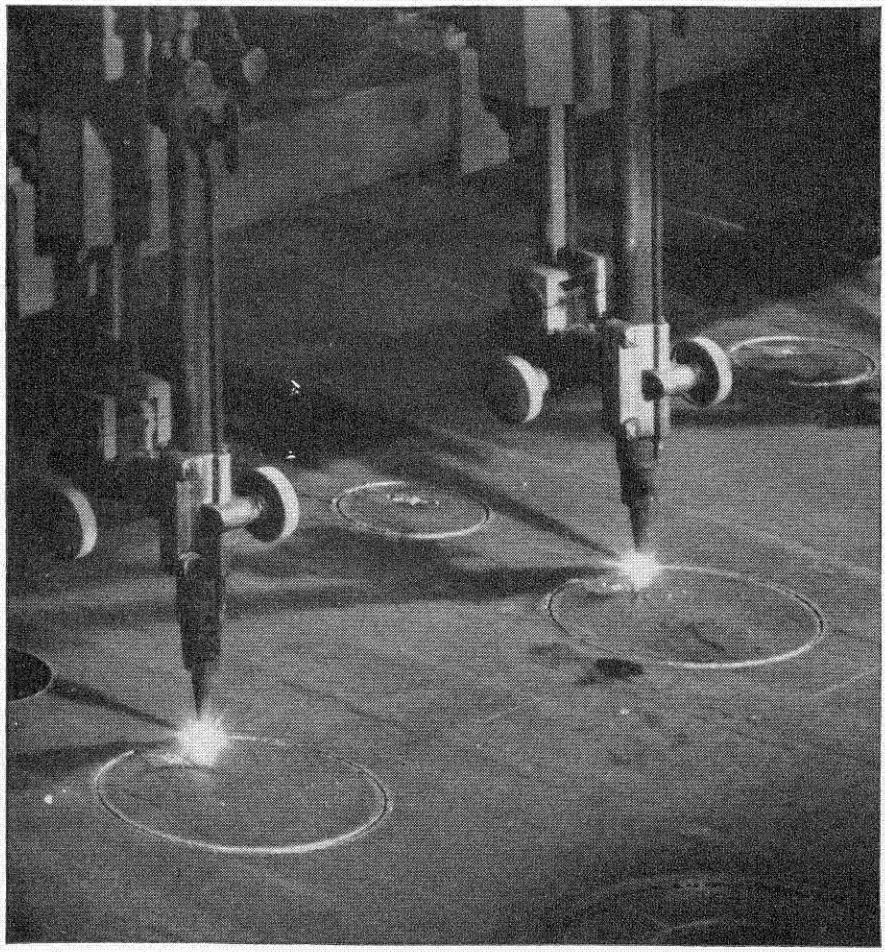
ENGINEERING | AND | SCIENCE

OCTOBER/1954

Freshman Camp . . . page 15

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Only STEEL can do so many jobs so well

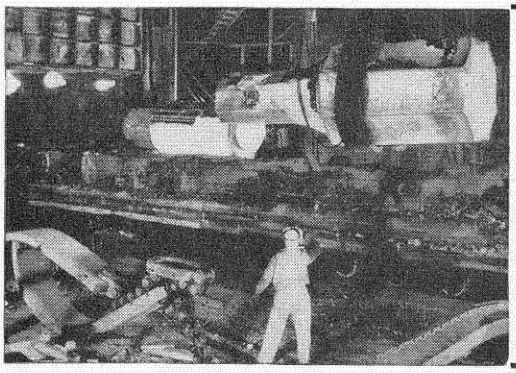


Cuts Steel Like Butter! This modern flame-cutting equipment, in use at U. S. Steel Supply Division warehouses, can follow the most complicated patterns accurately and turn out finished shapes of steel exactly as wanted. Many fabricators of steel products buy their steel from U. S. Steel Supply, and have it cut to shape before it is delivered to them.

The Spring's The Thing that gives a Trampoline its unique place in the world of exercise and entertainment. Around the edge of the resilient "bouncing" surface, more than 100 oil-tempered springs, carefully designed and precisely manufactured by U.S. Steel, quietly go about their jobs of supplying the "motive" power that enables a performer to bounce and leap as high as 26 feet.

OPPORTUNITIES WITH U. S. STEEL

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



A 42-Foot Car-Bottom Furnace heats big steel ingots like this up to forging temperature at U.S. Steel's Homestead Works. But proper heating involves a great deal of skill and experience on the part of the men who supervise the process. And U.S. Steel Forgings Division craftsmen are second to none in expertness at their various jobs. Many of them learned their skill from fathers and grandfathers who held the same jobs before them.

SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

MANUFACTURED FROM USS STEEL UNITED STATES STEEL

UNITED STATES STEEL

This trade-mark is your guide to quality steel

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

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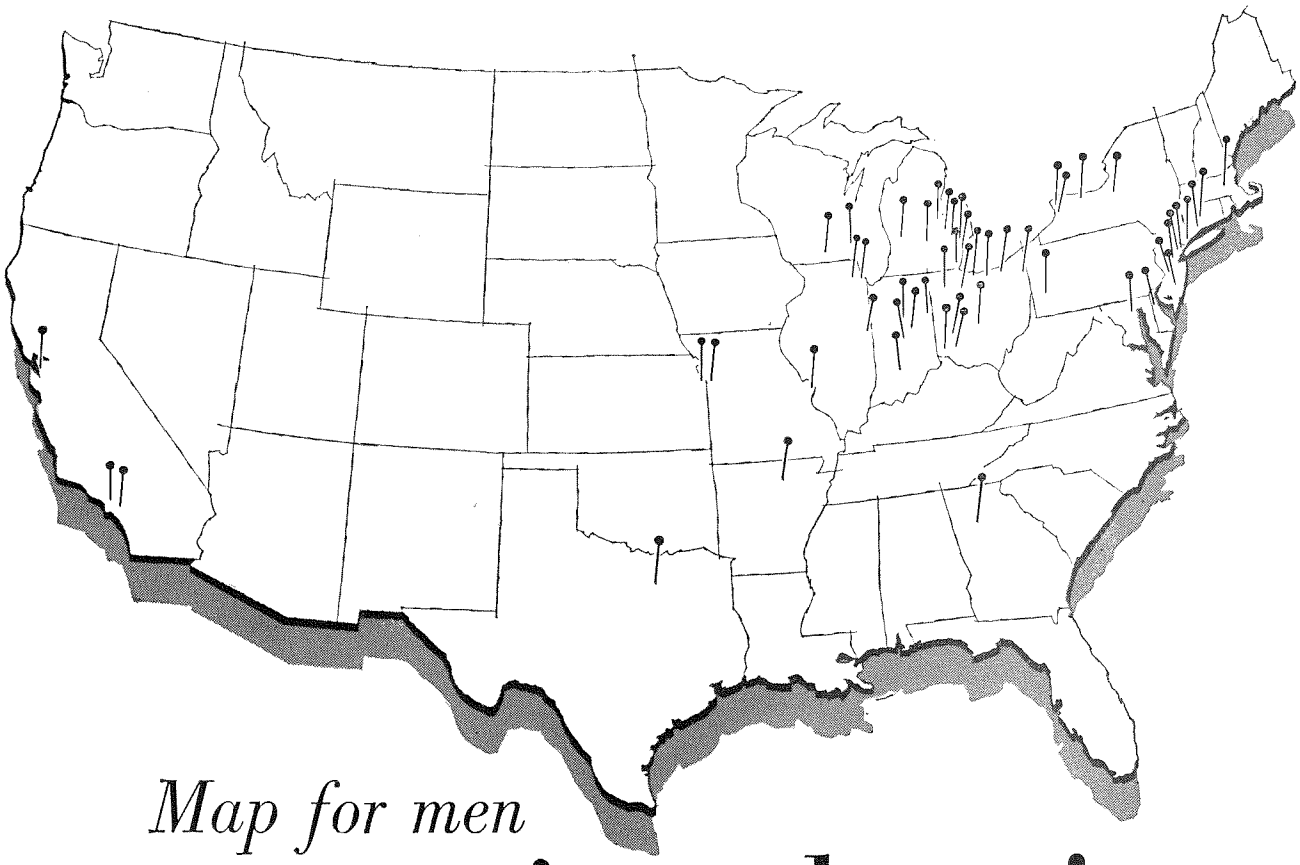
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 4-1094



Map for men going places!

EACH dot represents a city or town where at least one of the 116 General Motors plants is located.

These 116 plants—representing GM's 35 manufacturing divisions—provide a wide range of places in which you, as a young graduate engineer, might be working.

Each of these widely scattered plants offers the security and prestige of the GM name.

On top of that, each division has available to it the vast research facilities for which GM is famous.

In addition, we offer the scope of an organization which produces not only motorcars and their accessories, but also jet engines, refrigerators, electronic equipment, Diesel engines—just to name a few.

And most important is GM's deep-seated respect for engineering and engineers—the recognition of creative thinking that means "more and better things for more people."

You'll find plenty of wide-open spaces at GM if you can measure up to the chance and the challenge we offer. Why not start mapping it out in your mind?

Meanwhile, send for the booklet, "The College Graduate and General Motors," which goes into further detail concerning opportunities at GM.

GM POSITIONS NOW AVAILABLE IN THESE FIELDS:

MECHANICAL ENGINEERING
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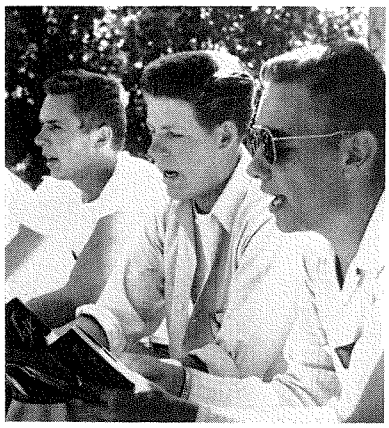
CHEMICAL ENGINEERING

GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan

ENGINEERING | AND | SCIENCE

IN THIS ISSUE



This month's cover shows three brand new freshmen having their first go at some of the Caltech songs and cheers — paying close attention to the words printed in the *Little T* (whose cover does not say "Salt"). The picture was taken at Freshman Camp — and you'll find more pictures and news of this year's camp on pages 15 to 17 of this issue.

President DuBridge's stimulating article, "The Inquiring Mind," on page 11, was originally delivered as a speech at the national meeting of the Institute of Food Technologists in Los Angeles this summer.

The modern era of heavier-than-air flight started more than 50 years ago, when the Wright brothers made their first successful but unheralded flights. The active life of Caltech's Guggenheim Aeronautical Laboratory spans just about half this period. In a special anniversary booklet, published this month by the Institute, the history and contributions of the GALCIT over the 25 years of its existence are reviewed. On page 24 of this month's *E&S* you'll find some extracts from this impressive anniversary booklet.

PICTURE CREDITS

Cover	Tom Bergeman '56
p. 16, 17	Tom Bergeman '56
p. 19	Walter Girdner Pasadena Star-News
p. 21	Tom Bergeman '56 Walter Girdner
P. 22	Walter Girdner Ross Madden — Black Star
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OCTOBER, 1954 VOLUME XVIII NUMBER 1

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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Tom Bergeman '56
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Professor of English, Emeritus

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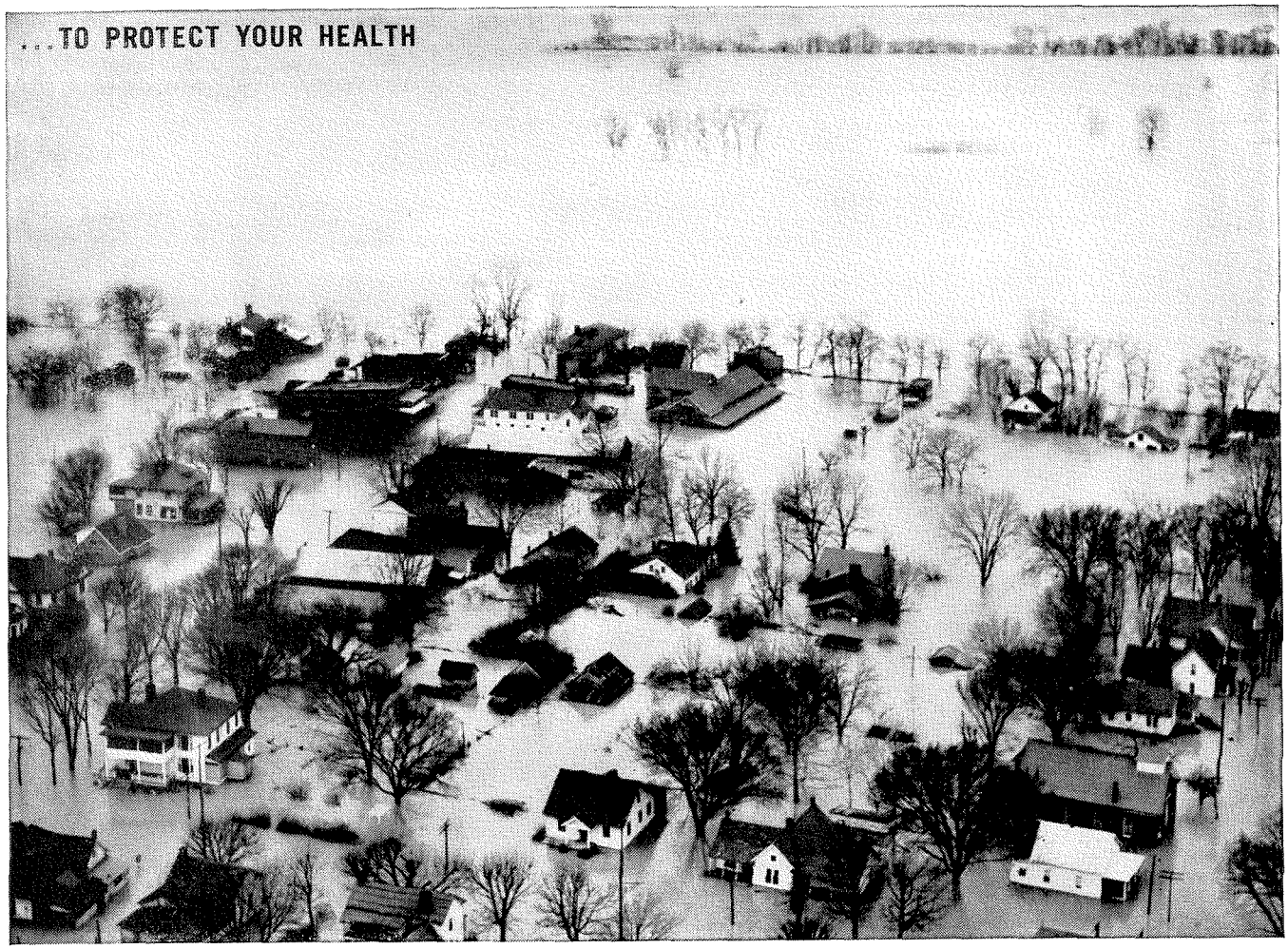
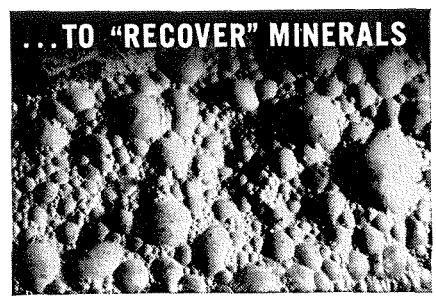


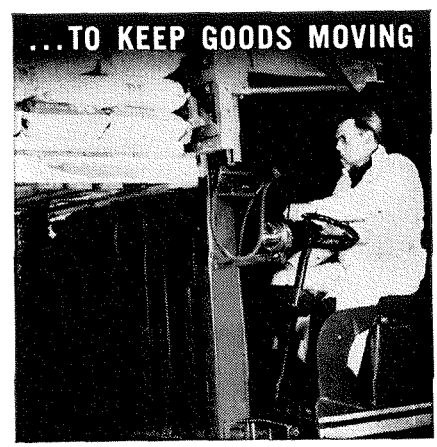
WHEN FLOODS COME, the threat to health from polluted waters is minimized by using pine oil disinfectants in clean-up operations. Pine oil disinfectants have long been recognized for their high germicidal action and good cleansing qualities. Economical to use, and possessing a pleasant fragrance, disinfectants, cleaning compounds, and soaps made with Hercules® Pine Oil are widely used in industry and the home.

HOW HERCULES HELPS...

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



THE FLOTATION PROCESS is used extensively in industry to separate fine particles of valuable minerals, ranging from coal to gold, from less useful materials by floating to the surface and removing in a froth formed by air bubbles. Hercules flotation agents, Yarmor® Pine Oil, Rosin Amine D Acetate, and others, serve as frothers or collectors in this job.



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Lockheed Aircraft Corporation : Van Nuys, California

An Invitation to
Physicists and Engineers:

Missile systems research and development is not confined to any one field of science or engineering. Broad interests and exceptional abilities are required by the participants. Typical areas include systems analysis, electronics, aerodynamics, thermodynamics, computers, servomechanisms, propulsion, materials research, design and fabrication.

Because of the increasing emphasis on the missile systems field, there is opportunity to share in technical advances which have broad application to science and industry.

Those who can make a significant contribution to a group effort of utmost importance -- as well as those who desire to associate themselves with a new creative undertaking -- are invited to contact our Research and Engineering Staff.

E R Quesada

E. R. Quesada
Vice President and
General Manager

BOOKS

THE MAN IN THE THICK LEAD SUIT
by Daniel Lang
Oxford University Press, N.Y., $3.50

DANIEL LANG, a reporter for *The New Yorker* magazine, has been concentrating in recent years on subjects having some connection with atomic energy. The results of this concentration, collected here, prove to be good reporting, lively reading, and practically perfect popular science writing.

Mr. Lang's footnotes on the atomic age include descriptions of the first atomic bomb tests at Yucca Flat, Nevada—and the effect of the tests on life in nearby Las Vegas; our civil defense plans in case of atom bomb attacks; the birth and growth of the atomic energy preserve at Oak Ridge, Tennessee—and of its H-bomb counterpart at Ellenton, South Carolina.

Most memorable of all are the people Mr. Lang runs across:

Wernher von Braun—once head of Germany's experimental guided missile station at Peenemünde, where the V-2 was developed, and now director of research and development projects at the Army Ordnance Guided Missile Center in Huntsville, Alabama—who believes that "any real scientist ends up a religious man."

Paddy Martinez, the part-Mexican, part-Navajo sheepherder who discovered one of the largest uranium deposits in the United States while on his way to the store for a pack of cigarettes.

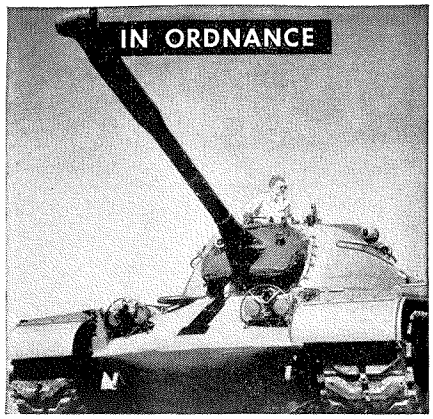
Mrs. W. R. Grace, of the shipping family, whose seven-thousand acre hunting preserve near Ellenton, South Carolina, was acquired by the government as part of its H-bomb development. "Oh, well," she says philosophically, "there's no point crying. I've had a good time. The hydrogen bomb hasn't been the only surprise. This past winter we had one of our cold snaps and the camellias went."

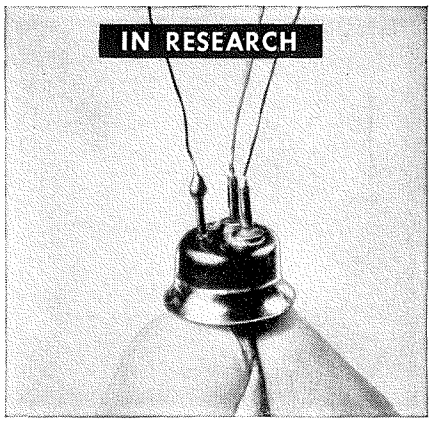
Samuel Goudsmit, chairman of the Physics Department at the Brookhaven National Laboratory in Upton, Long Island. ("We physicists are among the maladjusted veterans of the Second World War.")

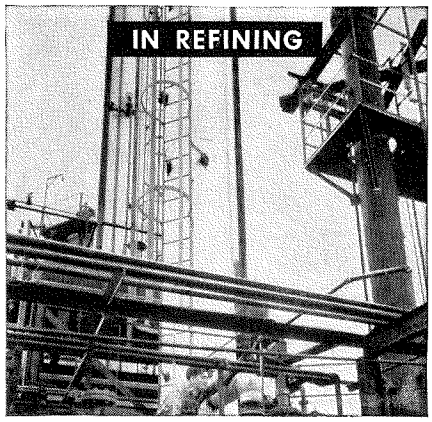
William G. Pollard, executive director of the Oak Ridge Institute of Nuclear Studies, who, after 20 years as a physicist, was ordained a deacon of the Episcopal Church. ("And all I ever hoped was that maybe Bill would go to church Sundays," says his wife.)

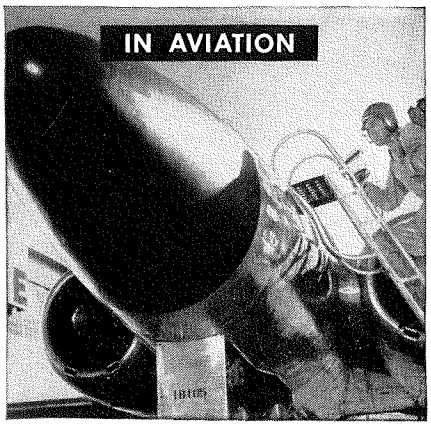
FLUID MECHANICS
With Engineering Applications
by R. L. Daugherty and
A. C. Ingersoll
McGraw-Hill, New York $7

THIS IS THE FIFTH edition of this work, formerly called *Hydraulics*, which has been standard in the field for nearly 40 years. It deals with the fundamentals of fluid mechanics together with the practical applications to hydraulic engineering and hydraulic machinery. Applications to fluids other than water are emphasized, and compressionable as well as incompressionable fluids are considered. Recent advances in fluid mechanics are thoroughly discussed, and an abundance of information concerning experimental data is included. Dr. Daugherty, a Caltech faculty member since 1919, is Professor of Mechanical and Hydraulic Engineering here; Dr. Ingersoll is Assistant Professor of Civil Engineering.









HONEYWELL OFFERS CHALLENGES UNLIMITED

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

The development and manufacture of tiny transistors for electronic control . . . the design and construction of giant control valves for oil refineries . . . the challenge of finding fish with underwater sonar . . . of providing automatic flight for supersonic jets . . . temperature controls for today's modern home . . . for atomic piles . . .

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

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

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

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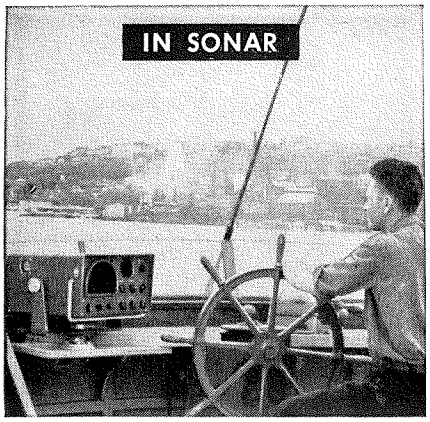
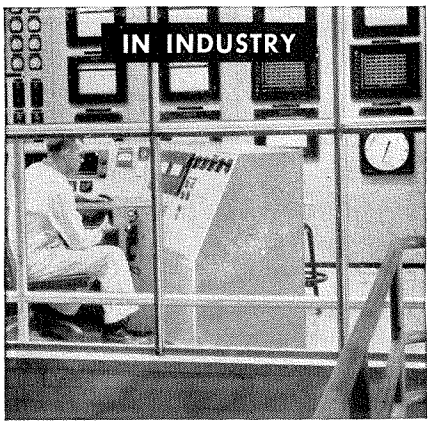
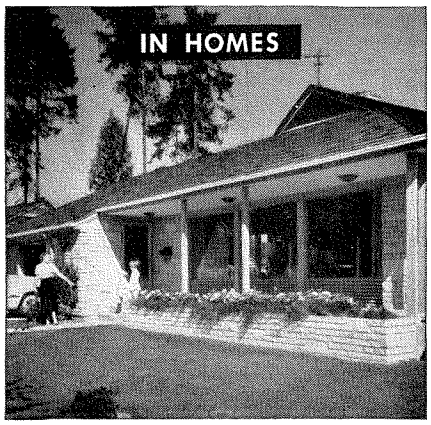
Divisions: Appliance, Aeronautical, Commercial, Heating Controls, Industrial, Marine, Micro Switch, Ordnance, Valve.







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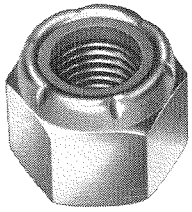
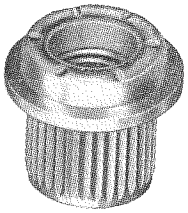
self-locking fasteners

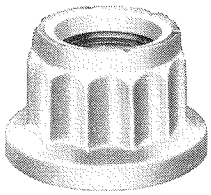
Elastic Stop nuts



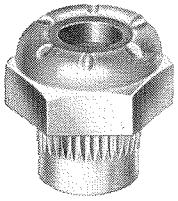
HEX NUT



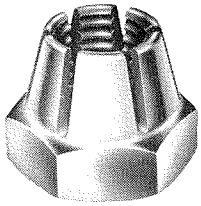
SPLINE NUT



HIGH TENSILE NUT

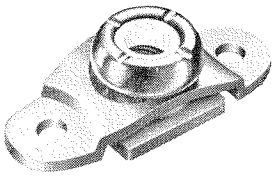


CLINCH NUT



1200° F. HIGH-TEMP. NUT

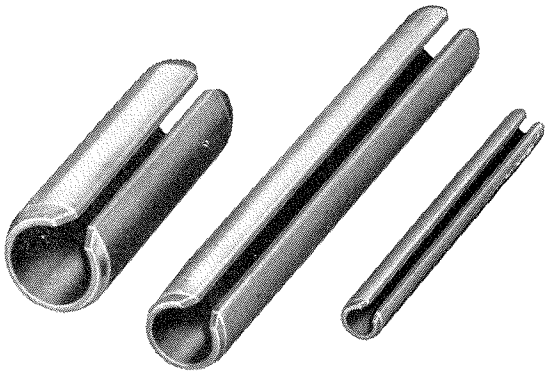
GANG CHANNEL NUTS



FLOATING ANCHOR NUT

Every major aircraft now being assembled relies on the vibration-proof holding power of ELASTIC STOP nuts. Only ESNA manufactures a complete line of all types and sizes of self-locking nuts.

Rollpins



dia. from 1/16" to 1/2"

Rollpins are slotted, tubular steel, pressed-fit pins with chamfered ends. They drive easily into holes drilled to normal tolerances, compressing as driven. Extra assembly steps like hole reaming or peening are eliminated. Rollpins *lock* in place, yet are readily removed with a punch and may be reused.

Cut assembly costs by using Rollpins as set screws, positioning dowels, clevis or hinge pins. Specify them in place of straight, serrated, tapered or cotter type pins.

ESNA TRADE MARK

ELASTIC STOP NUT CORPORATION OF AMERICA

ROLLPIN TRADEMARK

Mail Coupon for Design information

Elastic Stop Nut Corporation of America
Dept. N34-152, 2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin Bulletin
- ☐ AN-ESNA Conversion Chart
- ☐ Here is a drawing of our product. What fastener would you suggest?

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Firm_____

Street_____

City_____ Zone____ State_____

William R. Parlett, Cornell '48, Sets Sights on Executive Sales Job

BILL PARLETT has learned that helpful engineering suggestions promote good customer relations.

"Within the next ten years", says William R. Parlett, young Worthington Sales Engineer, "many of the officers of the corporation, district office sales managers and top salesmen will be retired.

"Appreciating the fact that someone must fill these jobs, our management is striving to develop capable leadership among the younger men of the corporation.

"As a prospective Worthington Sales Engineer, I received several months of classroom instruction by works managers, top sales personnel and application engineers at all of the Worthington plants. The background I obtained was a sound basis for further development and learning gained in one of the product sales divisions and then in a district sales office. After obtaining sufficient product knowledge and sales training, I was ready to sell directly to industry. As more important sales assignments are available, I feel I will progress in proportion to my own development and sales performance.

"As a Worthington salesman I contact a class of trade with which it is a pleasure to do business. The company's reputation is a key to a welcome reception by my customers.

"I have found that with Worthington you have job satisfaction, adequate compensation, and unlimited opportunity."

When you're thinking of a good job, think *high*—think *Worthington.* 3.6

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

WORTHINGTON

The Sign of Value Around the World

1927 — pioneer airliner, Boeing 40A, 144 m.p.h.

1954 — America's first jet transport, the Boeing Stratoliner, 550 m.p.h.

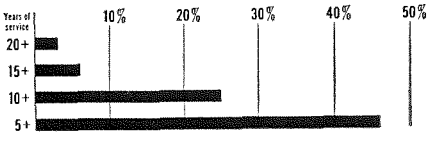
Two trail-blazing transports . . . both Boeings

America's pioneer transcontinental airline passenger plane, the 40A of 1927, was a Boeing. Today, America's first jet transport is another Boeing, the 707. This quarter-century of commercial design leadership is paralleled by military design leadership ranging from the old B-9 bomber to the fighter-fast Boeing B-47 and B-52 jet bombers of today.

For 38 years Boeing engineers have blazed exciting new trails in design, research and production. They're blazing them today in jet aircraft, guided missiles, and research in supersonic flight and the application of nuclear power to aircraft.

If such new-horizon engineering appeals to you, Boeing offers a rewarding career, whether you are in civil, mechanical, electrical or aeronautical engineering, or a related field. Boeing is expanding steadily, and employs more engineers today than even at the peak of World War II. Boeing also promotes from within, and holds regular merit reviews to give you individual recognition.

At Boeing you'll find an unusual range of opportunity, from applied research to production design, from work with new materials and techniques to contacts with a cross-section of industry through the company's vast subcontracting program. Boeing employs draftsmen and engineering aides to handle much routine work, thus freeing engineers for more stimulating assignments.



Boeing engineers enjoy stable careers —46% having been with Boeing for 5 years or more; 25% for 10, and 6% for 15. Many engineers have been here 25 years, and 7 have been with Boeing for 30.

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

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

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

BOEING

SEATTLE, WASHINGTON WICHITA, KANSAS

THE INQUIRING MIND

by L. A. DuBRIDGE

How are we doing in the fields of science and technology today? Have we properly visualized our task and our goals? Are we putting first things first? Do we even know which things ARE first?

IN 1798 A MONK by the name of Thomas Robert Malthus published a paper with a long and complex title which attempted to analyze man's future on this planet. Examining past experience and bringing to bear on this experience the brilliant logic of an analytical mind, he came to some rather dire conclusions about the future. It was quite obvious to him that men had to eat; that the only major source of food was the arable land; that the area of such land was limited. Therefore, there was a limit to the potential food supply, and hence to the population that could exist on the earth.

On the other hand, he noted that the human population tended to grow at an ever-increasing rate. Any sort of voluntary birth control, it seemed to him, would be either unnatural or immoral. Therefore, the only possible future was one in which the population eventually outgrew the food supply, and thereafter death by starvation, disease and war would take over to balance a birth rate which knew no control.

Clearly, a world in which most of the people would assuredly die of one of these causes was not a very pleasant one to contemplate.

However, here we are 156 years after the Malthusian prediction, and the portion of the world that we live in does not face the Malthusian death sentence. Our population is expanding at a rate never dreamed of in Malthus' time. There are four times as many people on the earth now as then. At the same time, here in the United States at least, we have far more trouble with food surplus than with shortage. We buy potatoes and dye them blue, butter and let it spoil, wheat and give it away, in our desperate effort to avoid the economic consequences of growing more food than we can eat.

Surely Malthus was the most mistaken man in history. Or was he?

Actually, as Harrison Brown points out in his recent book (from which I shall now borrow heavily), *The Challenge of Man's Future*. Malthus' reasoning and logic were entirely correct. His only misfortune was that his observations and assumptions were later rendered obsolete by unforeseeable new developments. What were these new developments? They were of two kinds—technological and social. On the technological side men learned how to raise more pounds of food to the acre, learned to get more nutritive value to the pound, and learned how to transport food quickly from areas of surplus to areas of shortage. On the social side, great segments of the human race came to regard voluntary birth control not as a sin but as a virtue.

Now I think it is quite evident that without this latter factor—voluntary population control—the Malthusian disaster can be only postponed, and not finally prevented, by any advances in technology. We must admit that the supply of land is limited, that the productivity of land can *not* be expanded beyond all limit. But population, if not controlled, does expand without limit, and sooner or later—in 50, 250, 500 or 5000 years—a population which is doubling every 75 years or so is bound to outrun any given food supply.

This makes it clear that the primary need of the world is to insure that in all parts of it the population recognizes the need for growth that is controlled by voluntary action rather than through starvation. Clearly, this is not primarily a job for science and technology, but rather for education.

But science and technology do have some terribly important tasks to perform in this field. First, there is the task of improving the technology of producing, processing and preserving food so that the food supply will keep pace with population for the 25, 50 or 100 years

required to complete the educational job. Second, there is the task of improving standards of living over a larger part of the world—for increased education goes only with increased living standards and increased disposable wealth. Finally, science and technology have the task of providing the necessary tools so that any segment of the population that has overcome the starvation limit can then proceed to help men and women lead happier and richer lives.

Now I claim that these constitute quite substantial and immensely challenging tasks. Another way of expressing them is to say simply that if men are to attain those social, moral and spiritual goals which we of the Christian nations believe desirable, then science and technology must provide the physical tools to make their attainment feasible.

This being about as important a goal as I can think of, it behooves those of us who are working in the fields of science and technology to ask ourselves how we are doing. Have we properly visualized our task and our goals? Have we properly analyzed and evaluated the steps which need to be taken, the prerequisites for progress? Are we putting first things first and do we know which things *are* first? Are we creating within science and technology itself, and within the community at large, the conditions most likely to nurture progress and success?

Now it would be presumptuous of me to attempt to answer these questions or to try to solve the problems they suggest. But I can presume to raise the questions and ask you to think about them, in the hope that if enough people think about them, we may some day get them answered.

The goals we seek

It seems to me obvious from the way in which I have stated the problem that it is important that we keep in mind the goals we seek. As I have suggested, these goals are not merely more food, more products, more gadgets. Our goal in the last analysis is a moral goal—more happiness for individual human beings, expressed in whatever terms their own philosophy of life dictates.

I emphasize and repeat this matter of ultimate goals precisely because it is so obvious to us that it is often forgotten. We become so absorbed in our gadgets, our machines, our new foods, new medicines, our new weapons, that only too often we think of them as ends in themselves—forgetting what they are *for*.

Now if we ourselves—if we scientists—forget the ends in our absorption with the means, that is bad enough; for then our work loses its meaning. But it is even more dangerous if we let the public believe that our machines and our mechanisms are ends in themselves. For then our work, which in the end depends upon public support, will surely be destroyed. And it will be destroyed by the public even though the public itself, rather than the scientists, would be the principal losers.

Let us bring this closer home. It is a paradoxical fact that, in these days of the mid-20th century, science and technology are being simultaneously praised to the skies and damned with religious fervor; they are being handsomely supported and heartily kicked. Scientists are publicly acclaimed as a group and privately slugged as individuals.

Why is this?

Clearly, we have not told our story adequately. Our physical achievements are evident. But, because they are physical, we are accused of being materialists. Because the tools of science are powerful, their power is feared and those with the power are suspected of evil motives. Because weapons have been produced to help men fight in their own defense, it is assumed that they also make men *want* to fight. So we see that as we brag about our knowledge but are silent about our aims, then the public will come to ignore our knowledge and denounce our aims.

What scientists work for

So my first plea is that scientists shall throw off their reticence in speaking of their feelings and come out boldly and unashamedly to say, "We are working for the betterment and happiness of human beings—nothing less and nothing more."

But, in spite of the romanticism of the poet, we know full well that for most human beings *happiness* is not attained solely by sitting under a tree with a loaf of bread and a jug of wine. And even if it were, someone has to bake the bread and bottle the wine. The poet was right in suggesting that the essential elements of happiness consist of food, shelter, companionship and leisure. He only forgot to mention that these must be achieved by effort, and that the effort itself may bring happiness, too.

In any case, we are forced at once to consider how human effort can be most effectively employed to provide the physical elements for happiness and also the leisure to enjoy them. Nor are we content—as were those of medieval and ancient times—to have *many* people exert the effort and a few people enjoy the leisure. We have proved that *all* may work and *all* may play.

Now what is it that has made it possible for us today to think of a modest amount of happiness coupled with a reasonable amount of work as a possible goal for *all* people, rather than just a few? The answer is, clearly, that a series of *intellectual achievements* have enabled men to enlarge, to expand, and to dream of achieving a moral goal.

What are the intellectual achievements?

I think it is fair to say that the essential cause of the difference in the physical and the moral outlook of the western world in the 20th century, as compared to the 10th is simply that, along some time between those dates, men invented a new process of thinking.

Men had, of course, always thought, always observed, always speculated, always wondered, always asked ques-

tions, always explored. But along about 1700 men began to do these things in a new way. Men began to realize that by making observations carefully and analyzing them quantitatively, it could be shown that nature behaved in a regular manner and that these regularities could be discovered, reduced to mathematical form and used to predict future events.

This was an astonishing discovery. And as this new concept, outlined by Francis Bacon, was pursued—first by Galileo, then by Newton, then many others—a new world of understanding was opened to men's minds. Nature was partly comprehensible, not wholly mysterious and capricious. The falling stone and the moving planets became suddenly not only understandable but miraculously and simply related. Men couldn't *affect* the motion of the planets, but they *could* control the motion of the stone and of other objects.

And so, machines were invented, the concept of energy emerged, steam was put to work—and suddenly, after thousands of years of doing work only with the muscles of men and animals, men found that a piece of burning wood or coal could take the place of many slaves or horses or oxen.

From that time on, happiness and leisure for all men became a possible goal, not a crazy dream.

A limitless quest

But that was only the beginning. The scientific method led from physics to astronomy to chemistry to biology. A beachhead on the shores of ignorance became a vast area of knowledge and understanding. Yet, as the frontiers of knowledge advanced, the area of ignorance also seemed to enlarge. Nature was not simple after all. A literal eternity of new frontier was opened up. The quest for understanding, we now see, will, for finite man, be limitless.

I need not recount the way in which this new understanding has spread—often slowly, often with startling rapidity—from one field to another.

But I would like to direct your attention to the conditions that are required for knowledge and understanding to grow and to spread. Intellectual advancement does not come about automatically and without attention. There have been throughout human history only a few places and a few periods in which there have been great advances in knowledge. Only under certain special conditions does the inquiring mind develop and function effectively. Can we identify these conditions? Certainly we must try.

The first condition, of course, is that at least a few people must recognize the value of the inquiring mind. Here we all take for granted that new advances in understanding come only from the acts of creative thinking on the part of individual human beings. We know that, and we respect and admire the men who have shown the ability to think creatively. But we mustn't get the idea that our admiration for original thought is shared by all people.

Even in this country, the man who thinks differently is more often despised than admired. If he confines his new thoughts to the realms of abstruse theoretical physics or astronomy, he may not be molested. For then he will be speaking only to those who understand him. But if he wanders into biology or medicine, into psychology or sociology or politics, then he should beware.

Now in recognizing the virtues of thinking differently, we do not mean that we must encourage the idiot, the criminal or the traitor. Honest, truly intellectual inquiry is perfectly easily recognizable by those who have some training in the field. But just here we run into difficulty. Those who are incompetent to judge may nevertheless render judgment and pass sentence on those with whom they disagree, or whom they fear.

One of the great unsolved problems of a democracy is how to insure that, in intellectual matters, judgments are left to those who are competent, and the people will respect that competence. But when uneducated fanatics presume to choose and to censor textbooks, when government officials impose tests of political conformity on the scholars that may leave or enter a country, and when the editors of a popular magazine set themselves up to judge who had the proper opinions of nuclear physics, then the inquiring mind finds itself in an atmosphere not exactly conducive to maximum productivity.

Fortunately, for the past 100 years in Western Europe and in the United States the impediments to creative scholarship have been less important than the great encouragements. In the past 10 years the physical conditions necessary for research in the sciences have enormously improved. More opportunities have been created to study, to travel, to carry on research, than ever before existed.

The needs of the inquiring mind

But physical conditions are not enough. Big, beautiful laboratories do not themselves produce research—only the men in them can think. And if conditions are such as not to attract men who think or such as to impede their thinking, then the laboratory is sterile. Such laboratories, as you well know, do exist. There is no use storming and raging at the perverseness of scientists who refuse to work when conditions are not just to their liking. We don't call a rose bush perverse if it fails to bloom when deprived of proper water and soil. A community or a nation which wishes to enjoy the benefits that flow from active inquiring minds needs to recognize that the inquiring mind is a delicate flower, and if we want it to flourish we are only wasting our time if we do not create those conditions most conducive to flowering. The cost of doing so will be well repaid.

The inquiring mind then needs, first of all, some degree of understanding and sympathy within the community. And if there are those who cannot understand, then at least they must be insulated by those who do, so that they do the least harm. As someone has said, we can stand having a few idiots in each community

—as long as we don't put them on the school board.

As I have already suggested, it is not enough for the scholar or the scientist to wring his hands and wish that there were fewer idiots or that they had less influence. He must also, to the extent of his ability, explain to those who can understand what he is doing and why. We now see that an intelligent and informed segment of public understanding is essential to the progress of scholarly endeavor.

Scientist and government

This leads me to another subject which has become timely to the scientist and to the citizen in recent years; that is, the relation of the scientist and the government. This is obviously a very large subject which I cannot attempt to explore here. But as the scholar needs an informed community to support him, so he owes an obligation to that community.

The prime obligation of the scholar, of course, is to pursue scholarship. That is, he must seek answers to important questions, observe carefully, analyze accurately, test rigidly, explain imaginatively, and test and test again. Then he must publish his results, fully, fearlessly, objectively, and defend them enthusiastically unless or until the facts prove him wrong. Through such intellectual struggle does the truth emerge.

But in these days the results of science impinge so heavily on public affairs that the public—in particular the government—needs the scientist's help in so many ways. Obviously, the government needs the direct services of thousands of scientists and engineers to carry on work in public health, standards of measurement, agriculture, conservation of resources and in militory weapons, to name a few.

But when there is developed a new weapon, a new treatment for a disease, a new way of using public resources, does the scientist's responsibility end there? I think not. There are so many ways in which important matters of public policy are affected by these new scientific achievements that scientists must stand by as advisers at least to interpret, explain, criticize and suggest on policy matters.

Scientific advice

We would not think, of course, of allowing a new law affecting public health to be passed without asking a physician's advice on whether it is wisely conceived. Yet I am sure state and federal legislatures *have* thought of it—in the various antivivisection bills, for example. Fortunately, (for this purpose at least) the medical profession has great influence and can make its opinions heard. And most of the public respects its doctors.

But when national security matters are being discussed which involve the nation's strength in atomic weapons, it is clear that those in charge of forming policy will need to have much help on questions of what atomic weapons really are, what they do individually, and what would be the effects of setting off the whole stock pile. I am not saying that such scientific advice is not sought (though I think it is not always adequately used). But I do say that scientists need to be ready to help. Yes, they may need to be ready to intrude with their advice even if it is not asked for.

This problem has, of course, caused much recent trouble and misunderstanding. Many prominent citizens, including many politicians and editors, apparently feel that scientists should stick to the laboratory and let public policy matters be handled by others. Now no one argues that *decisions* on public matters must be made by the properly constituted responsible officials. But *advice* and *information* on scientific aspects of the problem is often essential and must come from scientists.

It is often true that the scientific aspects of a problem are so important that they overshadow all else—and the scientist's advice becomes adopted as a decision. But in other cases, other factors may appear important and the scientist's advice may be wrong, or may not be taken. Even the scientist, being human and being a citizen, will take non-scientific matters into account in rendering his advice. He may be just as competent to do this as anyone else. Being a scientist does not disqualify a person from being an intelligent citizen. But the possibilities of disagreement and misunderstanding are very great.

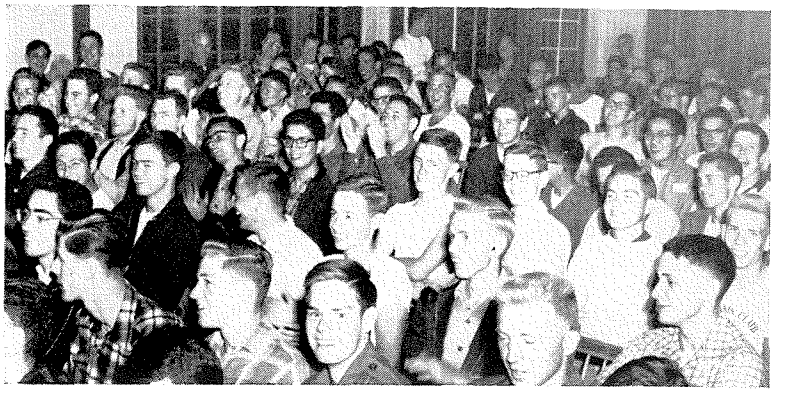
A risky course

A very great and admittedly loyal scientist is right now being persecuted partly because, though he gave advice of surpassing value on many, many occasions, he gave on one occasion advice which some (but by no means all, then or now) believe was wrong. The sad part of this case is not so much the harm to the individual, as the harm to the country that will result if scientists cannot give honest advice to their government officials, or will be no longer asked for advice, or listened to. Dire disaster could indeed follow from such a course pursued in the thermonuclear age.

I fervently believe that the world has been remade the past century—remade physically, socially, and spiritually—by the work of the inquiring scholars. These scholars have sought new knowledge and new understanding; they have sought to use this understanding to produce those things that men needed—or thought they needed—to improve their health, their comfort, their happiness, their security.

Scholars will continue these activities and the world will continue to change. Their efforts must be aided; for though what they do may yield dangers, the dangers are far greater if they do less. And since what they do affects the world, affects you and me and our community and our country, we should have these inquiring and active minds around all the time to direct their attention to the most difficult of all problems—how to help men make better use, in their relations with each other, of the great new areas of knowledge which can yield so much to make men happier and better.

1958 CHECKS IN



ONCE AGAIN Camp Radford, high in the glorious San Bernardino Mountains, has settled back into its restful off-season, and Caltech's other campus, the one in Pasadena, has settled into the lazy routine of its on-season. Which is to say that frosh camp is gone, past, history, and the new school year has begun.

Although some of the new students were on campus as much as two weeks ahead of registration time, the bulk of the new class of '58 moved in on Monday, Tuesday, or Wednesday of the week of September 20. Impressed by the campus and by the surprisingly friendly attitude of the upperclassmen (who seemed to exist only for the benefit of the frosh, in spite of expectations to the contrary), the newcomers were treated to a couple of nights of carefree activity before the time came for departure.

Thursday, September 23, they found out what registration was, as the usual epidemic of writer's cramp ran rampant among them. But the excitement of the big, streamlined buses awaiting them, and the wondrous contents of the streamlined *Little T* (edited this year by the unstreamlined Rube Moulton, '57), kept their minds off their aching fingers. Three-hour bus rides are also known to divert attention from aching fingers to other overworked parts of the body.

Thursday night was the time of the first meal from the student house kitchens, and many of the new students revealed great stamina and spirit as they devoured the dubious repast with feigned relish and even managed to croak a polite something about how good the food was.

Then the speeches began. Little need be said here about the volume and nature of these orations. Statistically, it may be found that a total of nine faculty members and twelve students gave individual talks. In addition to this twenty-one-gun salvo, Howard Vesper ('22) reminisced upon his years before and after graduation from Tech, the twenty-four student leaders who were invited to camp led seminars on "How to Study" (as if they knew), and the Amalgamated Band went from encore to encore through an unusually long and successful concert.

By the time the students had heard the last of the talks, the keen minds among them had already realized that Camp Radford is really less of an attack on the mind than on the behind.

An innovation this year was the presentation of a series of skits by the Beavers which was designed to prevent the annual spectacle of frosh going around from group to group trying to impress each other with their vast stores of knowledge.

In these skits, the most obnoxious of these familiar types were caricatured in a thorough-going manner—yet the point was lost; for, although one skit depicted the over-zealous radio ham and his log book, immediately after the program that evening a slightly embarrassed freshman got up and announced that there were so many frosh interested in radio that there would be meetings held at camp! Can't win 'em all, though.

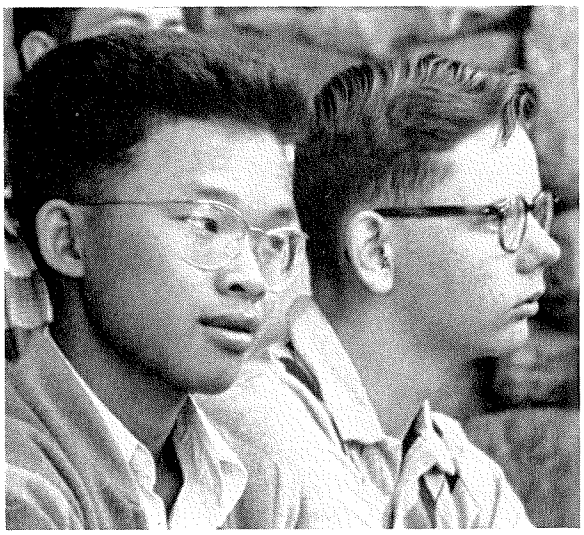
Two other interesting changes were noted: Dean Strong completely forgot to warn the frosh about the wild asses, and Harvey Eagleson purportedly gave a new speech (although nobody could remember the old one).

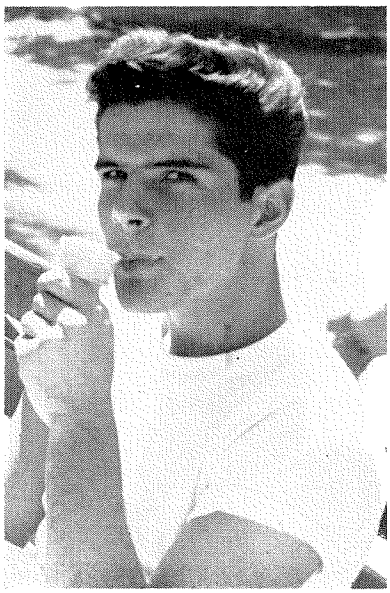
The frosh-faculty softball game was a complete wipe-out, with the freshmen winning 9-2 and not so much as a sweaty brow. This was in spite of the presence of "Win Games" Huttenback, Caltech's ex-soccer coach, who might have been expected to inspire the older men to better things.

It was, in general, a triumphant freshman class indeed which roared into Pasadena Saturday night the 25th, in their giant streamlined cross-country motor coaches, after three days of inspiration, indoctrination, mountain golf, and not enough blankets. Triumphant in softball, talented in music, strangely silent about flaws in the theory of relativity, and half-eager, half-afraid to begin classes, they were one of the best freshman classes ever to arrive on campus.

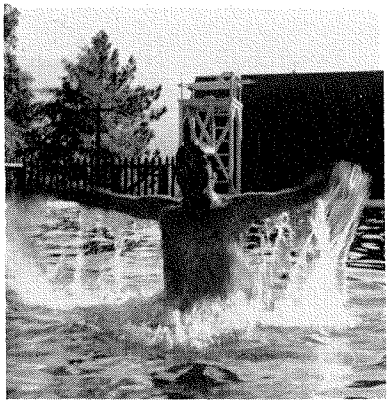
Dean Strong said so himself.

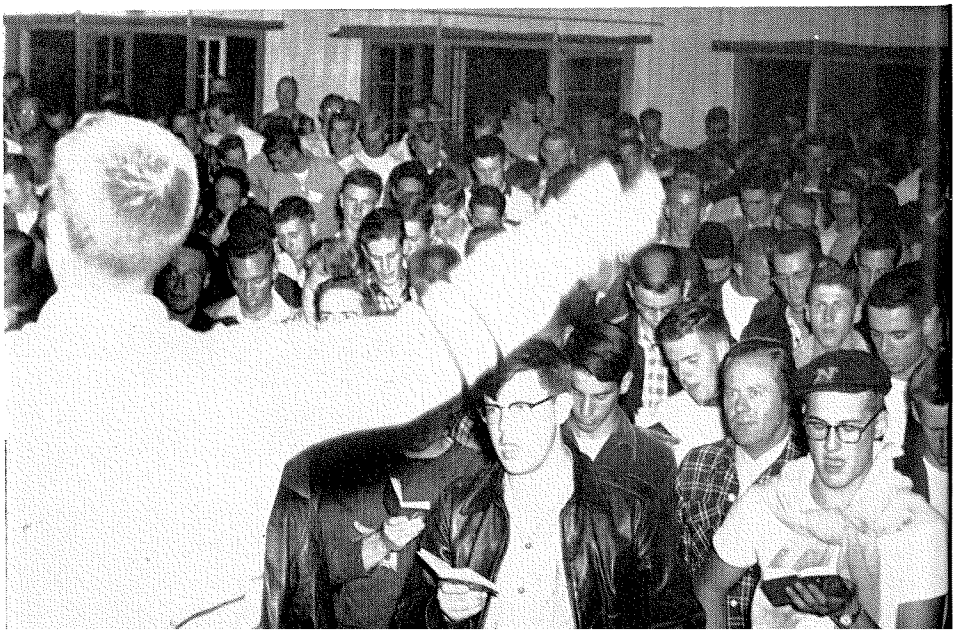
—*Martin Tangora, '57*

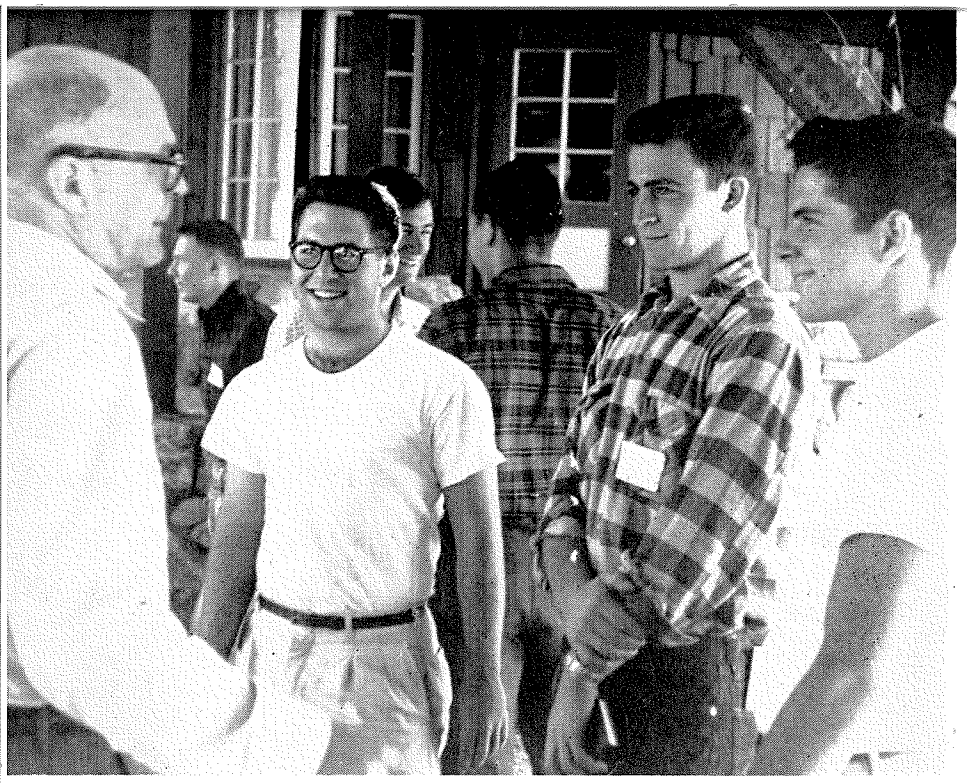


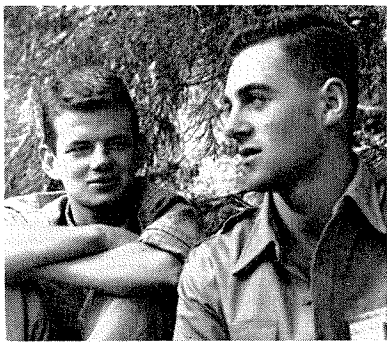


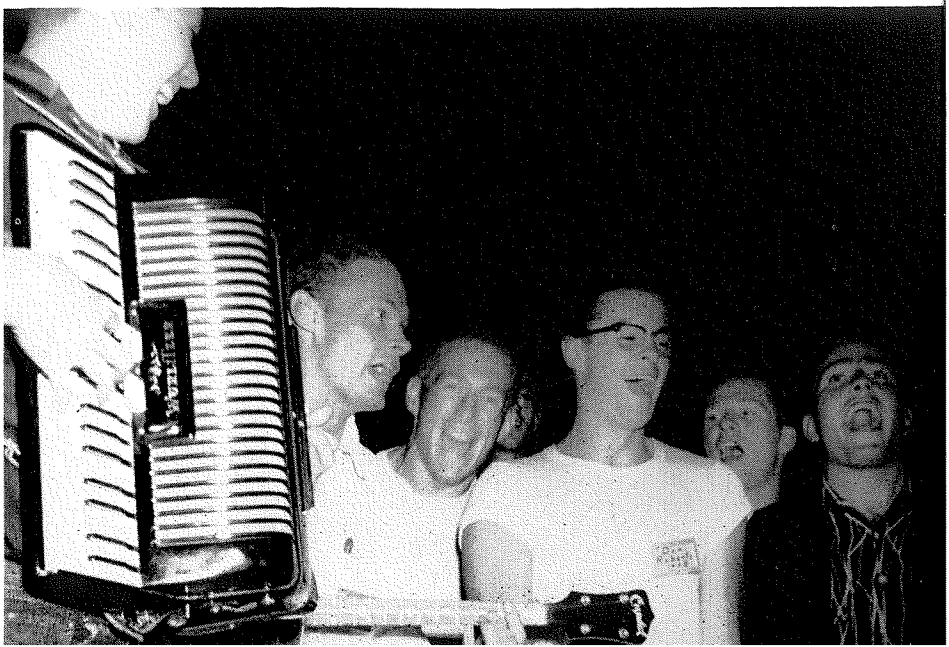
FRESHMAN CAMP
1954

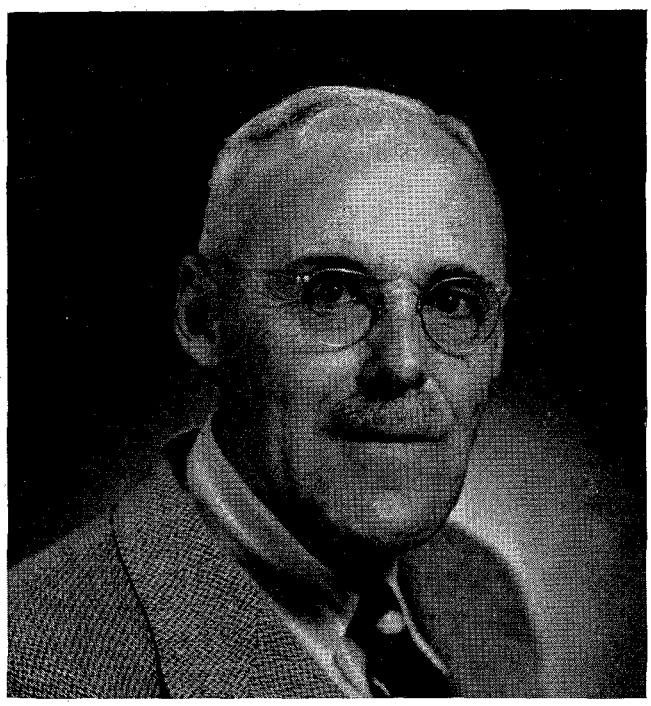












John P. Buwalda

THE SUMMER AT CALTECH

DR. JOHN P. BUWALDA, Professor of Geology and founder of the Geology Division at Caltech, died suddenly on August 19, while on a field trip with his son, Robert, in Frazier Mountain Park, Ventura County. He was 67 years old.

Dr. Buwalda came to Caltech in 1926 to organize the Division of Geological Sciences. He assembled the staff, worked out the instruction and research programs in geology, paleontology, and geophysics, and supervised the design and construction of the Charles Arms and Seeley W. Mudd Laboratories on the campus.

Born in Zeeland, Michigan, he was graduated from the University of California at Berkeley in 1912. After he got his doctorate there in 1915, he remained for two years as instructor in geology, then transferred to Yale University as an assistant professor of geology. In 1921 he returned to Berkeley as an associate professor, and stayed until 1926, when he came to Caltech.

Dr. Buwalda served as chairman of the Caltech Division of Geological Sciences until 1947, when he resigned to devote more time to research in structural geology. He continued with his teaching duties, however.

In addition to teaching, he had a distinguished career as a consulting geologist. He conducted the geological surveys for the dams and tunnels of the Colorado River Aqueduct of the Metropolitan Water District in southern California. He served as a consultant to the State Highway Division on the seismic safety of the San Francisco East Bay Bridge, and for 30 years he worked to convince the California public of the necessity of earthquake-resistant construction methods.

For many years he served on the board of expert advisers for the National Park Service, as a consultant to the U. S. Geological Survey, and as a research associate of the Carnegie Institution in Washington. From 1951 to 1953 he was president of the Seismological Society of America.

"For 40 years," said Robert P. Sharp, now chairman of Caltech's Geology Division, "John Peter Buwalda has been a major figure among geologists on the Pacific Coast. His distinguished career has combined education, administration, scientific work and public service.

"Through his work on earthquakes and as an engineering geologist on numerous large construction projects he has made a major contribution to the development and growth of the southern California community. The great sense of loss felt by his family, colleagues, students, and many friends and associates, is partly offset by the satisfaction derived from a review of his many accomplishments."

JPL Director

DR. WILLIAM H. PICKERING, Professor of Electrical Engineering, was appointed new director of the Jet Propulsion Laboratory last month, succeeding Louis G. Dunn, who resigned to join the staff of the Ramo-Wooldridge Corp. of Los Angeles. Dunn will be associate director of the firm's guided missile research program.

Dr. Pickering, a native of New Zealand, received his BS from Caltech in 1932, his MS in 1933 and his PhD in 1936. He has been a member of the teaching staff here since that time. He was associated with the late

Dr. Robert Millikan and Dr. Victor Neher in pioneer cosmic ray studies, and during World War II he served on the Scientific Advisory Board of the U. S. Air Force. He joined the Jet Propulsion Laboratory staff in 1944 as a section chief, and in 1951 was appointed chief of the Guided Missile Electronics Division.

Dr. Dunn, also a Caltech graduate (BS '36, MS '37, MS '38, PhD '40) became director of the Jet Propulsion Laboratory in 1945, having served previously as a member of the faculty of Caltech's Guggenheim Aeronautics Laboratory.

John J. Burke, still another Caltech graduate (BS '46) has succeeded Dr. Pickering as chief of JPL's Guided Missile Electronics Division. He came to the Lab in 1948 as a research engineer, and had been serving as section chief of Component Developments.

New Trustees

THREE NEW MEMBERS were elected to the Institute Board of Trustees last month: Robert L. Minckler, President of the General Petroleum Corporation; Alden G. Roach, President of the Columbia-Geneva Steel and Consolidated Western Steel Divisions of the United States Steel

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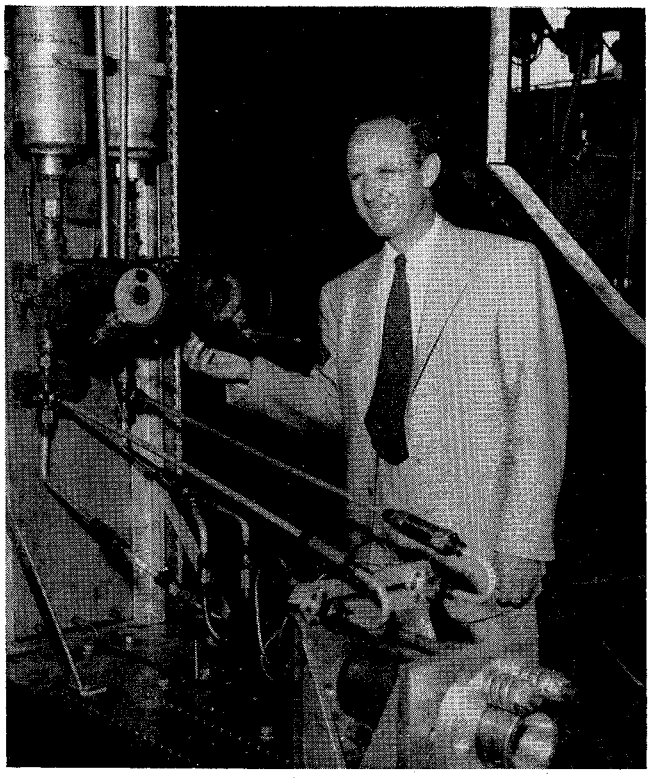
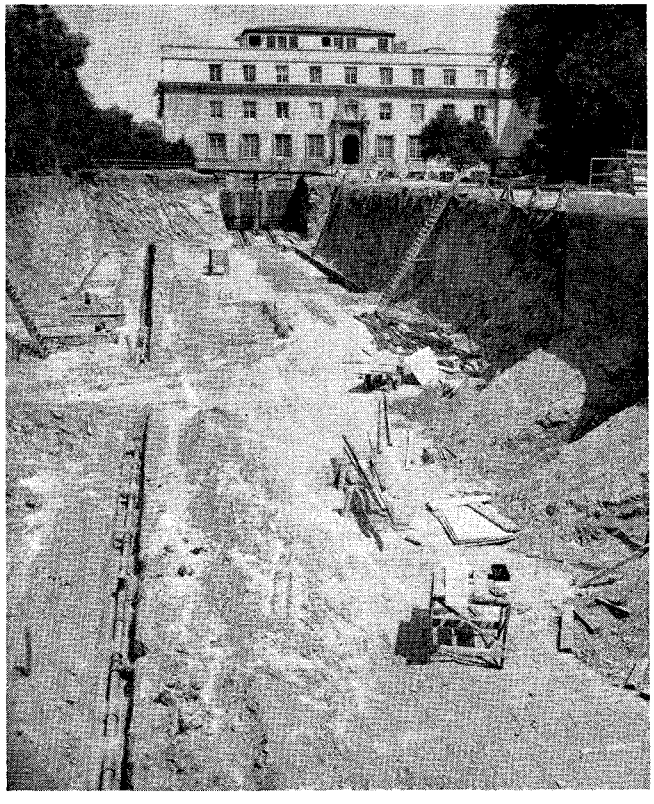
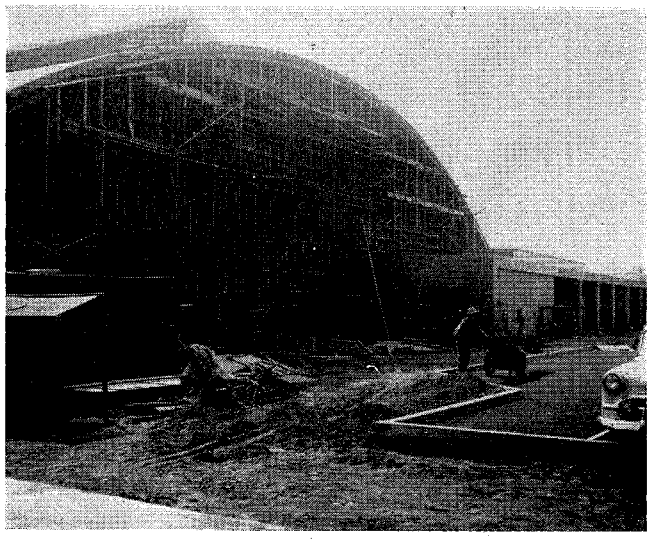


William H. Pickering, new Director of JPL

GOING UP



Construction is now under way on the two latest additions to the Caltech campus—the Norman Church Laboratory of Chemical Biology (left) and the Scott Brown Gymnasium. The gym is scheduled for completion by mid-December, in time for the opening of the basketball season. The adjoining Alumni Swimming Pool should be finished by January. The Church Laboratory will be ready for occupancy next summer.



Corporation; and Howard G. Vesper, Vice President of the Standard Oil Company of California.

Mr. Minckler, a native of Minneapolis, and an alumnus of the University of Washington, has been associated with the General Petroleum Corporation since 1924. Following wartime service as Director of Petroleum Supply of the Petroleum Administration for War, he returned to General Petroleum and became president of the company in 1948. He also serves as director of the Western Oil and Gas Association, director of the American Petroleum Institute and as a member of the National Industrial Conference Board. He is active in southern California community affairs and since 1948 has been a member of the California Institute Associates, serving as a director of that group since early this year.

Mr. Roach, a native of St. Louis, and a civil engineering graduate of the University of Illinois, has been in the steel business for 28 years. He was associated with the Union Iron Works of Los Angeles which in 1929 merged with two other steel fabricators to become Consolidated Steel Corporation. In 1941 he became president of this company which, on acquiring Western Pipe and Steel, became Consolidated Western Steel Corporation. When the United States Steel Corporation acquired Consolidated in 1948, Mr. Roach was named president of the Columbia Steel Company in addition to continuing as president of Consolidated Western. Mr. Roach has been a member of the California Institute Associates since 1952.

Mr. Vesper has been with the Standard Oil Company of California ever since he was graduated from Caltech with a BS degree in Chemical Engineering in 1922. (He is the second alumnus of the Institute to become a trustee—Arnold O. Beckman, PhD '28, having been elected to the Board in 1953.) In 1938 Mr. Vesper became manager of Standard's sales of lubricating products. Later as manager of gasoline, Diesel fuel and fuel oil sales, he was responsible for most of Standard's supplies of these products to both civilians and the military during the war years. Mr. Vesper was elected to his present position in 1952. He served for several years as a civilian consultant to the work of the former Research and Development Board of the Department of Defense, and until recently had served in the same capacity to the Assistant Secretary of Defense. He is currently president of the Industrial Research Institute, Inc., a member of the Board of Directors of the Atomic Industrial Forum, Inc., and a member of the Permanent Council of the Fourth World Petroleum Council.

Wedding

EARNEST C. WATSON, Professor of Physics and Dean of the Faculty, now on his first extended leave from Caltech in 35 years, is to be married this month to Miss Jane Werner of New York. The wedding will take place in Scotland, and the Watsons will return to Pasadena sometime in November.

Caltech's 3-2 Plan

REED COLLEGE of Portland, Oregon, has entered a co-operative "3-2 plan" with Caltech, whereby recommended students from Reed will be admitted to Caltech as juniors after three years of study in an agreed-upon program. After the student successfully completes two years at Caltech, he will be awarded the bachelor of arts degree by Reed and the bachelor of science degree by Caltech.

Four liberal arts colleges are now cooperating with Caltech in this plan—Reed, Occidental, Pomona, and Whitman College in Walla Walla, Washington. The plan may be extended to other schools if it works out to the mutual benefit of the students and colleges involved in this initial trial period.

News Bureau

MR. JAMES R. MILLER was appointed Director of the Institute News Bureau this summer. A graduate of Trinity College, Hartford, Connecticut, Mr. Miller has worked on the editorial staffs of *The Literary Digest*, *Scribner's Magazine* and *Look Magazine*. From 1942 to 1945 he served in the Navy as Anti-Submarine-Warfare officer on a destroyer-escort. In the years since the war, he has worked as a free-lance writer, as a staff writer for *This Week Magazine*, and has done general public relations and publicity on industrial accounts for the public relations office of Vernon Pope, New York City.

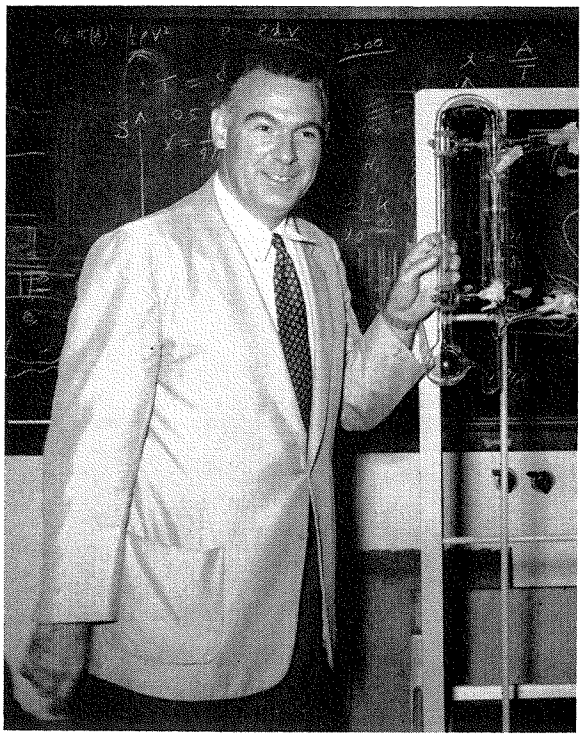
New Faculty

NEW MEMBERS of the Institute's Staff of Instruction and Research for 1954-55 include:

JOHN R. PELLAM, Professor of Physics, and an outstanding investigator in the field of low temperature physics. Dr. Pellam, who was chief of the Cryogenic Physics Section of the National Bureau of Standards, is noted for his studies of liquid helium, which he has carried close to absolute zero. He was graduated from the Massachusetts Institute of Technology in 1940 and received his PhD there in 1947.

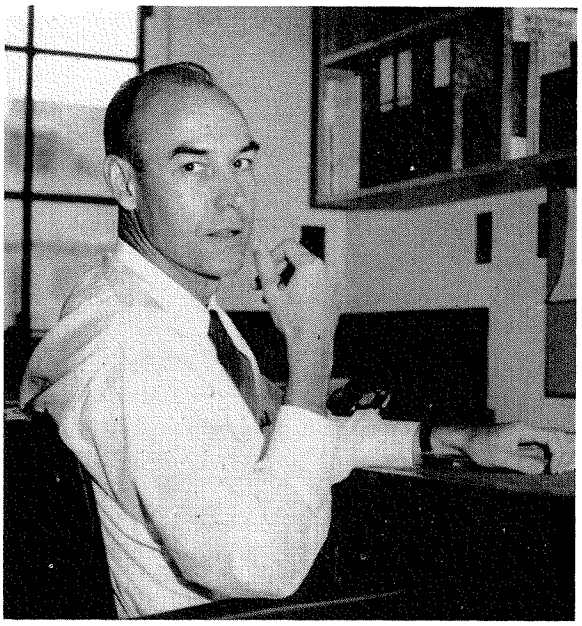
ROGER W. SPERRY, Professor of Psychology, who comes to Caltech from the University of Chicago and the National Institutes of Health at Bethesda, Maryland, where he has held a joint appointment as research associate in psychology and chief of the Development Neurology Section at the National Institute of Neurological Diseases and Blindness. Dr. Sperry studied at Oberlin College, and received his PhD from the University of Chicago in 1941.

GEORGE P. MAYHEW, Assistant Professor of English and Master of the Student Houses. A Harvard graduate, Mayhew also received the MA and PhD degrees in English language and literature there. Before coming to Caltech, he served as Assistant Dean and as Assistant to the Dean of Admissions at Harvard.

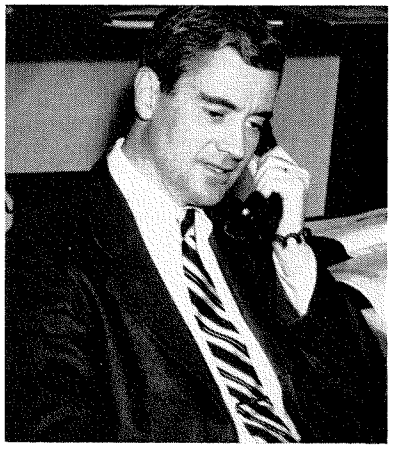


John R. Pellam

Lt. Col. Lyle F. Johnston

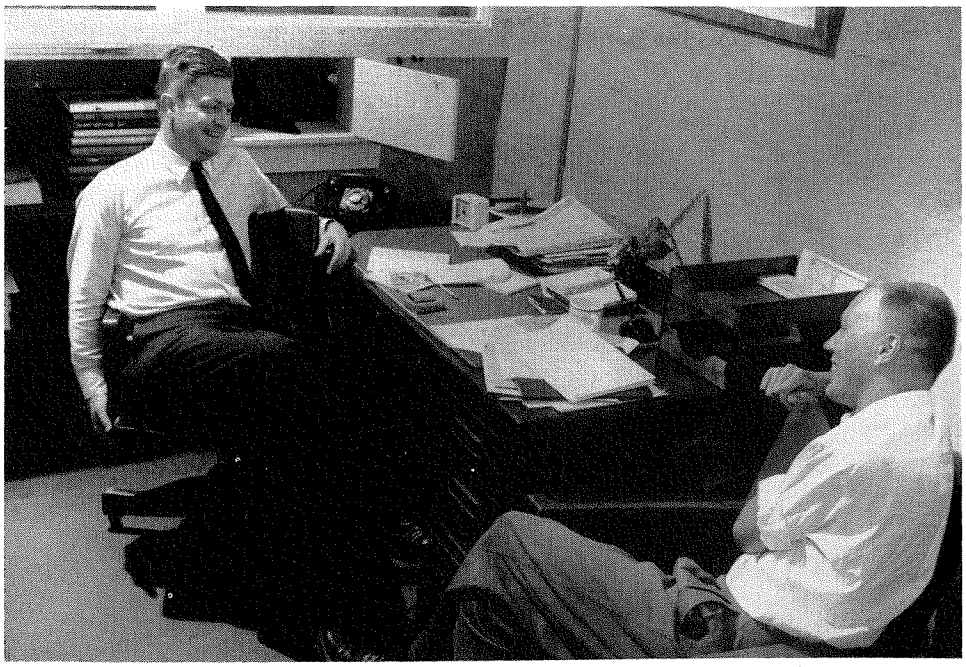


Roger W. Sperry



James R. Miller

NEW FACES



George P. Mayhew

Allen Lein, Visiting Professor of Chemistry, on leave of absence from Northwestern University Medical School, where he is Associate Professor of Physiology. He will be working with Dr. Linus Pauling on problems of the application of chemistry to biology and physiology.

Erik Hallen, Visiting Professor of Electrical Engineering, will continue his research in the field of classical electromagnetic theory while here at Caltech. He is on leave of absence from the Royal Institute of Technology in Stockholm, Sweden.

Lyle F. Johnston, Lt. Col., USAF, will be Professor of Air Science and Commandant of the Air Force ROTC at Caltech, succeeding Lt. Colonel Arthur Small.

Arthur L. Grey, Assistant Professor of Economics, on a two-year appointment.

Eugenie Calabi, Assistant Professor of Mathematics, on a one-year leave from Louisiana State University.

Edward P. Clancy, Research Associate in Physics, on a one-year leave from Mt. Holyoke, where he is Associate Professor of Physics and Department Chairman.

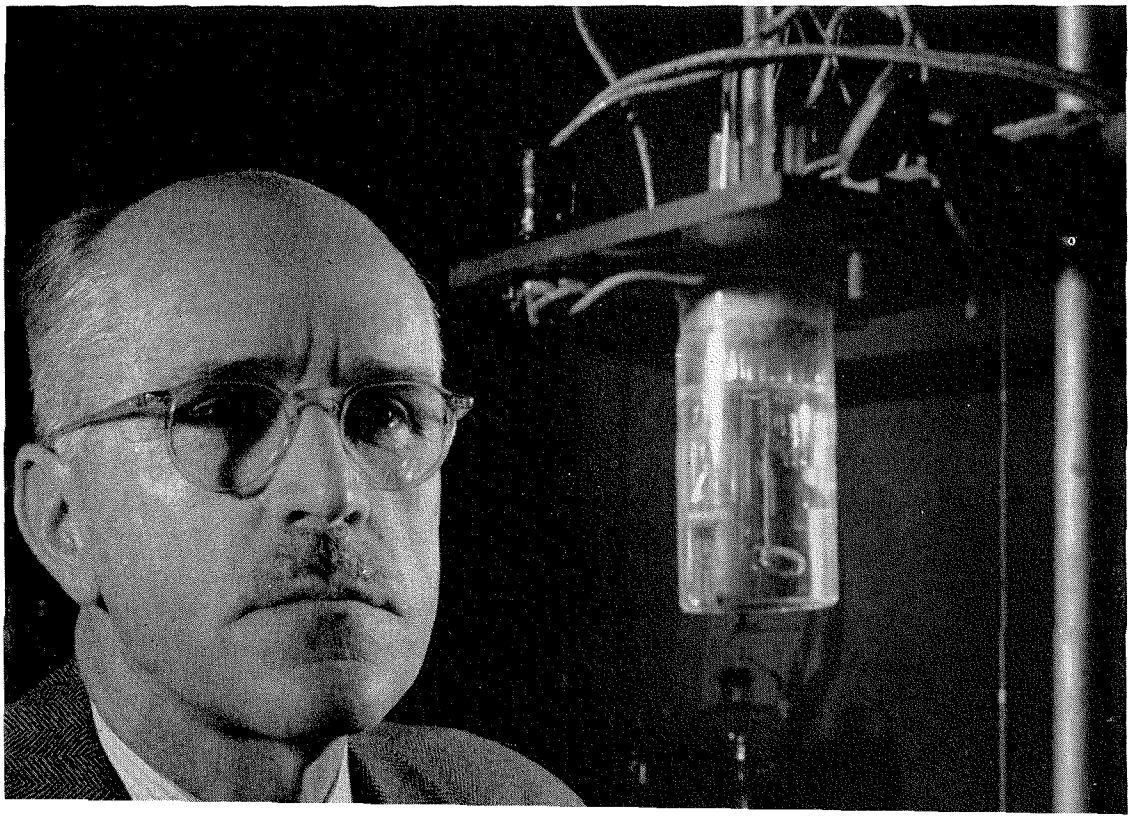
Honors and Awards

Norman R. Davidson, Associate Professor of Chemistry, has been chosen 1954 recipient of the California Section Award of the American Chemical Society.

The award is made annually to a young chemist living in one of the 11 western states, who has done his major work in the West. The award, a gold medal, will be presented to Dr. Davidson at a dinner to be held October 11 in the San Francisco Bay area.

Professor Davidson is to be recognized specifically for his investigations of the rates of very fast chemical reactions. This study, which has been his major re-

Norman R. Davidson, 1954 winner of the California Section Award of the American Chemical Society



Ernest H. Swift, named recipient of the 1955 Fisher Award of the American Chemical Society.

search project at Caltech, involves reactions that take place in less than a thousandth of a second. He has done pioneering work in developing techniques to initiate and study such reactions.

ERNEST H. SWIFT, Professor of Analytical Chemistry, has been named recipient of the 1955 Fisher Award in Analytical Chemistry of the American Chemical Society.

The $1,000 award is made annually in recognition of outstanding contributions to the science of pure and applied analytical chemistry in the United States or Canada. It will be presented to Dr. Swift at the spring meeting of the ACS in Cincinnati.

BENO GUTENBERG, Professor of Geophysics and Director of the Seismological Laboratory, has been elected a foreign member of the Geological Society of London. This award is in recognition of Dr. Gutenberg's "great contributions to seismological science, aiding in our understanding of the earth and its structure."

Dr. Gutenberg's contributions to geophysics include investigations of the structure of the earth and its core, seismic waves, the structural differences between continents and ocean bottoms, and the magnitude of earthquake shocks.

Faculty Changes

THE FOLLOWING PROMOTIONS have been made in the Caltech faculty for 1954-55:

TO PROFESSOR

C. Hewett Dix—Geology
Renato Dulbecco—Biology
A. E. J. Engel—Geology
A. L. Klein—Aeronautics

Dr. Dix came to Caltech in 1947 after 13 years as a geophysicist with the United Geophysical Co., the Socony-Vacuum Oil Company, and the Humble Oil and Refining Company. He received his BS in physics from Caltech in 1927 and the MA and PhD degrees from Rice Institute in mathematics. After teaching mathematics at Rice for several years, he turned to geophysical studies and has since remained in that field.

Professor Dulbecco received the MD degree from the University of Turin, Italy, his native country. He has served on the Turin faculty and at Indiana University. His major investigations have dealt with animal viruses, and at Caltech, where he came in 1949, he developed a new technique to simplify virus research by growing a virus on a specially prepared culture of living cells. This technique has been used to isolate, for the first time, genetically pure strains of the known types of polio virus.

Dr. Engel came to Caltech in 1948 to teach physical geology. He has directed his research toward unraveling the origin of some of the oldest rocks in the earth's crust. The Guggenheim Memorial Foundation has awarded him a grant to continue these studies in the Carribbean and Red Sea areas, the Pyrenees, and the Italian and Swiss Alps. He received his PhD from Princeton in 1942, and joined the Caltech faculty after six years with the U. S. Geological Survey.

Dr. Klein, a Caltech alumnus, has been on the staff of the Institute since 1921. He supervised the design of the wind tunnels and other apparatus at the Guggenheim Aeronautical Laboratory, and is also a member of the design group of the Southern California Cooperative Wind Tunnel. Since 1931 he has been consultant to the Douglas Aircraft Company.

TO ASSOCIATE PROFESSOR

J. Kent Clark—English
Eugene W. Cowan—Physics
Samuel Epstein—Geochemistry
Samuel Karlin—Mathematics
Guido Münch—Astronomy
Charles H. Papas—Electrical Engineering
George K. Tanham—History

TO SENIOR RESEARCH FELLOW

Charles A. Barnes—Physics
James C. Keck—Physics
Marguerite M. Vogt—Biology
Anatol Roshko—Aeronautics

TO ASSISTANT PROFESSOR

Norman H. Brooks—Civil Engineering
Thomas K. Caughey—Applied Mathematics
Henry Aroeste—Jet Propulsion, Applied Math.
Thad Vreeland, Jr.—Mechanical Engineering

ON LEAVE OF ABSENCE, 1954-55

Ray E. Untereiner, Professor of Economics, to serve as a member of the California Public Utilities Commission on a four and a half year term.

Howard J. Lucas, Professor of Organic Chemistry, to serve as Visiting Professor at Ohio State.

William A. Fowler, Professor of Physics, to conduct research at the Cavendish Laboratories in England.

A. C. Ingersoll, Assistant Professor of Civil Engineering, to serve with the Technical Cooperation Administration in India as advisor on engineering problems.

Norman Horowitz, Professor of Biology, to study in France on both a Guggenheim and Fulbright Fellowship.

H. P. Robertson, Professor of Mathematical Physics, to act as Scientific Advisor to the Supreme Allied Commander in Europe (General Alfred M. Gruenther), SHAPE.

Guido Münch, Associate Professor of Astronomy, to act as Visiting Professor of Astrophysics at Harvard University for the fall term.

Harrison Brown, Professor of Geochemistry, on a six-months leave to conduct research throughout Europe, and to make a study of India's mineral resources, on a Rockefeller Foundation Grant.

RETURNED FROM LEAVE OF ABSENCE:

Henry Dan Piper, Assistant Professor of English, after a year in France, where he taught American literature at the University of Lille.

Harold Wayland, Associate Professor of Applied Mathematics, from the University of Strasbourg, France, where he was studying on a Guggenheim Fellowship.

Caltech's Guggenheim Aeronautical Laboratory

AERONAUTICS AT CALTECH

THE IMPRESSIVE RECORD of accomplishment of Caltech's Guggenheim Aeronautical Laboratory is described in a 25th anniversary booklet* published by the Institute this month.

The story really begins some ten years before the construction of the laboratory itself. The January, 1917, Catalogue of the Throop College of Technology (which later became the California Institute of Technology) contains the following:

> Just as this catalogue goes to press, generous and wise friends of the college have undertaken to provide facilities for research in the science of Aeronautics, with every prospect of the cooperation of the United States Government. A wind tunnel will immediately be built and equipped in the best fashion, and a graduate course will probably be provided for students desiring to specialize in this branch of physics and engineering.

Between $5,000 and $6,000 was made available for these purposes, and during the subsequent year a small wind tunnel was constructed having maximum wind velocity of 40 miles per hour. The Throop Catalogue for the following year contains the first mention of two staff members concerned with matters aeronautical. Mr. A. A. Merrill, one of the very early American pioneers, whose active participation in aviation dates back to the 1890's, appears as Research Assistant; he was given the responsibility for designing, supervising the construction of, and operating the wind tunnel. (He also doubled in brass as Instructor in Accounting.) Dr. Harry Bateman, a brilliant Cambridge-trained mathematician, is listed as Professor of Aeronautical Research and Mathematical Physics. The catalogues of the next few years list a number of aeronautical courses given by these two staff members. However, the number of students must have been very small, and there was no Aeronautics Department, nor were any aeronautical degrees awarded.

In 1926 R. A. Millikan secured a $300,000 grant from the Guggenheim Fund for the construction of a laboratory and the establishment of a graduate school of aeronautics at the Institute. Dr. Theodore von Kármán, the eminent applied mathematician, scientist and engineer, came here to advise on the educational policies and the experimental facilities of the new graduate school and laboratory.

In 1928 the laboratory was completed, and the GALCIT began its active career in aeronautical instruction and research. In 1928-29 the first class at the GALCIT had three enrolled students. During World War II and immediately afterward enrollment hit a peak of well over 100. Now it has leveled off at about 80. The academic staff has increased from 6 to 17 (plus a large number of graduate fellows and assistants.) Dr. von Kármán, who was Director of the laboratory from the beginning, was called to Washington to serve as special assistant to General Arnold in 1942, and later as Chairman of the Air Force Scientific Advisory Board. Dr. Clark Millikan, Acting Director of the lab since 1945, was appointed Director in 1949 when Kármán became Professor Emeritus.

MAJOR RESEARCH FIELDS

Fluid Mechanics. A large part of the research activities at the GALCIT has always been occupied with work on the fundamental aspects of fluid mechanics. In the early years the problems of paramount interest centered around boundary layer flow and turbulence. Now work in these fields has been supplemented by work in the fields of transonic, supersonic, and hypersonic flow and their host of new problems.

* *The Guggenheim Aeronautical Laboratory of the California Institute of Technology: The First Twenty-five Years.*

For a 25-year-old, Caltech's Guggenheim Aeronautical Laboratory has an impressive record of achievement

Clark B. Millikan, Director of the GALCIT

Applied Aerodynamics. Another important part of the research effort at the GALCIT has been (and still is) connected with applied aerodynamics— airfoil and wing theory, the linearized theory of supersonic wings and bodies, non-stationery wing theory, wind tunnel techniques, and those topics which couple dynamics and aerodynamics, (such as performance, stability, and control.)

Elasticity and Structures. From the beginning it was decided that one of the major fields of study to be emphasized was that of aircraft structural analysis and design. This work not only concentrates on fundamental research but maintains a practical interest in the current problems of the airframe companies.

Jet Propulsion and Rockets. Interest in rocket propulsion at Caltech dates back to 1935 when members of the GALCIT faculty and grad students began experimental and theoretical studies in this field. The first substantial outside support for the program came from the National Academy of Sciences in 1939, and in 1941 the Army Air Force took over sponsorship of the work. By 1941 the scope of both theoretical and experimental work had been greatly extended. In August 1941, the first practical solid propellant had been developed, and the first successful assisted-takeoff tests were made. These first rocket motors shortened takeoff distances of small aircraft by as much as 50 percent. After the development work was completed and the assisted-takeoff motors went into extensive service use, large-scale production was undertaken by the Aerojet Engineering Corporation, which was subsequently acquired by the General Tire and Rubber Company, and has recently become the Aerojet-General Corporation.

These major developments by the GALCIT Project, in addition to the lab's extremely important basic research studies, contributed to a large extent in the formation of the basic technical framework of the present guided-missile industry.

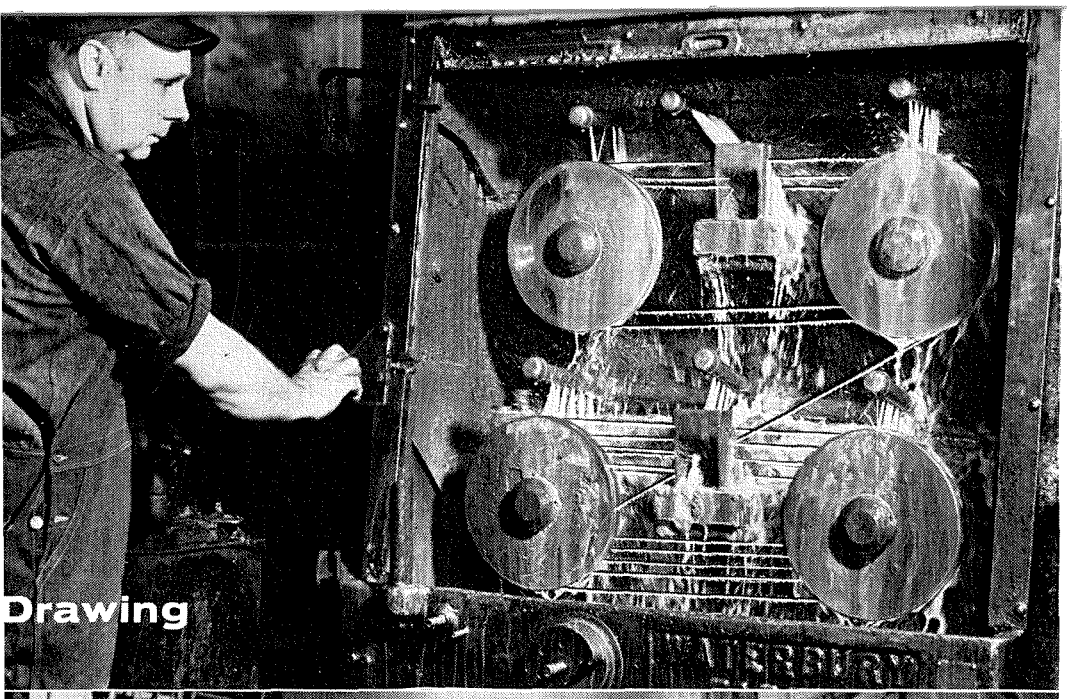
In 1944 the first long-range rocket research and development program in the United States was started. By this time the size of the GALCIT Project had increased to a point where the organization of a separate laboratory seemed desirable. Accordingly, on November 1, 1944, the Project separated from GALCIT and became known as the Jet Propulsion Laboratory. Through the formative years and down to the present time, members of the GALCIT staff have played an important part in the organization of JPL.

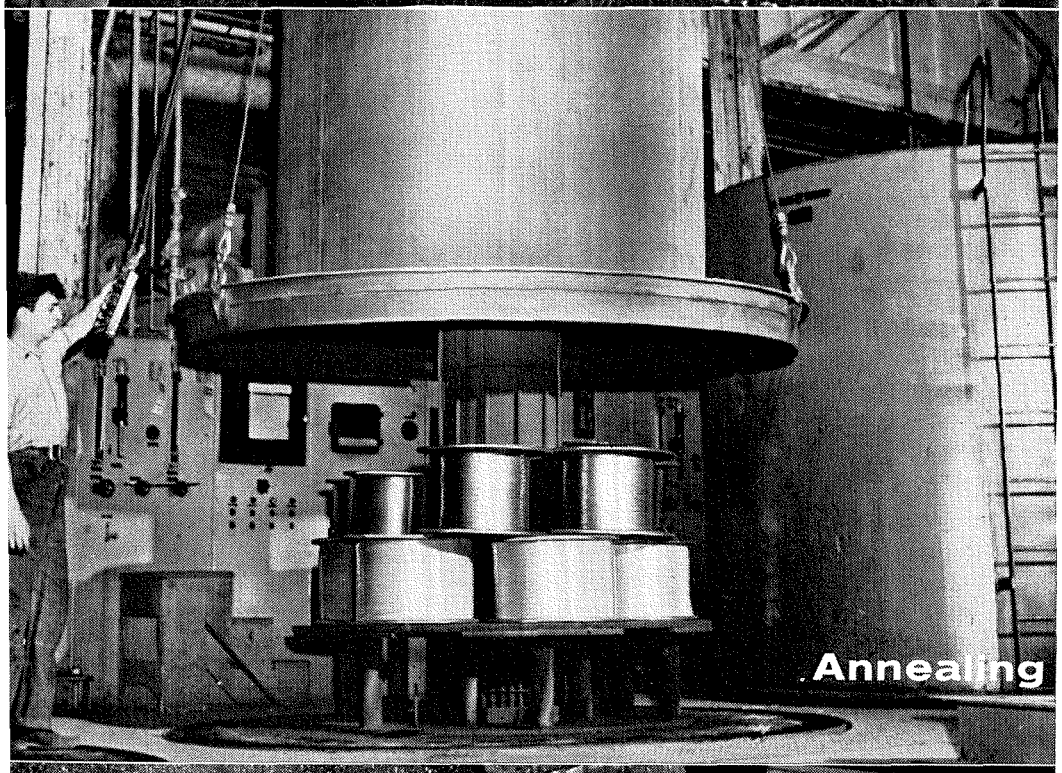
Wind Tunnels. Wind tunnels have always been a dominant feature of the GALCIT. The largest experimental facility in the laboratory as originally constructed was a 200-mile-per-hour wind tunnel with a test section 10 feet in diameter. When it was placed in operation in 1929 it was one of the highest performance wind tunnels in existence, and it has continued to render yeoman service even to the present.

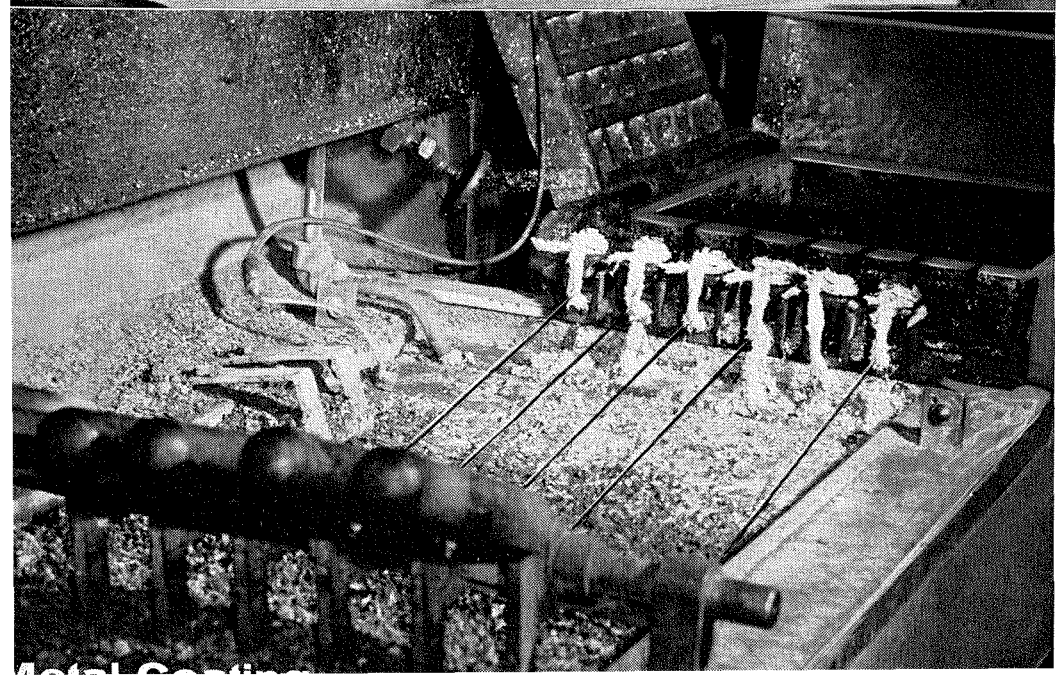
A few statistics in connection with the industrial and governmental testing activities of the GALCIT 10-foot tunnel are of interest. As of May, 1954, a total of 790 separate wind-tunnel test programs had been carried out, and over 700 formal reports issued. These cover tests on over 550 distinct aircraft types for some 35 United States and foreign aircraft companies, as well as investigations for some 6 government agencies. Although the tunnel's performance is now greatly exceeded by many more recently constructed facilities, its operation on an overtime basis is still required.

Although this first wind tunnel is the largest in the GALCIT, it is far from being the only one. Over half-a-dozen small, low-speed tunnels have been constructed for specific research investigations—especially in connection with low-speed boundary-layer and turbulence researches—and several of these are still in active use.

The of







Electrical conductors for wires and cables are generally made from either aluminum or copper. Except as noted below under annealing and metal coating, essentially the same method is used in preparing electrical conductors from these metals.

Preparation of Wires

The metal, after purification at the refinery, is cast into billets about four inches square and about four feet long. For use in electrical conductors, this billet is reduced in cross-sectional area to produce the flexibility required in the finished wire or cable. For example, weatherproof wire for outside power distribution, where little flexibility is required, contains conductors that are solid or made of relatively few wires. For heater cord and welding cable, where excessive flexing in service occurs, the conductors are made up of a large number of small wires. Between these two extremes there is a wide variety of cable constructions requiring numerous sizes of wires.

The reduction in area of the billet is begun on the rolling mill where the billet is reduced to rods, the commercial sizes of which vary from about one-quarter to three-quarters inch in diameter. Rods are reduced to final wire sizes by drawing through a succession of dies of gradually decreasing diameter, the reduction in area per die or draft being about 30 per cent.

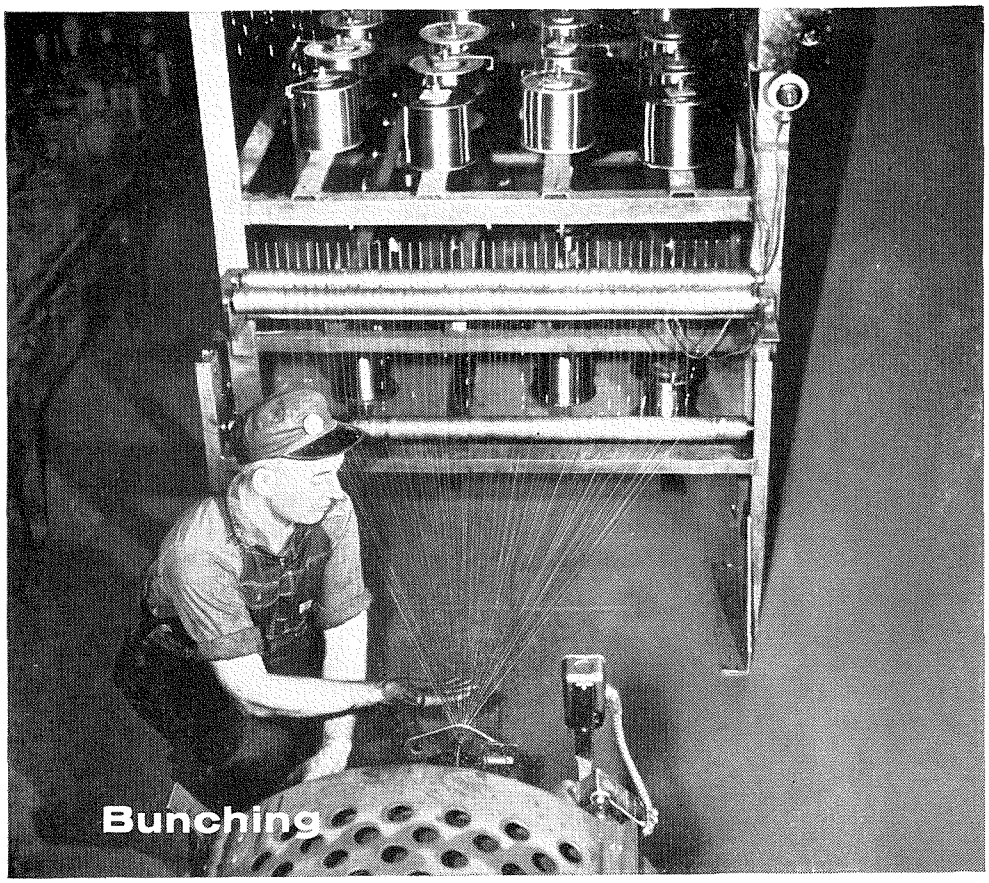
Drawing

The drawing of wire increases its hardness and tensile strength and decreases its elongation and electrical conductivity. Since elongation determines the ability of a material to withstand repeated bending or flexing, it follows that the drawing of wire reduces its flexibility. Except where strength is important, as in weatherproof wires supported aerially, practically all electrical conductors should have greater flexibility and electrical conductivity than that provided by hard-drawn wire. Both flexibility and conductivity are improved by annealing hard-drawn wire.

Annealing

Annealing consists of subjecting the wire in coils or on spools to a temperature of about 650°F for about two hours. Large coils or spools may require a longer time and higher temperature. To prevent tarnishing during the annealing of copper wire, it is necessary to anneal in an inert (oxygen free) atmosphere. This precaution is not necessary in annealing aluminum wire. Annealing of hard-drawn wire increases its ultimate elongation about 2000 per cent and electrical conductivity about 3 per cent.

electrical conductors



Metal Coating

Unprotected copper in contact with rubber insulation combines with sulphur in the insulation to form copper sulphide. This reduces the conductivity of the copper and makes it brittle and difficult to solder. Furthermore, copper in contact with rubber, accelerates the combination of rubber with oxygen and hence promotes the deterioration of rubber insulation. To prevent this mutually harmful action, copper for use in rubber-insulated wires and cables is protected with either a thin continuous coating of inert metal, such as tin, lead, or lead-tin alloy on the individual wires or a separator consisting of a wrap of threads or tape over the uncoated conductor.

Metal coating consists of passing the individual copper wires successively through (a) dilute hydrochloric acid, (b) molten metal or alloy, (c) a wiper, (d) a cooling bath and finally to a take-up reel. The hydrochloric acid cleans the surface of the copper insuring a perfect union between the copper and the coating metal and a complete coverage of the copper by the coating metal. The wiper removes the excess coating material and produces a smooth surface on the coated wire.

Metal coating or a separator is not required on aluminum conductors for rubber insulated cables since aluminum does not combine readily with sulphur and does not accelerate the deterioration of rubber.

Stranding of Conductors

As pointed out above, the purpose of wire drawing is to so reduce the cross-sectional area of the billet or rod that a conductor of the required flexibility can be produced. In addition to adequate flexibility, the conductor must also have sufficient cross-sectional area to provide the current carrying capacity and voltage drop required for a particular application. In general, the service conditions and current carrying capacity of wires and cables are such that conductors of greater flexibility than is obtained with a single wire (solid conductors) are required. Solid conductors are used generally only on sizes 6 Awg. and smaller conductors and then only for fixed (not portable) installations. Most conductors, are, therefore, made up of more than one wire.

The formation of a conductor by bringing together the required number of wires is known as stranding, and the conductor thus formed is known as a stranded conductor. There are two fundamentally different types of stranding, namely, bunched stranding and concentric stranding. These differ in the manner in which the wires are assembled to form a conductor.

Bunched Stranding

In bunched stranding, the required number of wires are simply twisted together with no attempt being made to control their relative positions within the group. The length of the group requiring a complete turn of any one wire is known as length of lay of the strands. The length of lay varies widely with the number and size of the wires and the flexibility desired in the conductor.

Concentric Stranding

In concentric stranding the individual wires are laid up symmetrically in the form of a geometrically compact group. For example, six wires will lay snugly around one central wire, twelve wires will lay around a group of seven, etc. All of the wires are laid up around the same or a common center, hence the term "concentric stranding". The number of wires in the outer layer increases by six and the total number of wires in the assembly becomes 1, 7, 19, etc. The wires in any one layer are cabled or twisted around the central core with a definite length and direction of lay. The direction of lay of the wires is reversed in alternate layers to equalize the torsional forces resulting from twisting the wires about the central core. The length of lay depends on the size of the individual wires and the number of layers in the conductor.

Rope Stranding

A modification of concentric stranding known as rope stranding is used chiefly in the preparation of large flexible conductors for portable and welding cables. This differs from concentric stranding in that a group of wires, known as ropes, instead of individual wires, are laid up in a geometrically compact form of six around one, etc. These groups of wires may be either concentric or bunched stranded. This type of stranding makes possible building up a conductor with a greater number of wires than can be produced by concentric stranding on a machine with a given number of spools.

Other Strandings

Other types of conductor strandings, such as "sector-shape", "compact-strand" and "segmental" are used for special purposes to reduce conductor diameters and conductor losses.

A small transonic tunnel has been used by Professor Hans Liepmann's group to produce important and fundamental data on flow characteristics in the neighborhood of the speed of sound.

The first continuously operating, supersonic tunnel in this country to reach Mach numbers above four was designed jointly by Professors H. S. Tsien and M. Serrurier, and constructed some years ago under the sponsorship of the Army Ordnance Corps. Allen Puckett (now chief of the Systems Analysis and Aerodynamics Department at Hughes Aircraft) carried out many investigations using the tunnel as a pilot or model tunnel for a much larger wind tunnel built subsequently at the Ballistic Research Laboratory at Aberdeen Proving Ground. It continues to be a valuable research tool.

A hypersonic test facility has also been constructed at the GALCIT, with Army Ordnance and Air Force support, where Mach numbers of over 10 have been reached. This is currently being used in the exploration of the new and important field of very high Mach number flows.

Finally, a 175-mile-per-hour wind tunnel with a 3-foot by 4-foot test section was installed in 1950 to be used primarily for student instruction and thesis research. This was dedicated to A. A. Merrill in recognition of his pioneering work in aeronautics at the Institute, and is known as the Merrill Tunnel.

THE MOST IMPORTANT PRODUCT — GRADUATES

IN JUNE, 1929, the first two degrees were awarded by the Guggenheim Graduate School of Aeronautics: master's degrees to E. E. Sechler and A. E. Lombard. Both of these men subsequently received doctors' degrees and went on to aeronautical careers. Dr. Sechler is now Professor of Aeronautics at Caltech, and Dr. Lombard is Scientific Advisor in the Directorate of Research and Development, Headquarters U. S. A. F. Since that time, through June, 1953, a total of 964 graduate degrees have been awarded. Of these, 544 were fifth-year or master's degrees, 330 were sixth-year or "professional" degrees, and 90 were doctorates. The total number of students corresponding to these degrees is 744, since the same man often takes two degrees consecutively.

In 1933 Captain Paul Kemmer of the Army Air Corps, who was the first student sent by one of the military services, received the professional degree.

Every year since 1934 has seen a group of officers from the Naval Postgraduate School working towards professional degrees at the GALCIT, and many Air Force officers have also been assigned to the graduate school for study. A total of over 250 officers from the United States have received degrees from the GALCIT during the past twenty years, and there have been a number of officers from foreign countries.

The majority of the civilian students have gone on to engineering positions in the aircraft industry, where many now occupy key technical and administrative positions. Many others have entered academic life or research laboratories, and a considerable number are now in government service as research administrators or scientific and technical advisors.

These GALCIT alumni are typical of the large number who have attained distinction in a wide variety of activities: Three are now heads of aeronautics departments at major universities; W. R. Sears at Cornell, F. Clauser at Johns Hopkins, and M. Clauser at Purdue. H. S. Tsien is Goddard Professor at Caltech's Jet Propulsion Center. L. G. Dunn, formerly Director of Caltech's Jet Propulsion Laboratory, is now associate-director of the guided missile research program at the Ramo-Wooldridge Corporation in Los Angeles. Roy Marquardt is president of the Marquardt Aircraft Company. W. Bollay heads the Aerophysics Development Corporation. Rear Admiral C. M. Bolster recently retired as Chief of the Office of Naval Research and is currently Manager of Research at the General Tire and Rubber Company. Lieutenant General D. L. Putt is Deputy Chief of Staff for Research and Development of the U. S. Air Force.

RELATED ACTIVITIES

THREE MAJOR DEVELOPMENTS at the California Institute had their origins at the GALCIT and then grew into independent organizations. Although all are administratively quite separate from the GALCIT, close contact and cooperation are maintained with all three.

1. Jet Propulsion Laboratory

During World War II, the California Institute of Technology was asked to contribute creative engineering talent to a number of defense research projects, among them the development of jet propulsion devices. The results of this effort were of such value to the Department of Defense that, in the latter part of the war, the Jet Propulsion Laboratory was established to continue the program, under the administrative supervision of Caltech.

Since the end of the war, the Laboratory has grown from a small group assigned to the task of developing a simple thrust-producing device for the assisted-takeoff of aircraft to a completely equipped laboratory having a wide variety both of equipment and scientific talent. *(E&S, October 1952.)* The staff currently numbers over 1,000 persons.

Fundamentally, JPL is a research center whose efforts are directed toward the acquirement of basic information in the engineering sciences related to missile development and the various phases of jet propulsion. Especially in the field of aerodynamics, close liaison and cooperation are maintained with the GALCIT. Research and

WHO ARE INDUSTRY'S TOP YOUNG SCIENTISTS ?

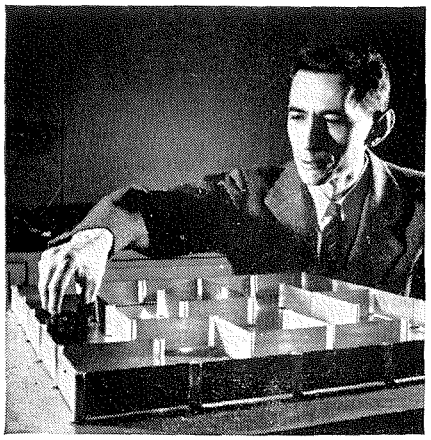
Ten men between the ages of 26 and 40 were featured in a recent national magazine article which presented a portrait of the young scientist in America today. These particular men are a sample of the most brilliant young scientific minds in industry.

It's interesting to note that three of the ten are with Bell Telephone Laboratories, three with General Electric and one each with four other companies.

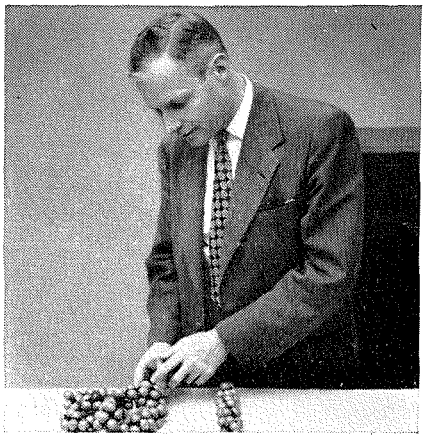
The variety of opportunity in research and other phases of telephone work has always attracted an unusually high percentage of the nation's best young men.

Consult your Placement Officer about opportunities with Bell Laboratories . . . also with the Bell Telephone Companies, Western Electric and Sandia Corporation. Your Placement Officer will be glad to give you details.

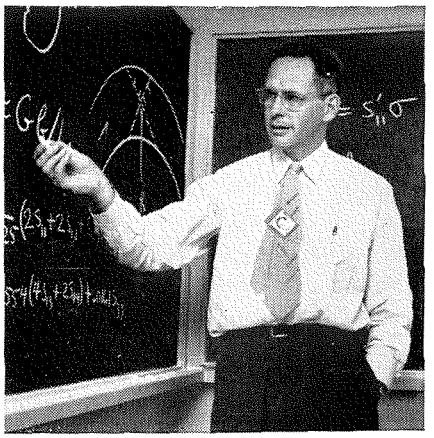
THREE OF THE TEN ARE AT BELL TELEPHONE LABORATORIES—



Mathematician Claude Shannon won fame for his Communication Theory



Physical Chemist William Baker introduced new concepts that have improved synthetic rubber and fibers



Physicist Conyers Herring is known for his understanding of the quantum mechanics of the solid state

BELL TELEPHONE SYSTEM

development are conducted under contracts with governmental agencies, and close liaison is maintained between JPL and the various military services.

2. Southern California Cooperative Wind Tunnel

By the late 1930's it was becoming apparent that before many years aircraft would be flying fast enough so that the effects of the air's compressibility would become important. Wind tunnel facilities capable of producing velocities up to the neighborhood of the speed of sound (approximately 1100 feet per second under standard sea-level conditions) were obviously going to be required for the development of such aircraft. The GALCIT 10-foot wind tunnel had proved extremely valuable for development testing, but its 200-mile-per-hour top speed would clearly be inadequate. What would be needed was a tunnel with test section dimensions comparable to those of the 10-foot tunnel, but with a 750-mile-per-hour speed capability. Unfortunately, these two requirements implied extremely large power for the drive and a construction cost running into several million dollars.

After much thought and discussion a group of aircraft companies decided to undertake a cooperative effort to produce such a facility. The Curtiss-Wright Corporation agreed to finance the construction of a wind tunnel at Buffalo, and four southern California companies, Consolidated-Vultee, Douglas, Lockheed, and North American, jointly undertook to sponsor one in Pasadena. Essentially the same design was to be used for both.

The Pasadena tunnel, which is some three miles from the campus and adjacent to the Pasadena City Power Plant, was dedicated as the Southern California Cooperative Wind Tunnel in May, 1945, and shortly thereafter began routine operations . These have continued ever since on a two-shift basis. Some years ago the McDonnell Aircraft Co. purchased one-half of Consolidated-Vultee's interest in the tunnel, so that the CWT, as it is usually called, now has five owner companies. As of May, 1954, some 400 test programs had been completed, not only for the owner companies, but also for most of the other major aircraft companies of the country, as well as for numerous government agencies. The laboratory, with something over 150 employees, is operated by the California Institute under a management agreement, with an annual operating budget of over a million dollars. Clark Millikan is Director on a part-time basis, and J. E. Smith, a GALCIT alumnus, serves as full-time Associate Director.

Less than ten years after the CWT was designed aircraft performance had advanced so spectacularly that it was clear that supersonic speeds were soon to be matters of routine operation. The owner companies accordingly authorized an $8,000,000 modification program for the CWT. This will involve an increase in the drive power from 12,000 hp to 40,000 hp, and make possible testing at speeds up to 1.8 times the speed of sound. Construction on the modification program is currently in active process and should be completed and the tunnel ready for operation in mid-1955.

3. Guggenheim Jet Propulsion Center

The Jet Propulsion Center, an independent unit in the Division of Engineering of the California Institute of Technology, was established by the Daniel and Florence Guggenheim Foundation in 1948. The Center is an outgrowth of the activities of the Guggenheim Laboratory in the fields of rockets and turbomachinery, and its purpose and guiding principle are quite different from those of the Jet Propulsion Laboratory.

To quote the Institute Catalogue:

> "This center was created specifically to provide facilities for postgraduate education and research in jet propulsion and rocket engineering, with particular emphasis on peace-time uses. The objectives of this Center are to provide training in jet propulsion principles, to promote research and advanced thinking on rocket jet propulsion problems, and to be a center for peace-time commercial and scientific uses of rocket and jet propulsion."

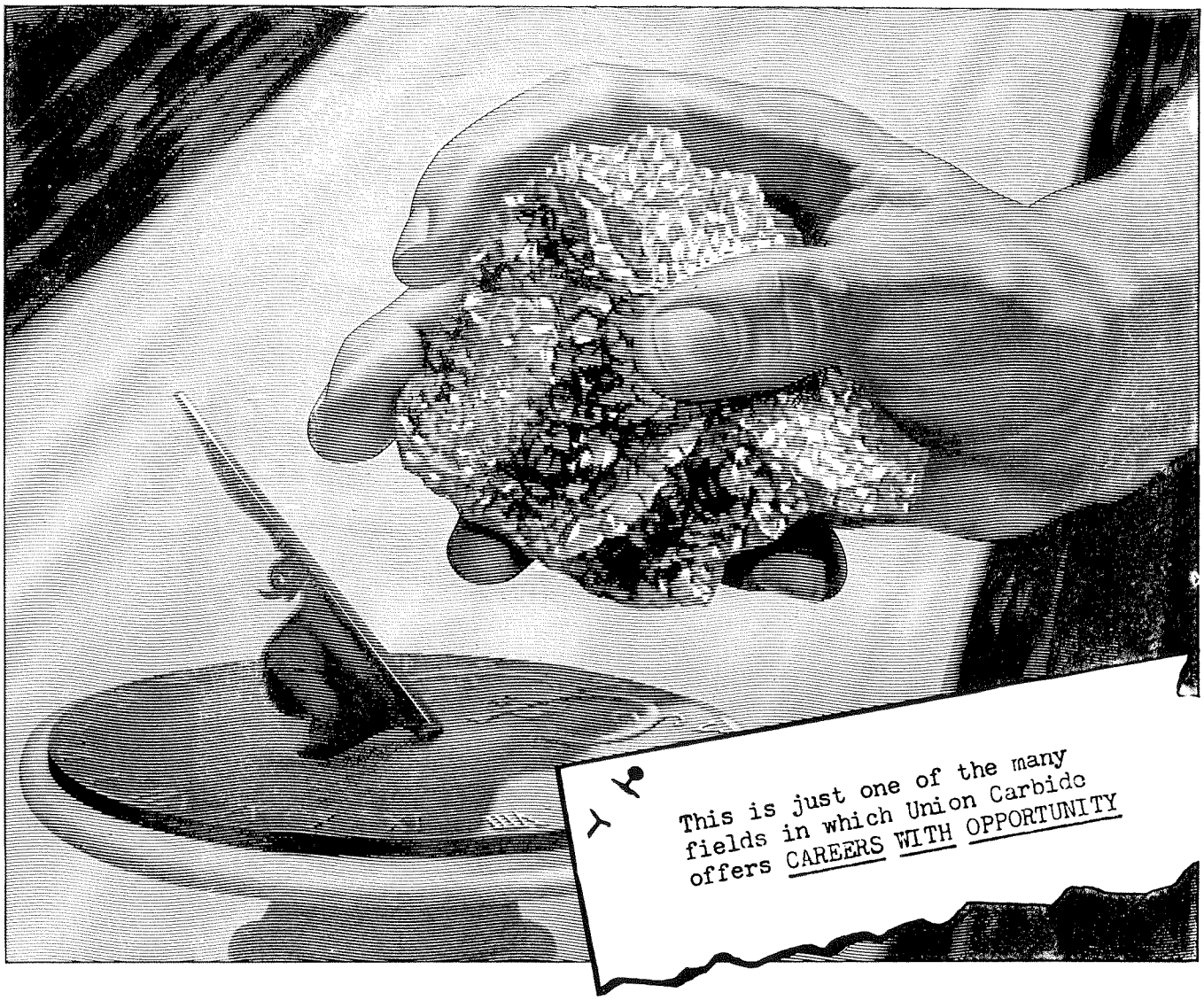
An important part of this program is the Daniel and Florence Guggenheim Fellowships in Jet Propulsion. These Fellowships carry a stipend up to $2,000 a year in addition to tuition.

Research carried on in the Jet Propulsion Center emphasizes the fundamental problems in rocket and jet propulsion engineering. Current activities proceed along four main lines: (1) fluid mechanics of turbomachinery, (2) basic combustion problems, (3) gas emissivities and application of modern spectroscopy to detailed analysis of combustion, and (4) theory of the control and guidance of complex systems.

RELATIONS WITH GOVERNMENT

ONE OF THE GREATEST CONTRIBUTIONS which an academic institution can make to the defense of the country lies in the training which it can give to officer and civilian government servants so that they may better discharge their responsibilities. With the enormous increase since the beginning of the last war in the role of science in the armed forces, this is particularly true of a technical institution like the California Institute of Technology. Some details have already been given of this aspect of the GALCIT activities programs.

The laboratory has also contributed by carrying out technical and scientific investigations at the request of the armed services. The setting up of the rocket program and later of the Jet Propulsion Laboratory are examples which have been discussed. The members of the staff have also participated intensively in government activities. Kármán was for many years consultant to all three services, and after 1942 devoted most of his time to setting up and leading the Air Force Scientific Advisory Board. Millikan has served on advisory committees to the three services and was for three years Chairman of the Guided Missiles Committee of the Department of Defense Research and Development Board. Sechler has



The metal that makes time stand still

Thanks to chromium, steel now serves you with strength and beauty that lasts a lifetime

IN TIME, one of man's most useful materials—steel—is often the victim of such destructive forces as rust, corrosion, heat, or wear.

THESE NATURAL ENEMIES of steel now are mastered by the metal called chromium. When the right amount of chromium is added to molten steel, the result is strong, lustrous stainless steel that defies the ravages of time.

IN HOMES, TODAY, stainless steel is a shining symbol of modern living. It brings us care-free sinks, gleaming tableware and kitchen utensils—all with beauty that lasts a lifetime.

IN INDUSTRY—Food is prepared in super-sanitary stainless steel equipment. Streamlined trains and buses are made of this wonder metal. Vital parts of jet planes that must withstand both blazing heat and sub-zero cold are made of tough, enduring stainless steel.

SERVING STEEL...AND YOU—The people of Union Carbide produce alloys of chromium for America's steelmakers. This is another of the many ways in which UCC transforms the elements of nature for the benefit of everyone.

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

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served on Air Force Committees; he, Millikan, Lees, and Fung are currently active on such an assignment. Stewart has consulted with Army Ordnance and is a member of the Air Force Scientific Advisory Board. Millikan, Sechler, and Liepmann serve on sub-committees of the National Advisory Commitee for Aeronautics.

These are examples of services by the GALCIT staff for government agencies. On the other hand, the Army, Navy, Air Force, and NACA have very wisely adopted policies of supporting research projects at universities. The researches mentioned earlier have for many years been supported to a large extent by these agencies, and there are currently active projects sponsored by all four. Much of GALCIT's history of the past twenty-five years could not have been written had it not been for its close association with these agencies of the government.

RELATIONS WITH INDUSTRY

IN ITS RELATIONS with industry as with the government, probably the GALCIT's greatest contribution has been the students it has trained and sent out. Of these, the largest percentage has entered the engineering departments of aircraft companies. As has already been mentioned, it has been a continuous policy that close contact be maintained with industry in the GALCIT's day to day life. The first airplane design course was given by a practicing aeronautical engineer; and, ever since, one course each year is given by engineers from local aircraft companies.

The testing program in the 10-foot and Cooperative wind tunnels obviously results in intimate contacts between staff members and students and aircraft company engineers, and similar contacts are also frequent in other fields. Company engineers are invited to attend the GALCIT seminars, of which there are several each week, and the invitations are frequently accepted. Members of the staff are encouraged to undertake part-time consulting responsibilities if they care to do so, and many avail themselves of the opportunity. Experience has shown that, with a strong and active program of fundamental research on campus, such consulting activities actually contribute to the staff's creative work, rather than interfere with it. This is certainly due in part to the dynamic nature of the aircraft industry and to the number of problems whose solution requires the most advanced scientific knowledge and techniques.

ENGINEERS

or

PHYSICS GRADUATES

To those interested in advanced academic study while associated with important research and development in industry, Hughes offers two separate practical programs:

HUGHES COOPERATIVE FELLOWSHIP PROGRAM

for Master of Science Degrees

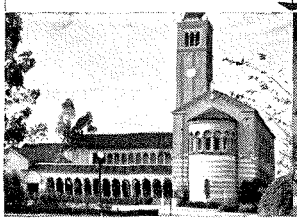
A program to assist outstanding individuals in studying for the Master of Science Degree while employed in industry and making contributions to important military work. Open to students who will receive the B.S. degree in Electrical Engineering, Physics or Mechanical Engineering during the coming year, and to members of the Armed Services honorably discharged and holding such B.S. degrees.

Candidates must meet entrance requirements for advanced study at the University of California at Los Angeles or the University of Southern California. Participants will work full time during the summer in the Hughes Laboratories and 25 hours per week while pursuing a half-time schedule of graduate study at the university.

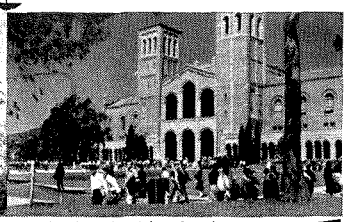
Salary is commensurate with the individual's ability and experience. Tuition, admission fees and books for university attendance are provided. Provision is made to assist in paying travel and moving expenses from outside Southern California.

HOW TO APPLY

for the Hughes Cooperative Fellowship Program: Address all correspondence to the Committee for Graduate Study



University of Southern California



University of California at Los Angeles

THE HOWARD HUGHES FELLOWSHIPS

in Science and Engineering

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

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

HOW TO APPLY

for the Howard Hughes Fellowships in Science and Engineering: Address all correspondence to the Howard Hughes Fellowship Committee

California Institute of Technology

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

PERSONALS

1922

W. D. Potter, employed by the Bureau of Public Roads in Washington, D. C., is being sent by them to Cornell University this year for graduate study in statistics. Bill writes: "Kind of late for this sort of thing, but I'm looking forward to a very pleasurable experience."

1924

Brigadier General Don Zimmerman, MS '36, has been appointed dean of the faculty for the new United States Air Force Academy, which will probably go into operation sometime next year. General Zimmerman will be in charge of the selection of personnel to teach the air cadets.

At the 1924 class reunion at the Annual Alumni Banquet last spring, a number of people expressed the desire for information about *M/Sgt. Joseph Laracy*, who, as instructor in Military Science, had served under Captain Hans Kramer at Caltech. Upon inquiry, the Office of the Adjutant General states that M/Sgt. Laracy, who served in Headquarters Company, 7th Engineers, in World War I, is now deceased.

1925

Frank Clayton, chief plant engineer at Convair in Fort Worth, Texas, has been elected a director of the Fort Worth Rotary Club.

1926

J. A. Van den Akker, PhD. '31, doesn't want any of his classmates to think he has forsaken the field of physics, even if he has become a member of the American Chemical Society. The membership was necessary, it seems, so that he could be chairman of a symposium held at the Fall meeting of the ACS on "The Rheology of Cellulose Fibers and Sheets." This symposium will be sponsored by the cellulose division of the ACS. Johannes is still teaching, and is active in research (in physics) at the Institute of Paper Chemistry in Wisconsin.

1927

William M. Aultman has resigned as assistant director of the Department of Water and Sewers in Miami, Florida, to accept a position with Alvord, Burdick & Howson, consulting engineers in Chicago, Illinois. His work continues in the same field as previously—sanitary engineering.

J. E. Marsland was promoted recently to manager of the Technological Department of the Shell Oil Company.

1929

Andrew V. Haeff, MS, PhD '32, was recently appointed director of the Research and Development Laboratories at Hughes Aircraft. Before joining Hughes in 1950 he was with the Naval Research Laboratory in Research and Administration.

Roland W. Lindhurst died suddenly on August 29. He was Vice President of the Applied Research Labs in Glendale.

1930

J. G. Pleasants, MS, PhD '33, has been elected to the newly-created position of Vice President in charge of Research and Development at Proctor & Gamble. Previously he was Vice President in charge of Manufacturing.

1931

Perry M. Boothe, MS '32, who has been on duty in Schenectady for four years with the project for nuclear propulsion of submarines at Knolls Atomic Power Laboratory, has been transferred to the Pacific Division, Bureau of Yards and Docks, Pearl Harbor. Perry's wife Marcia and children Allen, 17, Lorraine, 13, and Tommy, 5, are finding the islands a welcome change from the "rigorous" New York climate.

1933

E. A. Hayes is now assistant director of the Guided Missile Division of Hughes Aircraft. In his new work Ed will be responsible for research and development. He has been with Hughes since 1946.

1935

Henry W. Stoll thinks someone had a dizzy spell when they nominated him to serve on the ASME Fluid Meters Committee, but the appointment to the big one follows several years of service on subcommittees. The Stoll family now numbers five children, twin boys, two single boys, and a girl. Henry is an engineering physicist at the Taylor Instrument Company in Rochester, N. Y., and is doing his best to keep Rochester Caltech conscious, along with *Don Chapin*, MS '49, the only other Caltech man in town, who works at Taylor Instrument.

1936

Fred Stitt, PhD, returns to the Western Research Branch of the U. S. Department of Agriculture in Albany, California, after serving since February 1953 as a member of the Weapons Systems Evaluation Group, Office of the Secretary of Defense in the Pentagon.

1937

Walter L. Moore, MS '38, is president of the Austin Branch of the ASCE. Walt is professor of civil engineering at the University of Texas, with special interest

Audio, Video and Freedom

Millions of eyes are watching . . . millions of ears listening. They are seeing the significance in each expression, hearing the overtones in every word.

The American people are sitting in judgment.

When they speak their decision, it will be spoken with a sureness that can come only from seeing for themselves.

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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 training and experience at a good salary with opportunities for advancement. Among many projects with unusual promise:

- Development and design of radio receivers (including broadcast, short-wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to College Relations Div., RCA Victor, Camden, N. J. Also many opportunities for Mechanical and Chemical Engineers and Physicists.

in hydraulics and fluid flow problems. All girls in the Moore family—three of them: Claire, 9 years, Cathy, 7, and a baby, Geneva Elaine, a year old in November.

Charles F. Gates, MS '38, has recently been advanced to the post of chief production engineer for the General Petroleum Corporation's production department. Charles has been with General Petroleum ever since he received his MS.

Dr. Dean Nichols, at the King's Daughters Clinic in Temple, Texas, is chief of the dermatology clinic and assistant in Radiology—and is enjoying his work of building up the clinic immensely. He was married last February to Mrs. Warren Allen Smith, thereby acquiring a 15-year-old stepson.

1938

Thomas V. Davis, MS '47, and wife Mildred report the arrival of Margaret Susan, their first child, on June 4th in Seattle. Tom is a senior group engineer for Boeing. The Davis family hopes to visit Southern California during the Christmas-New Year holidays "for some of that wonderful sunshine."

1939

Harlowe J. Longfelder, staff engineer of aerodynamics at the Boeing Airplane Company in Seattle, has been elected to serve on a sub-committee of the National Advisory Committee for Aeronautics. He will be working with the sub-committee on high speed aerodynamics.

John W. Black has been appointed assistant director of the Guided Missile Division at Hughes Aircraft. John has been with Hughes 14 years, and has served in the Research and Development Laboratories continuously since 1940.

1940

Leo Brewer, assistant professor of chemistry at the University of California, is assisting with a study on the chemical reactions of stars. This will comprise part of a chemical inventory of the universe, being undertaken by the astronomy department of UC.

Ludwig Ivan Epstein, MS '41, is now working for the Glenn L. Martin Company in Baltimore. Ludwig says the work is entirely mathematical and very interesting. He's still single, still publishing in the Journal of the Optical Society of America.

1941

Robert H. Harris has sent a quick rundown of his activities since graduation, commencing with his marriage to Betty Ann Morice, a chemist, in 1946. Next notable event was the birth of Marten Hutchison Harris II in 1949. In February, 1951, Bob received his PhD in chemistry from Purdue, and is now assistant professor of inorganic chemistry at the University of Nebraska.

Colonel John K. Arnold, MS, who has been missing in action since January 12th, '53, when his B-29 disappeared in a combat mission over North Korea, has now been located as a prisoner of war. The alumni office has received the following letter, which may be of interest to his classmates:

Department of the Air Force
Headquarters United States Air Force
Washington 25, D.C.

Gentlemen:

In the past you have expressed your interest in Colonel John K. Arnold, Jr. As you may know, the Chinese Communists have reported that he is in their custody. I am writing to advise you that arrangements have been made whereby parcels and letters may be sent to Colonel Arnold.

The Office of Export Supply, Department of Commerce, has issued a letter of authorization to the legal next of kin which must be presented to the Postmaster when mailing packages.

Regrettably, the Department of the Air Force has been unable to procure letters of authorization for other than the legal next of kin. However, if you so desire, you may be able to make arrangements with Colonel Arnold's wife to include in one of her packages any gift you wish to send.

You may write as often as you desire.

Letters should be addressed as follows:

Colonel John K. Arnold
c/o Chinese People's Committee for World Peace
Peking, China

Your own name and address should be placed in the upper left-hand corner of the face of the envelope. The words "Prisoner of War Mail" will not be used.

Should you receive any form of communication from or concerning Colonel Arnold, I respectfully request that you furnish this Headquarters, without delay, the original card, or letter and envelope, or photostatic copy thereof. This information may be helpful in securing more definite details concerning his welfare. Any communications you may forward will be handled with strict confidence and returned to you after they have served their purpose.

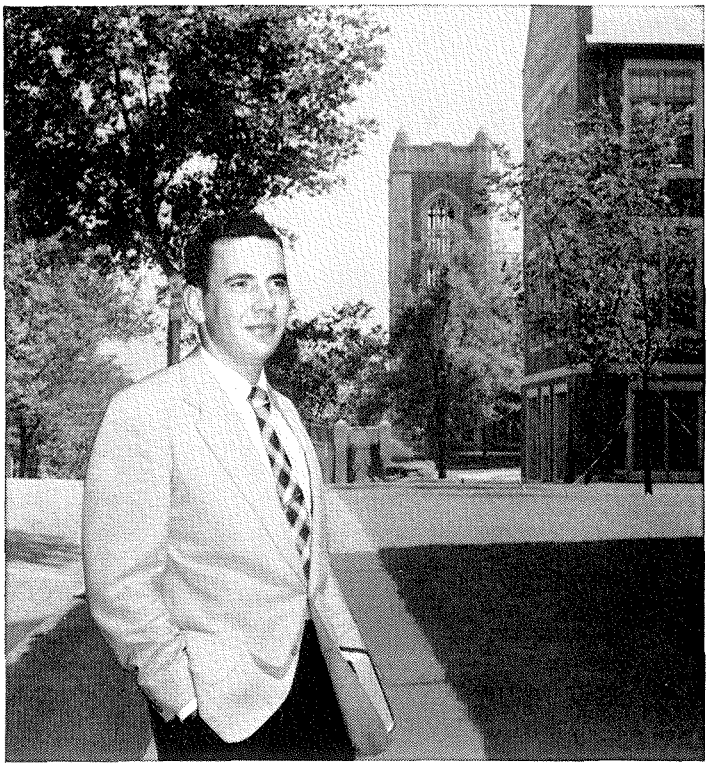
Your cooperation in this matter will be appreciated.

Sincerely yours,
R. W. Springfield
Lt. Colonel, USAF

If you would like to contact Mrs. Arnold, her address is 8 National Street, Montgomery, Alabama.

Stanley Sohler was elected president of the Western Sun Bathing Association in July.

David Wood, MS '46, PhD '49, assistant



Donald W. Sundstrom received his B.S. degree in Chemical Engineering from Worcester Polytechnic Institute in 1953. He's currently studying for an M.S. degree and expects to receive it next year. Like other engineering students, he's asking a lot of searching questions before deciding on a permanent employer.

Don Sundstrom asks:

What are my chances for advancement in a big firm like Du Pont?

Gerald J. Risser, B.S. Chem. Eng., Univ. of Wisconsin (1937), is now assistant manager of the Engineering Service Division in Du Pont's Engineering Department, Wilmington, Delaware.

Jerry Risser answers:

I THINK I know exactly what's behind that question, Don, because the same thing crossed my mind when I first graduated and looked around for a job. That was about seventeen years ago, when the Du Pont Company was much smaller than it is today. And there's a large factor in the answer, Don, right there! The advancement and growth of any employee depends to a considerable degree on the advancement and growth of his employer. Promotion possibilities are bound to be good in an expanding organization like Du Pont.

Right now, for example, construction is in progress or planned for three new plants. That means many new opportunities for promotion for young engineers. And, in my experience, I have found it is a fundamental principle of Du Pont to promote from within the organization—on merit.

My own field, development work, is a natural for a young graduate, because it's one of the fundamental branches of engineering at Du Pont. There are complete new plants to design, novel equipment problems to work on, new processes to pioneer—all sorts of interesting work for a man who can meet a challenge. Many of the problems will involve cost studies—some will require evaluation in a pilot plant—but, in every case, they'll provide the satisfactions which come from working with people you like and respect.

All in all, Don, your chances of advancement on merit are mighty good at Du Pont!

Want to know more about working with Du Pont? Send for a free copy of "Chemical Engineers at Du Pont," a booklet that tells you about pioneering work being done in chemical engineering—in research, process development, production and sales. There's a step-by-step outline of the leadership opportunities that confront a young Du Pont engineer—how he can advance—and how he can obtain help from experienced members of the team. Write to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware.

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BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

WATCH "CAVALCADE OF AMERICA" ON TELEVISION

professor of mechanical engineering at Caltech, has been appointed to the city council in Sierra Madre. During World War II Dave was engaged in research at Los Alamos.

1942

John H. Rubel is chief of the new Fire Control Systems Laboratory at Hughes Aircraft, heading three divisions: Radar, Computing and Control, and System Integration. John joined Hughes in 1946; previously he had been with Lockheed and General Electric.

1943

John R. Spencer received a double addition to the family a year ago; twins, a boy and a girl. The Spencers have one other child. Last spring John was promoted to assistant chief reservoir engineer or Continental in Ponca City, Oklahoma.

Albert Stallkamp, PhD, received his doctor's degree at Caltech this spring, and was married to Emilie Graeber June 26th in Pasadena. They had a wedding trip to Jasper, Lake Louise, and Banff, Canada, before returning to make their home in Pasadena.

1944

Ronald S. Johnson joined the Ford Motor Company in July. He is working in the Research and Statistical Department in Livonia, Michigan. At the same time Ronald is working on his PhD, which he expects to receive from the University of Michigan in February, 1955.

R. F. Mettler, MS '47, PhD '49, has been appointed as a special consultant to the U. S. Department of Defense. Rube started his special assignment in May for the Assistant Secretary of Defense, Research and Development. He is on leave of absence from his regular job as associate head of the Radar Division, Research and Development Laboratories, Hughes Aircraft.

C. Warren Hunt reports the arrival of a son, Malcolm Ian, on July 6th—the Hunts' wedding anniversary! This is their second child, the first being their three-year-old Lucile. Warren is currently chief geologist for Petcal Limited and Canadian Homestead Oils Limited of Calgary, Alberta. There are several other Tech alumni in Calgary: *John Legge* '36, a geo-physical consultant, *Ed Alcock* PhD '35, of National Geophysical, and *Paul Kartzke*, '34, Regional Manager of Shell Oil Company.

Alois W. Schardt, PhD '51, is a new member of the staff of the Los Alamos Scientific Laboratory of the University of California. Before going to Los Alamos, Alois worked for the Brookhaven National Laboratory.

1945

Dudley B. Smith was recalled (involuntarily) to active duty with U. S. Navy Seabees in 1952. After a two-year stint he was released in May, '54 to return to his patent law practice in Portland, Oregon. The Smiths' son, Michael, was born in the Philippines a year ago last September while pa was still on active duty with the Navy.

Raymond C. Wheeler has been promoted to the post of chief industrial engineer for General Petroleum's Marketing Department. Ray, who has been with the company since 1946, will make his headquarters in Los Angeles.

William J. Elliott has formed a partnership with *Ralph B. Pastoriza*, '44, to practice law in Santa Monica. They plan to specialize in patents and trademarks. Bill was formerly employed as an attorney in the Washington office of the Westinghouse Patent Department. Ralph has had a diverse background in patent law, most recently as a patent attorney in private practice in L.A. He was married in 1953 to Jennie Elms, who at that time was assistant head nurse at the Neurological Institute of the Columbia Presbyterian Medical Center in New York.

1946

Lt. George R. Pool is now with the staff of Vice Admiral Woolridge, Commander of the Second Fleet. George is the Carrier Controlled Approach Officer. The Second Fleet staff, based at Norfolk, Virginia, is composed of all the active Navy ships on the East Coast.

John Fleming, class secretary, sent in a note regarding the informal class reunion held June 26th at the Huntington Beach State Park. Twenty-three members met for a beach party, which started about 3:30 and went on until late in the evening.

The idea for the reunion originated with *Roger Clapp* and *Bob Sensibaugh*, and *John Tabor*, *Hal McMann* and *John Fleming* pitched in to organize it.

On hand were *James Evans*, *Louis Jensen*, *Colvin Kempton*, *C. R. McEwen*, *David Nielsen*, *Richard Schuster*, *Stan Mendes*, *Teck Wilson*, *Herb Royden*, *Don Root*, *Steve Babcock*, *Orison Wade*, *Howard Greenfield*, *Hal Comlossy*, *Hubie Clark*, *Wayne Blackman*, and *Phil Benton*.

Robert L. Schrag received his PhD in electrical engineering from Penn State on June 7th.

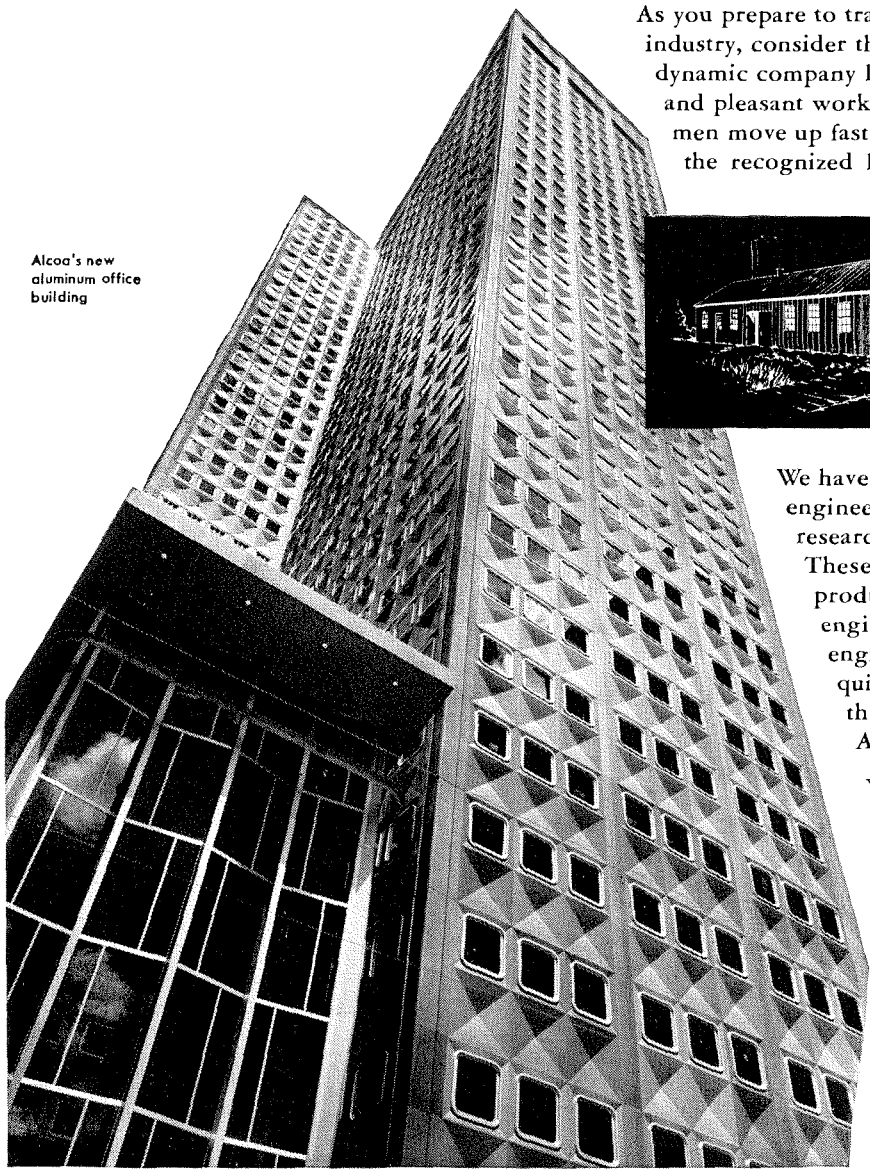
George A. Hufford was married last May. He is a math instructor at Princeton.

THE ALUMINUM INDUSTRY WAS BORN ON SMALLMAN STREET

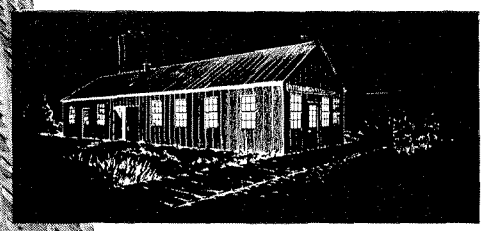
In 1888, the aluminum industry consisted of one company located in an unimpressive little building on the east side of Pittsburgh. It was called The Pittsburgh Reduction Company. The men of this company had real engineering abilities and viewed the work to be done with an imagineering eye. But they were much more than that. They were pioneers . . . leaders . . . men of vision.

A lot has happened since 1888. The country . . . the company . . . and the industry have grown up. Ten new territories have become states, for one thing. The total industry now employs more than 1,000,000 people—and the little outfit on Smallman Street? Well, it's a lot bigger, too—and the name has been changed to Alcoa. ALUMINUM COMPANY OF AMERICA . . . but it's still the leader—still the place for engineering "firsts".

As you prepare to trade textbooks for a position in industry, consider the advantages of joining a dynamic company like Alcoa—for real job stability and pleasant working conditions—where good men move up fast through their association with the recognized leaders in the aluminum industry.



Alcoa's new aluminum office building



We have fine positions for college graduate engineers—in our plants, sales offices and research laboratories from coast to coast. These are positions of responsibility in production supervision, plant and design engineering, industrial research or sales engineering. Right now it may be quicker than you think from a seat in the classroom to your career with Alcoa. Why not find out?

Your Placement Director will be glad to make an appointment for you with our personnel representative. Or just send us an application yourself. ALUMINUM COMPANY OF AMERICA, 1825 Alcoa Bldg., Pittsburgh 19, Pa.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Robert C. Siegel was released from active duty in the Navy last June, after serving 21 months in Yokosuka, Japan. He's now working for the Margo Operation Co. in Oceanside, California.

Ted Neale, Jr. has been named a member of the Southern California Advertising Agencies Association's board of directors. Ted is the son of the father-and-son Neale Advertising Associates.

Milton A. Strauss, MS '48, reports that he was discharged from the Navy last March, is now associated with his father in the summer resort business at Lake Mills, Wisconsin. "Latest family muster reveals three girls, one boy."

1947

Eugene Wyszpolski, MS, was recently appointed assistant chief engineer for the USN—Bureau of Aeronautics General Representative—Western Division. The Wyszpolskis (including a son) live in Arcadia.

Loren F. Stringer, MS, engineer at the East Pittsburgh, Pa., plant of Westinghouse, has been awarded a graduate scholarship for a year of advanced study. Loren served 36 months with the Navy in World War II before joining Westinghouse in 1947. As a member of the metal working section at Westinghouse he has been greatly concerned with the design and development of steel mill drives.

Walter Ogier, PhD '53, was married June 26th to Mayrene M. Groton of Pasadena.

1948

Leroy C. Land returned in May from 16 months duty with the Signal Corps in Korea. (For his work as G-3 Plans Officer for the Signal Corps Leroy received the Legion of Merit Medal and the Ulchi Medal from Korea. After an enjoyable 30 day leave with his family in Logan, Utah, he reported to Ft. Leavenworth for temporary duty with the staff and faculty of the Command and General Staff College. In September he started the regular course at the Command and General Staff College. His family—wife Marjorie, son Edward, age 7, daughters Mary Linda, age 11, and Susan Kaye, age 3, are living on the post.

Rupert M. Bayley received his MS degree in electrical engineering from USC in June. He is now working as a Transmission Design Engineer Associate for the City of Los Angeles.

1949

Bill Sylvies and wife have moved to Boise, Idaho, where Bill is working as an engineer-in-training for the State Highway Department.

Laurence H. Nobles, MS, is an instructor in geology at Northwestern University. In the summers he does glaciological research in northern Greenland.

Kenneth Gardner is coming back to the sunny west, after receiving his MS at MIT last month. Ken was married a year ago.

1950

Herbert A. Forrester received his PhD in June from Princeton, and will be teaching math this year at the University of Washington in Seattle.

Julian Brody received his PhD from Princeton in September. Immediate plans are being made for him by the Air Force.

Marco A. Romero has been living for the last year and a half in Camp Roblecito in the state of Guarico, some 100 air miles south of Caracas, Venezulea. (Just to give an idea of the terrain, Marco says

E&S SCIENCE WRITING CONTEST

for undergraduates & graduate students

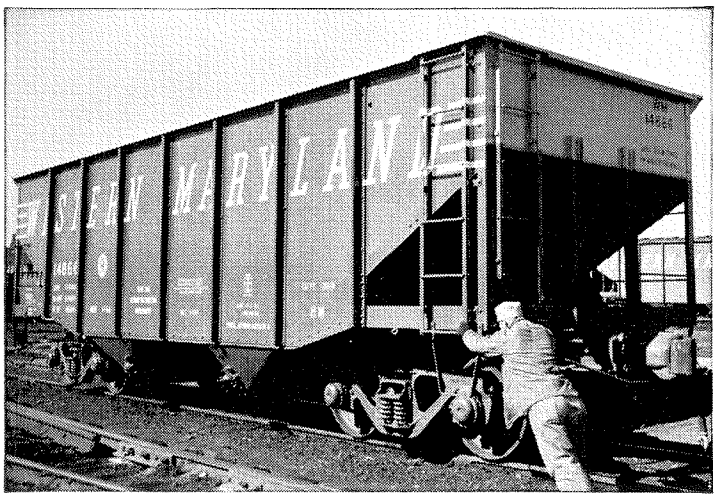
$100 first prize **$50 second prize**

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

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

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

Another page for YOUR BEARING NOTEBOOK



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You can make a big 55-ton freight car roll so easily one man can push it. How? By mounting its axles on Timken® tapered roller bearings. Timken bearings *roll* the load, eliminate the metal-to-metal sliding friction that makes old-style friction bearings start hard. They reduce starting resistance 88%. And, with Timken bearings, there's no danger of hot boxes —the major cause of freight train delays.

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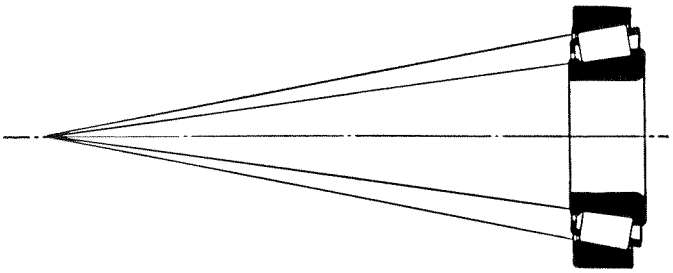
As you see here, all lines drawn coincident with the working surfaces of a Timken bearing meet at a common point on the bearing axis. This means Timken bearings are designed to give true rolling motion. And, since they're tapered they can take radial and thrust loads in any combination.



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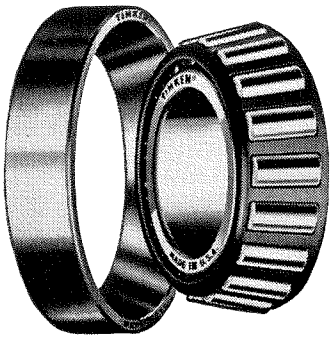

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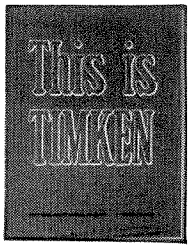
Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a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



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

that 100 miles can be traversed by car in seven hours). It's quite an isolated life, but with 60 American families there's plenty of company. Marco is working as a petroleum engineer, specializing in reservoir engineering. He reports the following news of other grads: "*Rex Ragon* has been working not far from Caracas as an interpreter with a United Geophysical seismograph crew. The only other grad I've seen outside of Pasadena is *John Holmes*, '51, whom I met while we were both in the Third Infantry Division in Korea in 1952. Recently I met *Gerald Sichel*, who made many friends in his three years as a chemistry major at Tech. He is now a sales promotion supervisor for the Upjohn Company in Caracas."

Harry Brough has been transferred to New York by the Shell Chemical Company.

Donald H. Baer is now a member of the technical staff of the Microwave Laboratory, Hughes Research and Development. He was formerly employed by the Phillips Petroleum Company.

Bruce B. Stowe received his PhD from Harvard on June 17th.

Dr. Raymond Brow, who is serving his internship at L. A. General Hospital, was married June 19th to Mary Wachter.

Vern A. Edwards was married June 12th to Doreen Lawson of Pasadena. He is employed as a civil engineering press engineer for an Oakland firm.

1951

Joe Carter, MS, research engineer for Boeing Aircraft in Seattle leads an active life in his spare time—mountain climbing, flying and skiing being just a few of his current activities. Joe mentions that there are quite a few Tech men at Boeing, and he occasionally sees *Rick Hughes*, *Dick Merritt*, *Virgil Sims*, and *Gib Oakes*; all graduate students of '51.

Richard Smyth and wife Emilie announce the arrival of Randolph Lyle Smyth on July 7th.

W. Duncan Rannie, PhD, associate professor of mechanical engineering at Caltech, left last June for Europe to serve as a member of the Scientific Advisory Board to the Chief of Staff, U. S. Air Force. He returned to Caltech early in September.

Robert Kraemer was married on June 20 to Ann Park in St. Theresa's Catholic Church, Alhambra. Bob is employed as a research engineer in rocket propulsion at North American Aviation.

Pierre St. Amand, MS, PhD '53, has been awarded a United States Educational Exchange Grant as a Research Assistant in Seismology. He will conduct research in geophysics at the Observatoire de Haute Provence and Observatoire in Lyon, France.

Marc Kampé De Fériet was married July 29th to Mademoiselle Huguette Giffo in the Cathédrale of Quimper, France.

Lt. Robert R. Munro, MS '52 is serving as resident officer in charge of Naval construction at Bristol, Tennessee.

1952

Ronald Shreve and *Denver Gore*, MS, are serving as resident associates in the student houses at Caltech this year. Ron will be in Ricketts and Denver in Dabney. Ron is taking graduate study in physics, and Denver came to Caltech as a Guggenheim Jet Propulsion Fellow in 1952.

Gerald Fasman, PhD, has been seeing Europe since receiving his doctorate. After leaving Caltech in '52 he spent two years at Cambridge, England, and the last year at the Eidg. Technische Hochshule in Zurich, Switzerland. Currently he is in Rehovoth, Israel, at the Weizmann Institute of Research, biophysics department.

1953

Donald A. Darms, now a private in the Army, recently arrived at the White Sands Proving Ground, Las Cruces, New Mexico. Don is an electronics research engineer.

Jean L. Vidal was married on June 18 to Joy Richardson in Passaic, New Jersey.

Oliver R. Price has joined the Hughes Research and Development Laboratories as a member of the technical staff of the Microwave Laboratory. He was formerly employed by the University of California in Los Angeles.

Bert E. Brown, MS, is a physicist with the Scientific & Tests Branch of the Puget Sound Naval Shipyard, Bremerton, Washington.

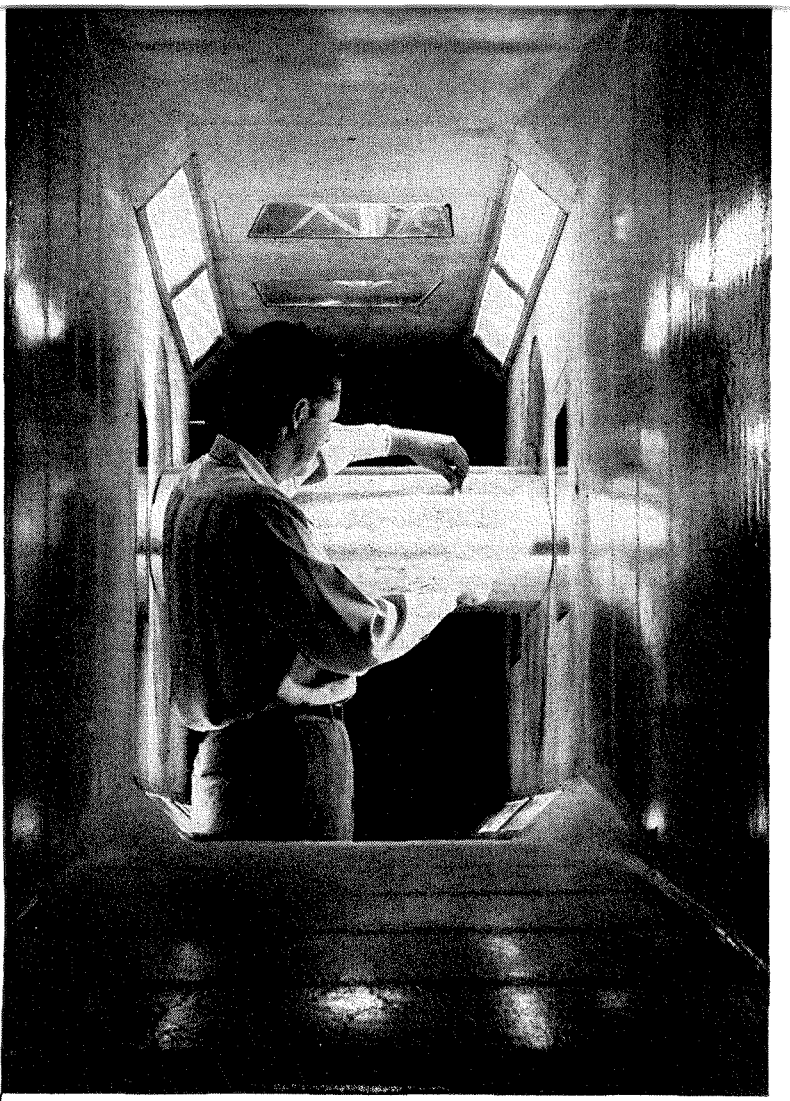
Rolf D. Weglein, MS '54, and *Arthur J. Stasney*, MS '54, have joined Hughes Aircraft as members of the technical staff of the Radar Division, Research and Development Laboratories.

1954

John J. Peyton was named outstanding senior cadet at the Air Force ROTC Summer Camp at McClellan Air Force Base, Sacramento. John was selected for the honor from the cadets representing 12 colleges and universities in the western states and Hawaii. Simultaneously, he received his commission as second lieutenant in the Air Force Reserve.

Howard E. Shanks is now a member of the technical staff of the Radar Division of the Hughes Research and Development Laboratories.

Carl Vrooman, icing tunnel group head, studies hot-air cyclic de-icing test on wing section of C-130 transport. The tunnel has a temperature range of −40° F. to +150° F. and maximum air speed of more than 270 mph.



New icing tunnel speeds thermodynamics research at Lockheed

Designed to meet a constantly increasing volume of thermodynamics work, Lockheed's *new icing research tunnel now* provides year 'round testing in meteorological environments normally found only in flight. It is the first icing research tunnel in private industry.

Lockheed thermodynamics scientists were formerly limited to testing time available at installations such as Mt. Washington. Now they are able to study in greater detail problems such as: thermal anti-icing; cyclic de-icing; various methods of ice removal; distribution of ice; rate of temperature changes in aircraft components; thermodynamic correlation between laboratory and flight testing; and development and calibration of special instrumentation.

C. H. Fish, design engineer assigned to the tunnel, measures impingement limits of ice on C-130 wing section. The tunnel has refrigeration capacity of 100 tons, provides icing conditions of 0 to 4 grams per cubic meter, droplet sizes from 5 to 1000 microns.

Thermodynamicist Ed Dean monitors main control panel in picture at left. Temperature, air speed, water flow rate, air pressure and other variables can be regulated independently.

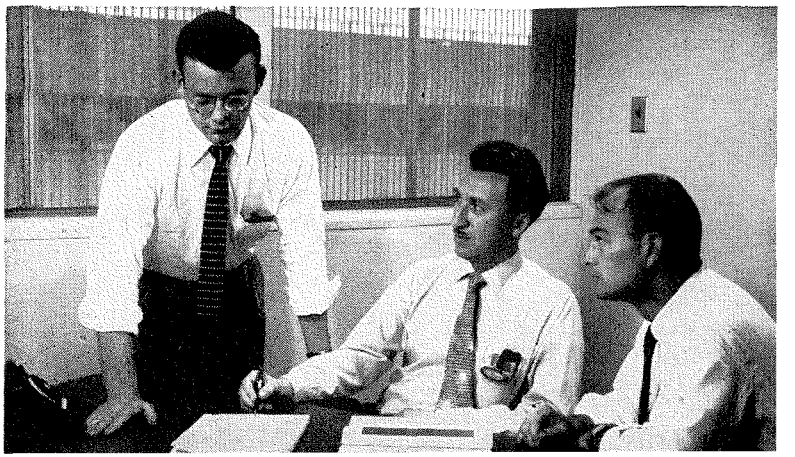
Career Opportunities at Lockheed

Increasing research and development work on nuclear energy, turboprop and jet transports, radar search planes, supersonic aircraft and a number of classified projects offers engineers outstanding opportunity for creative work.

This is true not only for men in thermodynamics but for Aerodynamicists and Aerodynamics Engineers, Structures Research Engineers, Airborne Antenna Designers, Flight Test Analysis Engineers, Physicists in fields of optics and acoustics, Mathematicians, and almost every other type of engineer.

You are invited to write for the brochure, "Your Future is Now" which describes life and work at Lockheed. Address E. W. Des Lauriers.

B. L. Messinger, department head, analyzes test results with Thermodynamics Engineer E. F. Versaw, right, and Thermodynamicist Tom Sedgwick, left. The report was in their hands *only two days* after it was decided to conduct the test.



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ALUMNI FUND

Report of the 7th Year — 1953 - 1954

YOUR CALTECH ALUMNI FUND has again demonstrated its capacity to serve the Institute. In the year ended June 30, 1954, a total of 1,074 alumni contributed $21,441.17.

This amount was sufficient to establish the first Alumni Scholarship, awarded to an entering freshman this fall.

While the figures for the number of contributors and and the dollar amount are somewhat disappointing when measured against the previous two years, it is to be remembered that 1953-54 marks the establishment of the new scholarship goal. The present program is directed toward the establishment of four-year, full-tuition undergraduate scholarships. Considering this shift in the Fund's goal, the results are indeed gratifying. Thus the alumni have demonstrated their support of the Alumni Fund as a perpetual medium for assisting Caltech.

It is of interest to note the substantial contribution made by men who received only higher degrees at the Institute. This past year the figure jumped $5,166, representing an average gift of $31.50 per contributor.

Undergraduate contributions are tabulated below. The names of all the 1953-54 contributors are listed on the following pages.

—Robert R. Bennett
—A. A. Ray
Directors in charge of the Alumni Fund 1953-54.

SEVENTH YEAR — 1953-54
(As of July 1, 1954)
Alumni Who Took Undergraduate Work at C.I.T.

CLASS	AMOUNT	NUMBER GIVING	AVERAGE GIFT	MEDIAN GIFT	NUMBER ELIGIBLE	PER CENT OF ELIGIBLE GIVING
Prior 1915	$ 25.00	3	$ 8.33	$ 10.00	24	12.5
1915	140.00	5	28.00	10.00	8	62.5
1916	15.00	2	7.50	7.50	7	28.6
1917	50.00	3	16.67	20.00	7	42.9
1918	408.02	4	102.00	12.50	30	13.3
1919	0	0	0	0	3	0
1920	100.00	10	10.00	10.00	27	37.0
1921	95.00	8	11.88	10.00	34	23.5
1922	2,500.00	19	131.58	25.00	59	32.2
1923	251.00	14	17.93	10.00	49	28.6
1924	195.00	10	19.50	10.00	73	13.7
1925	593.00	22	26.95	10.00	78	28.2
1926	1,382.00	17	81.29	10.00	99	17.2
1927	289.00	22	13.14	10.00	89	24.7
1928	254.50	19	13.39	10.00	60	31.7
1929	375.00	25	11.00	10.00	84	29.8
1930	463.01	21	22.05	10.00	102	20.6
1931	947.00	21	45.10	10.00	97	21.6
1932	240.00	18	13.33	10.00	94	19.1
1933	169.00	14	12.07	10.00	93	15.1
1934	433.00	25	17.32	10.00	103	24.3
1935	462.00	32	14.44	10.00	110	29.1
1936	1,488.00	33	45.09	10.00	115	28.7
1937	175.00	15	11.67	10.00	112	13.4
1938	265.00	23	11.52	10.00	125	18.4
1939	231.00	22	10.50	10.00	112	19.6
1940	429.00	34	12.62	10.00	140	24.3
1941	321.00	32	10.03	7.50	128	25.0
1942	377.50	41	9.21	6.00	149	27.5
1943	352.00	42	8.38	6.00	124	33.9
1944	485.99	41	11.85	10.00	208	19.7
1945	330.50	30	11.02	5.00	190	15.8
1946	164.00	23	7.13	5.00	163	14.1
1947	405.50	32	12.67	5.00	144	22.2
1948	326.50	49	6.66	5.00	192	25.5
1949	509.00	59	8.63	5.00	211	28.0
1950	392.50	43	9.13	5.00	183	23.5
1951	321.00	34	9.44	5.00	159	21.4
1952	189.00	23	8.22	5.00	126	18.3
1953	136.00	20	6.80	5.00	135	14.8
TOTAL	$16,285.02	910	$ 17.90	$ 10.00	4,046	22.5

CONTRIBUTORS TO THE ALUMNI FUND 1953 - 1954

1896
Haynes, Diantha M.

1911
Ward, Royal V.

1913
Koch, Louis J., Jr.

1915
Black, Harold A.
Burt, Earle A.
Holmes, William M.
Holt, Herbert B.
Wilcox, Charles H.

1916
Carson, Max H.
Dumond, Jesse W., Ph.D.

1917
Kensey, Alexander
Poole, Fred L., Ph.D.
Richards, Roy T.

1918
Hainsworth, Wm. R., M.S.
Heywood, Gene B.
Hoge, E. R.
Kirschman, H. D., Ph.D.
McDonald, G. R.

1920
Barnes, Hartwick M.
Barton, Paul D.
Hounsell, E. Victor
Hounsell, Theron C.
Sawyer, Mark A.
Smith, R. Carson
St. Clair, Harry P.
Suman, George O., Jr.
Whitworth, George K.
Woodbury, Roscoe E.

1921
Boggs, Chester A.
Case, Henry R.
Champion, Edward L.
Craig, Robert W.
Honsaker, Horton H.
Quirmbach, Charles F.
Stamm, Alfred J.

1922
Ager, Raymond W., Ph.D.
Alles, Gordon A., Ph.D.
Bear, Ralston E.
Benioff, Ben
Clever, George H.
Crissman, Robert J.
Darnell, Donald W.
Erb, Louis H.
Fleming, Thomas J.
Groat, Edmund T.
Hathaway, Edward A.
Honsaker, John, Jr.
Hopper, Francis L.
Jasper, Walter
Knight, Alfred W.
Marsh, Hallan N.
Ogden, Harold S.
Reynolds, Maynard S.
Vesper, Howard G.

1923
Baier, Willard E.
Bangham, William L.
Barnett, Harold A.
Blakeley, Loren E.
Dillon, Lyle
Endicott, Harold S.
Hopper, Basil
Lewis, Howard B.
Loughridge, D. H., Ph.D.
North, John R.
Puls, J. H.
Roberts, F. Fred
Schonborn, Robert J.
Stromsoe, Douglas A.
Woods, Robert E.

1924
Anderson, Kenneth B.
Clark, Rex S.
Goodhue, Howard W.
Irwin, Emmett M.
Kalichevsky, Vladimir A.
Losey, Theodore C.
Moyse, Hollis W.
Stoker, Lyman P.
Thomas, Rolland S.
Winegarden, H. M., Ph.D.

1925
Atherton, Tracy L.
Brunner, Michael C.
Burmister, Clarence A.
Clayton, Frank C. A.
Dalton, Robert H., Ph.D.
Ferkel, Albert J.
Freeman, Henry R.
Fulwider, Robert W.
Hart, Edward W.
Heilbron, Carl H., Jr.
Hertenstein, W.
Jones, Herbert J.
Jones, Walter B.
Miller, Leo M.
Pauling, Linus C., Ph.D.
Pearson, Rolland R.
Prentice, Leland B.
Rivinius, Paul C.
Sellers, W. D.
Simpson, Thomas P.
Stewart, Earl D.
Thompson, Wilfred G.

1926
Ball, Alpheus
Bogen, Robert
Bowman, Robert B.
Dinsmore, Daniel G.
Edwards, Manley W.
Foster, Alfred
Friauf, James B., Ph.D.
Gockley, Roscoe
Graham, Glenn
Hayward, C. D., Ph.D.
Kiech, Clarence F.
Kirkeby, Eugene
Macfarlane, Donald P.
Moodie, R. W.
Pompeo, Domenick J.
Schott, H. F., Ph.D.
Serrurier, Mark
Van den Akker, Johannes
Voelker, Joachim F.
Wise, Willis H., Ph.D.
Wulf, Oliver R., Ph.D.

1927
Bailly, Florent H.
Baldwin, Marshall A.
Baxter, Ellery R.
Bower, Maxwell M.
Boyd, James
Capon, Alan E.
Farrar, Harry K.
Gardner, David Z., Jr.
Gottier, Thomas L.
Hale, Frank S.
Heilbron, Robert F.
Hoover, Vaino A., Ph.D.
Jaeger, Vernon P.
Kaye, George R.
Lilly, Forrest J.
Mendenhall, H. E., Ph.D.
Moore, George E.
Moore, Robert M.
Peterson, T. S., Ph.D.
Schultz, Murray N.
Starke, Howard R.
Thompson, Russell E.
Warner, Arthur H., Ph.D.
Watson, Ralph M.

1928
Armstrong, Richard C.
Beckman, A. O., Ph.D.
Brighton, Thomas H.
Chilberg, Guy L.
Clark, Alexander
Coulter, Robert I.
Crosher, Kenneth R.
Duval, Richard H.
Evans, Robley D., Rh.D.
Folsom, R. G., Ph.D.
Gewertz, Moe W.
Jacobs, W. Morton
Kaneko, George S.
Kuhn, Jackson G.
Lash, Charles C., Ph.D.
Lindvall, F. C., Ph.D.
Lombard, A. E., Jr., Ph.D.
Minkler, Cyrus G.
Noel, Francis
Shaffer, Carmun C.

1929
Atwater, Eugene
Birge, Knowlton R.
Bosserman, Charles A.
Clark, D. S., Ph.D.
Cline, Frederick R.
Cravitz, Philip
Dunham, James W.
Exley, Sidney T.
Findlay, W. A., Ph.D.
Fredendall, Beverly F.
Grimes, Walter B.
Haeff, Dr. A. V., M.S.
Hugg, Enest B.
Keeling, Harry J.
Kingman, Kenneth E.
Larrecq, Anthony J.
Lau, Kam Hu
Lee, Edson C.
Milliken, Donald B.
Mohr, William H.
Myers, Albert E., Ph.D.
Noland, Thomas J., Jr.
Pierce, Firth
Raitt, Russell W., Ph.D.
Roberts, Bolivar
Russell, Kenneth F.

1930
Bechtold, Ira C.
Blohm, Clyde L.
Bode, Francis D., Ph.D.
Bungay, Robert H.
Butler, Albert
Carlson, Chester F.
Crawford, Franklin G.
Giebler, Clyde
Hopper, Rea E.
Howse, S. Eric
Johnson, Josef J.
Johnston, Norris, Ph.D.
Jones, Harlen R. E.
Levine, Ernest
Pritchett, Jack D.
Ross, George A.
Sawyer, H. G.
Sheffet, David
Strong, Austin W.
Thayer, Eugene M.
Towler, J. W.
Zipser, Sidney

1931
Arndt, Wm. Frederick
Arnold, William A.
Boothe, Perry M.
Cogen, William M., Ph.D.
Detweiler, John S.
Ferguson, Lawrence L.
Gerschler, James M.
Green, E. F.
Keeley, James H.
Kinney, Edward S.
Kircher, C. E., Jr.
Langsner, George
Leeper, Laverne D.
Lehman, Robert M.
Lewis, George E.
McMillan, John R.
Neher, H. Victor, Ph.D.
Overhage, Carl F. J.
Peer, Edward S.
Peterson, R. A., Ph.D.
Terry, Paul M.
Widess, Rubin
Wilmot, Charles A.

1932
Arnerich, Paul F.
Behlow, Lewis B.
Bowden, Frederick W.
Cox, John L.
Finney, Howard W.
Freeman, R. B., Ph.D.
Harsh, Charles M.
Hodge, Mills S.
Jones, Charles W.
Kent, William L.
Lipp, James E., Ph.D.
McLaughlin, James P.
Pruden, Worrell F.
Schuhart, Mervin A.
Sheffet, Joseph
Shockley, William
St. Clair, Robert W.
Wilson, C. E., Ph.D.

1933
Berkley, G. Merrill
Binder, R. C., Ph.D.
Bonillas, Ygnacio
Clifford, Alfred H.
Edwards, E. C., Ph.D.
Fletcher, Robt. D., Ph.D.
Johnson, J. Stanley
Lewis, Wyatt H.
Mathewson, Arthur, Jr.
Mendenhall, John D.
Meskell, John E.
Poulson, D. F., Ph.D.
Prater, Arthur N., Ph.D.
Root, L. Eugene, M.S.
Russell, Richard L.
Scholtz, Walter
Suhr, Henry B.
Washburn, Dana E.
Wattendorf, F. L., Ph.D.
Widess, Moses B., Ph.D.
Wilking, Arnold P.

1934
Bollay, William, M.S.
Boykin, Robert O.
Childers, Milford C.
Dietrich, Robert A.
Donahue, Willis R., Jr.
Escherich, Roland H.
Etter, L. Fort
Gordon, Garford
Gulick, Howard E.
Haskins, Ray W.
Howard, Ernest R .
Judson, Jack
Kidd, Ray E.
McCann, Gilbert, Ph.D.
McFadden, Wm. C.
McRae, James W., Ph.D.
Miller, Guy O.
Newton, Charles V.
Parker, Richard T.
Schaak, Frank A., Jr.
Sharp, Robert P.
Sherborne, John E.
Ugrin, Nick T.
Van Osdol, G. W.
Von Huene, Rudolf
Weaver, Glenn W.

1935
Baldwin, Lawrence W.
Browder, Lewis B.
Davenport, H. W., Ph.D.
Davenport, Lind B.
Davies, James A.
Dewees, Norman B.
Dunbar, Oliver C.
Fussell, Robert G.
Gluckman, Howard P.
Higley, John B.
Jones, Robert G.
Jones, Robert P.
Ketchum, Milo C.

FUND CONTRIBUTORS . . .

CONTINUED

Keyes, William F., Jr.
Kramer, Robert L.
La Rue, Robert O.
Leppert, Elmer L., Jr.
Levy, Henri A., Ph.D.
Lindsay, Chester W.
Nies, Nelson P.
Pitzer, Kenneth S.
Rader, Louis T., Ph.D.
Ray, A. Allen
Reynolds, Edward H.
Ribner, Herbert S.
Roehm, Jack M.
Sheff, Sander D.
Slater, Alfred L.
Snow, Neil W.
Stanley, Robert M.
Stick, John C., Jr.
Taylor, Jay C.
Tooby, George J.
Van Reed, Mabry

1936

Best, Charles W., M.S.
Boothe, Raymond H. F.
Bucknell, Wilson H.
Bush, Kenyon T.
Carley, Glenn R.
Davis, Frank W.
Dilworth, R. P., Ph.D.
Douglass, Malcolm E.
Gates, John I.
Graham, Ernest W., M.S.
Hamacher, Howard F.
Hammond, Paul H.
Harker, David., Ph.D.
Henderson, Everett B.
Jensen, Ray
Johnson, F. L.
Jones, Paul S.
Jordan, Charles B.
Kasnicka, Edward J.
Klocksiem, John P.
La Boyteaux, Ellsworth
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Nutting, Perley G.
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Ramo, Simon, Ph.D.
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Serrell, Peter V. H.
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Spalding, Luther P.
Stitt, Fred B., Ph.D.
Thompson, Tyler, F.
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Vermeulen, Theodore
Whipp, David M.
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1937

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Butterworth, Wesley T.
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Feuer, Stanley I.
Francis, George F., M.S.
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Miller, Nash H., M.S.
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Sullwold, John L.
Summerfield, M., Ph.D.
Van Dusen, C. A., Jr.
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Walseth, Erling S., M.S.
Webster, Martin H.
Wyckoff, Peter H.

1938

Baker, John R.
Bertram, Sidney
Cardwell, W. T., Jr.
Claflin, Waldo M., M.S.
Clarke, Charles W.
Custer, Robert S.
Davidson, Donald D.
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Wald, George, Jr.
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1939

Beanfield, B. F., M.S.
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Carstarphen, Charles F.
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Crozier, George O.
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Snyder, Willard M.
Stones, J. Eugene
Sullivan, Edwin F.
Tregidga, A. C., Ph.D.
Wilson, Warren E. M.S.
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1940

Avann, Sherwin P., Ph.D.
Barber, George C.
Blackinton, Roswell J.
Brewer, Leo
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Burton, Clifford C.
Carson, Donald B.
Daams, Gerrit
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1941

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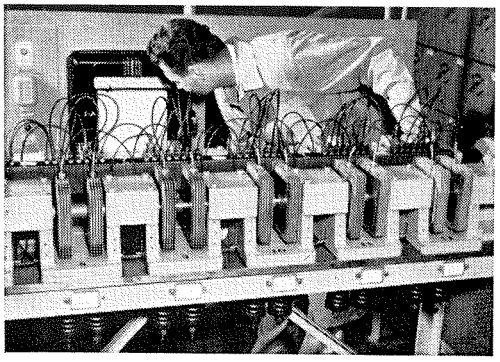
Such facilities are one of the many reasons why engineers and designers *call on New Departure* for assistance in **ball** bearing applications!



Research at New Departure has been responsible for development of such devices as the Rockwell hardness tester and many forms of precision grinding and gauging equipment . . . such advances as the preloaded angular contact double row ball bearing and the self-sealed, lubricated-for-life ball bearing.

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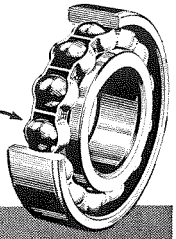

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1942

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1944

Andrews, Tway W.
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Soike, Richard J.
Solomon, Joseph
Stern, John L.
Warren, John C.
Welliver, Clarence L.
Zivic, John A.

1945

Ari, Victor A., M.S.
Austin, Dale H.
Bennett, R. R., Ph.D.
Brough, Harry W.
Cardall, John D., Jr.
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Dodder, Donald C.
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1946

Ahern, Dennis J.
Arequedas, Jose A., M.S.
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Benton, Philip H.
Bongardt, William G.
Buford, Phillip N.
Clapp, Roger W.
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Deodati, J. B., M.S.
Dick, Charles W.
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Zagorites, Jerry A.

1947

Bearson, Robert
Beymer, Ellis H.
Brueggemann, Harry P.
Caldwell, David O.
Comlossy, Harold, Jr.
Cowan, Edwin J.
DeGroff, H. H., Jr., M.S.
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1948

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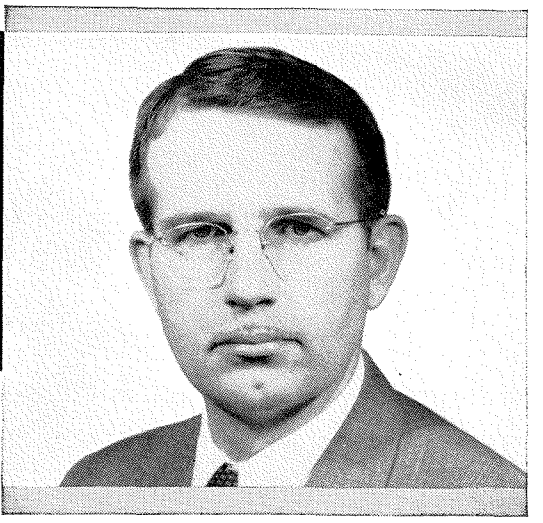
"Allis-Chalmers Graduate Training Course Gave me a head start"



says GERALD SMART

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"MOST MEN graduating from college don't have a clear idea of what they want to do. These individuals are helped by Allis-Chalmers Graduate Training Course to find the right job whether it be in design, sales, engineering, research or manufacturing.

"My case is a little different, however. I started the course with all my interest centered on tool design and 'in-plant' service. The reason is that I started getting vocational guidance from some very helpful Allis-Chalmers men back in 1940."

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"At their suggestion I had gone to school part time while working full time. This not only gave me the chance to serve an apprenticeship as a tool and die maker, and earn money, but I learned what I wanted to do after graduation.

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"The 18 months spent in the foundry, erection floor and machine shop have all proved valuable background for my present job.

"As supervisor of plant engineering at the Norwood Works, I am concerned with such problems as: Plant layout, material handling equipment and methods, new construction, new production methods to be used in building motors, centrifugal pumps, and *Texrope* drives. It's an extremely interesting job.

"From my experience, I'd say, whether you're a freshman or a senior it will pay you to talk to an Allis-Chalmers representative now. You can't start planning your future too soon. And you can't plan starting at a better place, because Allis-Chalmers builds so many different products that you'll find any type of engineering activity you could possibly want right here."

Facts You Should Know About the ALLIS-CHALMERS Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training. Length and type of training is individually planned.

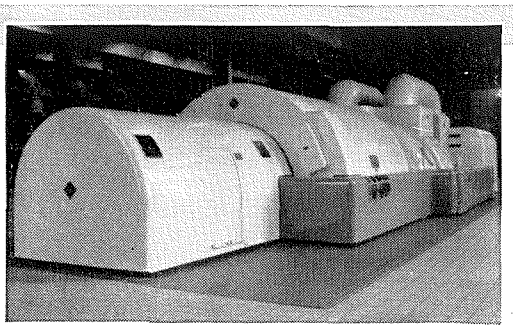
3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

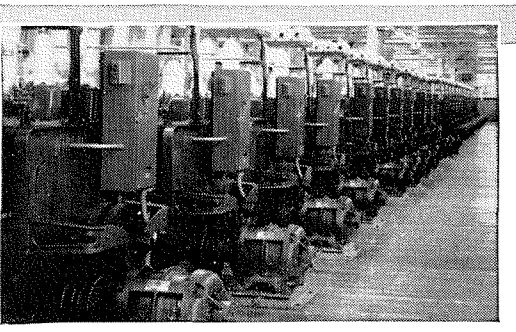
5. He will have individual attention and guidance of experienced, helpful superiors in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisc.



Steam turbines, condensers, transformers, switchgear, regulators are built for electric power industry.



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McCaldin, J. O., Ph.D.
McIntyre, Richard M.
McLellan, Wm. Howard
MacKenzie, D. B., Ph.D.
Markoff, Daniel
Meghreblian, R. V., Ph.D.
Montgomery, Jay A.
Mosich, John T.
Pastan, Harvey L., M.S.
Picciotto, Roger A.
Proud, William H.
Quandt, Ronald Lewis
Romero, Marco A.
Ross, Martin N.
Schuch, Adam F.
Schuyler, Arent H., Jr.
Shapiro, Henry
Sims, Virgil J., Jr.
Smoot, Roland Nesbit
Spencer, Eugene
Staats, William Thomas
Stowe, Bruce B.
Strauss, B. S., Ph.D.
Weeks, LeRoy W.
Worrell, Edsel A.
Wright, Richard Bruce

1951

Adler, Robert G.
Baily, Frederick G.
Bates, Charles J.
Bible, Robert E.
Boblett, Emil V.
Brown, E. A., Jr., M.S.
Bunker, Rodney S.
Caldwell, Ronald T.
Campbell, G. S., M.S.
Carter, Joseph M., M.S.
Clark, Bert H.
Cleland, G. H., Ph.D.
Elder, John .
Enslow, James A.
Hallstrom, John V.
Helfrey, Paul F.
Hermann, Julius
Homewood, R. H., M.S.
Hooper, Frank L.
Houser, Bradford C.
Hull, Herbert M., Ph.D.
Ibers, James A., Ph.D.
Ito, Henry
Jaskowsky, W. F., M.S.
Kamei, Hiroshi
Kinkel, John F.
Klarfeld, Marshall L.
Koerner, Terry W.
LeMay, Dan B.
Martin, Harold F.
Mason, Peter V.
Merkel, George
Merritt, R. G., M.S.
Mickey, Frederick, M.S.
Narud, Jan A.
Nuno, Richard K.
Paulson, Charles T.
Pfeiffer, Walter F.
Sato, Kazuhiko
Sawyer, George M.
Sharp, Richard S.
Staples, Wm. D., M.S.
Steese, Charles M., Jr.
Sweet, Sanford S.
Walp, Robert M.

1952

Altermatt, Robert B.
Baier, Rodger
Bettman, Max., Ph.D.
Blair, Robert
Butler, Sherman E.
Callaghan, Michael
Carrington, Tucker, Ph.D.
Cook, Samuel P.
Cuff, Leland
Ghauri, Waheed K.
Greene, Malbone
Holm, Robert J., A.E.
Howell, John L.
Irwin, William W.
Israelsen, Boyd P.
Jackson, Harold L.
Karasawa, Richard Y.
Kelly, Peter M., M.S.
Koons, David
Larson, Carl V.
Lew, Clinton
Oliver, Robert
Perpall, Robert C.
Phillips, Robert M.
Rogers, John J. W.
Staten, Wm. H., M.S.
Stegall, Gilbert E., M.S.
Wagner, Dudley W.
Wise, William L.
Wong, Edgar

1953

Arens, Moses, M.S.
Atkinson, J. H., Jr., M.S.
Bates, Philip K., Jr.
CoNine, R. Dysart
Crespo, Manuel J.
Delcamp, John N.
Eager, Walter J.
Gardner, William D.
Gee, John D.
Hunt, H. Robert, M.S.
Johnston, David
LaTourrette, James T.
LeTourneau, Budd W.
McCormick, William D.
Miller, C. E., Jr.
Minton, Stanley J., M.S.
Nicholson, Kenneth F.
Ogilvie, J. Morgan
Sheldon, Theodore D.
Spencer, Robert L.
Stanton, Robert J., Jr.
Stasney, Arthur J.
Stevens, David F.
Stofel, Edwin J.
Taylor, Thomas T., M.S.
Wallcave, Lawrence, Ph.D.
Willens, Ronald H.

ALUMNI DINNER MEETING

November 3, 7:00 p.m.
Rudi's Italian Inn
3773 Crenshaw, Los Angeles

Speaker: Bruce Findlay
Asst. Superintendent of Schools, Los Angeles

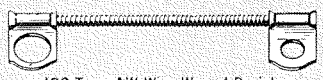
Precision, high-speed winding equipment for IRC elements

IRC WINDING SKILL OFFERS REALISTIC SAVINGS TO INDUSTRY

BASIC TECHNIQUE

Wire element is uniformly and tightly wound on an insulated core. Axial leads or other terminations are secured to element by automatic machinery. Insulated housing may be used or omitted.

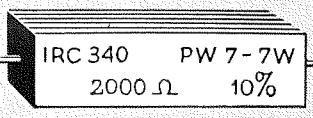
SPECIFIC EXAMPLES



IRC Type AW Wire Wound Resistors

IRC Type BW Insulated Wire Wound Resistors

IRC 4-watt Insulated Power Wire Wounds



IRC 7 and 10 watt Power Wire Wounds

. . . another reason why engineers specify IRC Resistors

Savings in the initial cost and assembly of component parts are an increasingly important factor to electronic engineers. That's why they depend upon IRC for their resistor requirements. IRC's mastery of winding wire elements—dating back more than 25 years—today provides a wide variety of unique units that offer realistic possibilities for savings.

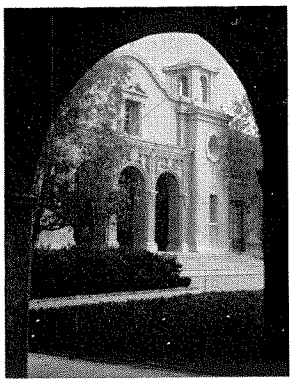
IRC

Wherever the Circuit Says

INTERNATIONAL RESISTANCE CO.

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

In Canada: International Resistance Co., Toronto, Licensee



ALUMNI CALENDAR

November 3	Dinner Meeting
January 12	Dinner Meeting
February 5	Dinner Dance Oakmont Country Club
April 16	Alumni Seminar Day
June 8	Annual Meeting Elks Club

CALTECH ATHLETIC SCHEDULE

VARSITY FOOTBALL

Oct. 2, 8 p.m.
Pomona at the Rose Bowl

Oct. 8, 8 p.m.
L.A. State at L.A. State

Oct. 16, 8 p.m.
Redlands at the Rose Bowl

Oct. 23, 8 p.m.
Whittier at the Rose Bowl

Oct. 30, 2:15 p.m.
Pomona at Pomona

FROSH FOOTBALL

Oct. 16, 2:15 p.m.
Occidental at Caltech

Oct. 23, 5:15 p.m.
Caltech at Whittier

Oct. 30, 2:15 p.m.
Pomona at Caltech

ALUMNI ASSOCIATION
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

BALANCE SHEET
as of June 30, 1954

ASSETS

Cash in Bank		$ 350.55
Postage Deposit		33.54
Investments:		
Share in Consolidated Portfolio of C.I.T. 6-30-54, prior to current year capital gain	$33,488.76	
Share in Savings account	8,325.04	
U.S. Savings Bonds cost	222.00	
Total Investments		42,035.80
Furniture & Fixtures at nominal amount		1.00
TOTAL ASSETS		$42,420.89

LIABILITIES

Accounts Payable	$ 232.12	
1954-55 Membership Dues paid in advance	$5,588.50	
TOTAL LIABILITIES		5,820.62

RESERVES

Life Membership Reserve:		
Fully paid life memberships	32,045.00	
Payments on life memberships under the installment plan	115.00	
TOTAL RESERVE		32,160.00

SURPLUS

Balance June 30, 1954	4,450.45	
Excess of expense over income for the year ended June 30, 1954	10.18	
TOTAL SURPLUS		4,440.27
TOTAL LIABILITIES, LIFE MEMBERSHIP, RESERVE, AND SURPLUS		$42,420.89

STATEMENT OF INCOME
For the year ended June 30, 1954

INCOME

DUES		$ 9,379.50
Less: Subscriptions to Engineering and Science Monthly for Association Members		7,200.00
Net Income from Dues		$ 2,179.50
INCOME FROM CONSOLIDATED PORTFOLIO OF C.I.T. Investment Income & Interest Income		1,877.89
PROGRAM AND SOCIAL FUNCTIONS:		
Income	2,450.00	
Expense	2,789.32	(338.82)
ANNUAL SEMINAR:		
Income	2,238.00	
Less Expense	2,012.94	225.06
SUNDRY INCOME:		33.60
NET RECEIPTS		$ 3,977.23

EXPENSES

ADMINISTRATION:		
Directors' expense	1931.91	
Postage	1,102.48	
Printing & supplies	629.02	
Total Administration	1,925.41	
Alumni Membership Solicitation	353.76	
Fund solicitation	867.14	
Student Relations expense	100.00	
Directory Expenses (Current year cost not covered by provisions)	741.10	
Total Expense		3,987.41
NET LOSS TO SURPLUS		$ 10.18

AUDITOR'S REPORT

Alumni Association
California Institute of Technology
Pasadena, California

I have examined the balance sheet of the Alumni Association, California Institute of Technology as of June 30, 1954, and the related statement of income for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the accompanying balance sheet and statement of income present fairly the financial position of the Alumni Association, California Institute of Technology at June 30, 1954, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

September 24, 1954

DALE J. STEPHENS,
Public Accountant
South Pasadena

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Engineering & Science
Calif. Inst. of Technology
Pasadena, Calif.