jr.
Lundy, William P.
Monoukian, John
Moorehead, Basil E. A.
Myers, Franklin O.
Robinson, Leland P.
Rosell, Fred E., Jr.
Shackford, Robert W.
Stephenson, Thor E.
Stiles, Stanford G.
Tvedt, Joseph A.
Veale, Joseph E.
Werner, Jerard

1948

Buhler, James L.
Chapman, Curtis, Jr.
Crawford, Walliam D.
Epprecht, George W.
Fisher, Luther F.
Garber, Max
Garbin, Walter W.
Jenista, Chas., Jr.
McCollam, Albert E.
McJones, Robert W.
Metzler, David E.
Mitchell, Edward E.
Oberbeck, Thomas E.
Ogilvie, Douglas C.
Reed, Arthur W.
Slusher, John T.
Steward, Malcolm H.
Stewart, Robert S.
Svimonoff, C.
Swain, John S.
Swank, Robert K.
Taylor, Edward A.
Taylor, James K.
Tomlin, Raymond N.
Walters, James W., Jr.
Whitney, James E.
Willmer, David B.
Winniford, Robert S.
Zwick, Eugene B.

1949

Albert, Joseph L.
Baker, Joe D.
Barish, David T.
Bauman, John L., Jr.
Brown, George J.
Cantwell, Joseph R.
Cooper, Harold D.
Craighead, Emery M.
Crate, James H.
Hrebec, George M.
Jacomini, Omar J.
Kashiwabara, Naomi
Kenney, James T., Jr.
Krasin, Fred E.
Lind, Ralph E., Jr.
Love, Everett E.
Love, John R.
McElligott, R. H.
Mattina, John C.
Merrell, Richard L.
Mirza, Rafat
Moore, Robert T., Jr.
Nielson, Jack N.
Petty, Charles C.
Pollack, Richard J.
Rosner, Arnold S.
Shull, James R.
Simpson, Colin G.
Wayne, Lowell G.
Wilson, M. Kent
Zieman, Clayton M.

1950

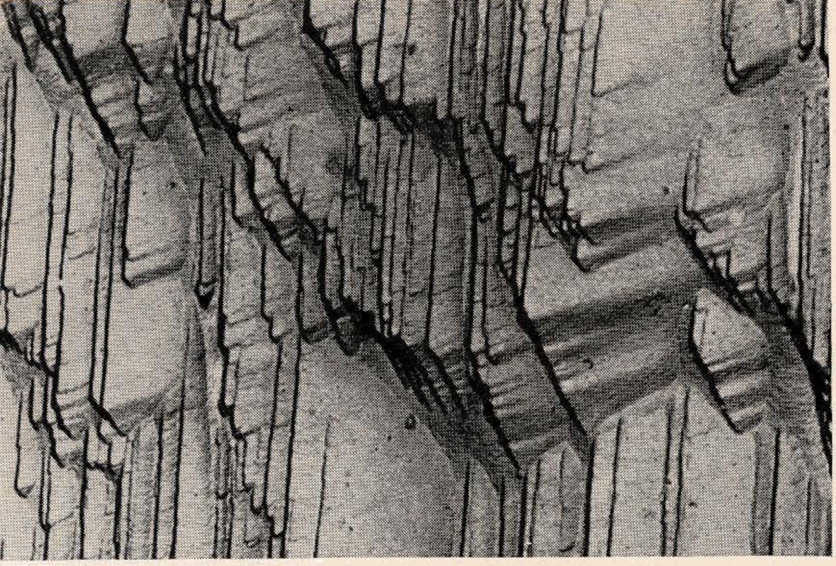
Alexander, Joseph B.
Barrie, Donald S.
Blaker, Robert H.
Brow, Raymond E.
Brooks, Marvin C.
Bucholz, Werner
Burket, Stanley C.
Conly, James C.
Connolly, Thomas J.
Coons, Thomas P.
Craig, Roy P.
Crossley, Harry E.
Curtis, Robert N.
De Lauer, Richard D.
Frinstead, Robert R.
Garrison, James B., Jr.
Glaser, Donald A.
Goodwyn, James C.
Gross, Frederick A.
Hendrickson, James B.
Holmes, Geoffrey B.
Honda, Shigeru I.
Jacobson, Norman F.
Larson, Robert R.
Leinbacb, F. H., Jr.
Lemaire, Henry
Lerman, Leonard S.
Li, Chung Hsien
McDaniel, Edward F.
McLaughlin, Jack E.
McMillan, Robert
Mansfield, James M.
Mesara, R. Reha
Montemezzi, Marco A.
Nelson, Robert C.
Petzold, Robert F.
Quigley, Milner D.
Roberts, Morton S.
Rutherford, John B.
Schuch, Adam F.
Seaborn, Garland B.
Shoenhair, Jack L.
Sletten, Harold L.
Soldate, Albert M.
Stewart, Dale F.
Stoloby, Alexander
Strange, David A.
Streaker, Harold A.
Sullivan, John H.
Tang, You-Chi
Vivian, James A.
Whitehill, Norris D.
Zwick, Stanley A.

1951

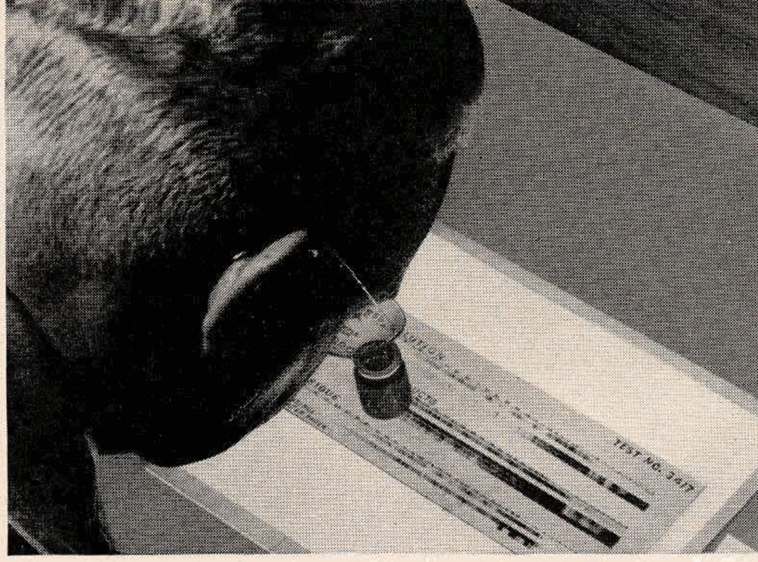
Day, Robert P.
Frye, Robert P.
Jannarone, John R.
Lafdjian, Jacob P.
Radey, Kendrick
Robertson, Donald S.

Ex-Students

Breen, John M. '36
Carrick, Thomas H. '34
Dusel, Alvin K. '37
Frazee, John L. '31
Fagin, Verne A. '22
Grisworld, Edward A. '32
Horton, Warren B. '30
Jackson, William D. '27
Kenney, James T., Sr. '22
Kuert, William F. '20
Lawrence, Franklin R. '36
Merrill, Robert A. '23
Nivens, Francis A. '34
Osman, Kurt F. '35
Pine, Frank W. '24
Poon, Yuk Pui '39
Reinen, Otto F., Jr. '28
Sarno, Dante H. '30
Shields, Alex M. II '39
Smith, Richard H. '30
White, Fletcher H., Jr. '30
Wiley, Charles A. '29
Wilson, Harry D. '35
Young, David R. '24

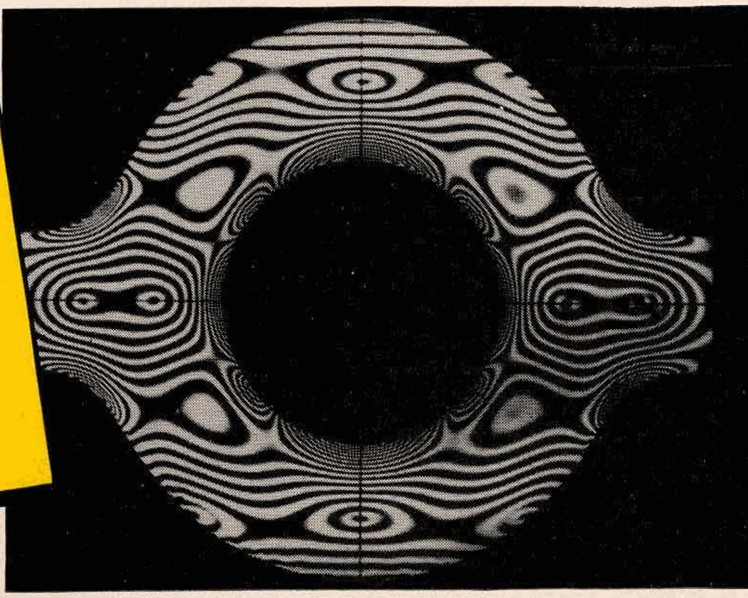


REVEALS NEW FACTS ABOUT METAL STRUCTURE. Electron micrography—up to X50,000 with the electron microscope—reveals new facts about metal structure, surface protection, and effect of processing procedures.



DETERMINES COMPOSITION OF MATERIALS. The composition of almost any material is shown in a flash through spectrography. It is a means of making frequent production line analyses that keep a check on specifications.

Engineering has an ally in photographic analysis



SHOWS STRESSES AND STRAINS VISUALLY. By photographing the patterns developed by polarized light as it passes through a plastic model of a part, the engineer can have visible evidence of the points of stress within the part.

In the engineering laboratory—on the production line—photography is today an important tool. It searches metal structure through electron micrography, x-ray diffraction, and micro-radiography. It makes swift mechanical motions seeable by showing them at a snail's pace with high speed movies. Or it can halt an instant of an instrument's fleeting trace and record it for study.

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Mercer Island, Washington

38A

QUESTION: *What are the advantages of working for a large company?*

ANSWERS: *From a poll of college graduates with ten years' experience at General Electric*

In order of mentions:

1. *Greater variety of opportunities.* Sample quotes: "More chances of getting into a type of work you will thoroughly enjoy." "Wider choice of jobs." "Plenty of opportunity to find the right job." "There are more opportunities for potential managers than there are candidates." "All sizes of puddles for all sizes of frogs." "More opportunities becoming available due to expansion, transfers, retirements."

2. *Greater opportunity for adjustment.* "G.E. goes out of its way to find the corner you are happiest in and best suited for." "Didn't have to decide on a particular specialty until I had looked the field over." "You can investigate many types of work before choosing your own special field." "Chance to change jobs without losing advantages connected with length of service." "You can change your line of work almost at will without changing employer."

3. *More chance to learn.* "More opportunity to get a good orientation and training program." "Unlimited training." "Better organized and planned training courses." "Opportunity of finding the best of training in my chosen field." "G-E training programs a good bridge between college and industry." "Training from experienced men." "Good chance to learn by association with established experts in many fields."

4. *Greater stability and security.* "Business more stable in large company." "Stability—*if* ability is proven." "Progressive policies concerning pensions, health insurance, etc." "Good security if you do a good job."

5. *Broader sources of information.* "Tremendous wealth of scientific knowledge and information no further away than telephone." "Ease of obtaining technical information, special information, services." "Wealth of knowledge and experience to draw from." "Experts available for consultation." "Access to latest and best technical information and ability."

6. *Better facilities and resources.* "Best technical skills and facilities are available." "Good research facilities and projects." "Better facilities for doing a better job." "Best in equipment and facilities." "If an idea or project is worth while and you sell it, there are adequate resources of men, material and financial backing."

7. *High standard of ethics.* "More honest effort to put value into the product." "Most people I know at G. E. are more interested in building good equipment than in profits by any means." "Fair treatment by management." "Near certainty that you will receive fair treatment." "No fear of relatives of the boss getting *my* promotion."

8. *Chance for greater personal prestige.* "Prestige of working with a company known nationally and internationally." "Friendships all over country among people of your own background and education." "Community recognition."

You can put your confidence in—

GENERAL ELECTRIC