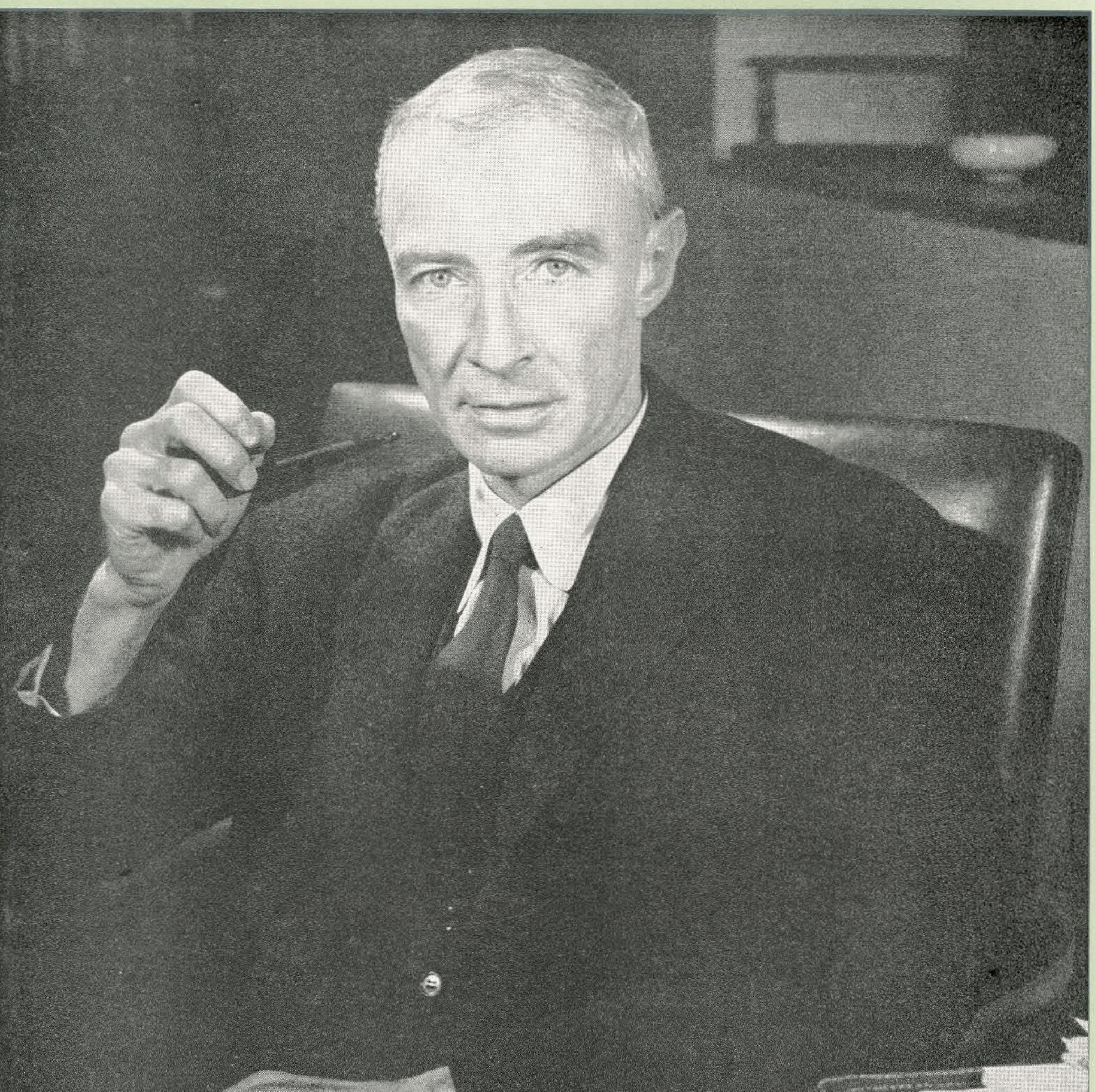
ENGINEERING | AND | SCIENCE

MARCH/1957

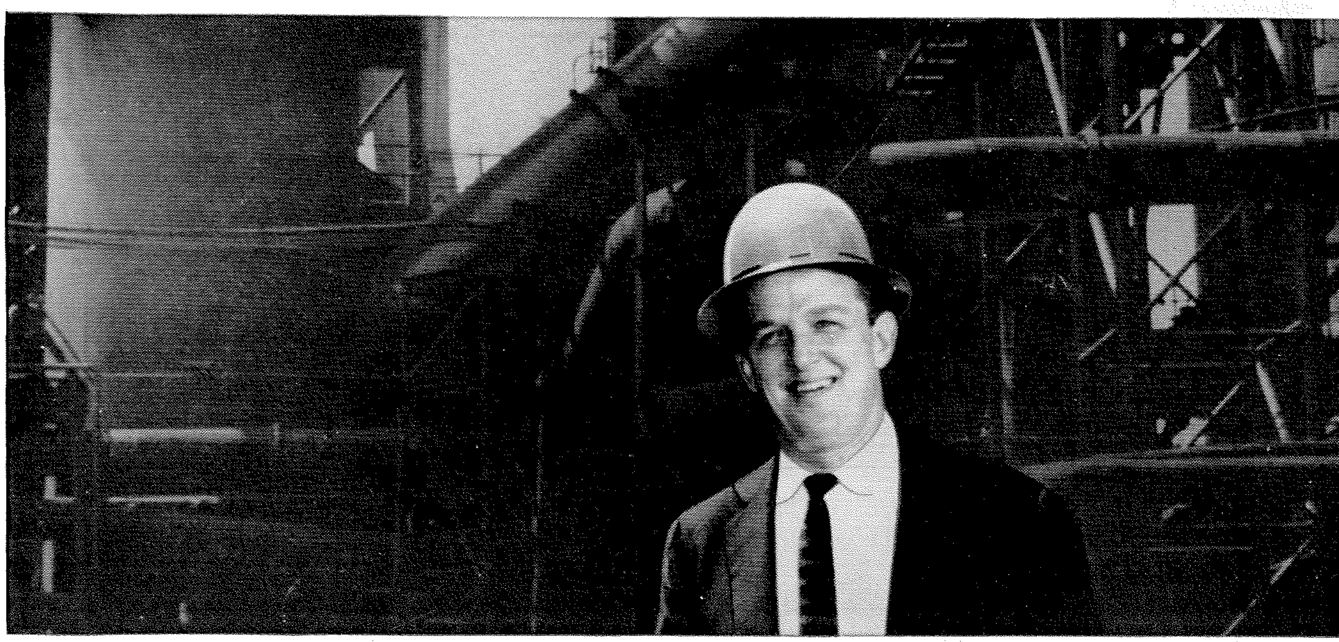


Talk to undergraduates . . . page 17

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Thomas A. Beattie, class of '47, speaks from experience when he says:

"At U. S. Steel one has a great amount of varied experiences. There is truly never a dull moment."



After receiving his B.S. in Mechanical Engineering in 1947, Mr. Beattie entered the employ of U. S. Steel as a student engineer. That was on September 22, 1947, and included service in the United States Navy from 1943 to 1946.

Mr. Beattie's progress from that date onward is typical of that of many engineering graduates who plan their future with U. S. Steel. For, within two years, we find Mr. Beattie advanced to the position of Process Engineer, Maintenance Department. Then on April 16, 1951, he was promoted to Relief Foreman, Shops, Maintenance Department. On March 1, 1952, he was made Turn Foreman, Blooming and Bar Mills, Mechanical Maintenance Department. And on January 1, 1955, he was promoted to his present post of Assistant Superintendent, Maintenance Department, of U. S. Steel's National Tube Division's National Works.

In this position, Mr. Beattie's responsibilities are numerous. They include the Service Power House and Skelp Mill area; maintenance of four blast furnaces and blast furnace auxiliaries, plus a sintering plant; maintenance of two blooming mills and soaking pits; maintenance of one bar mill; maintenance of three Bessemer converters, three open hearth furnaces, three open hearth auxiliaries, and seventy overhead cranes ranging from two to 200 tons. He supervises 680 men.

As Mr. Beattie remarks: "A steel plant includes all departments . . . every craft known to industry. In the space of three years, a U. S. Steel engineer can obtain experience that may take three times as long under different employment circumstances. One meets all types of problems and personnel. Each day is varied, certainly not dull, and yet no problem is insurmountable. Certainly, there is no possibility of getting 'into a rut' here."

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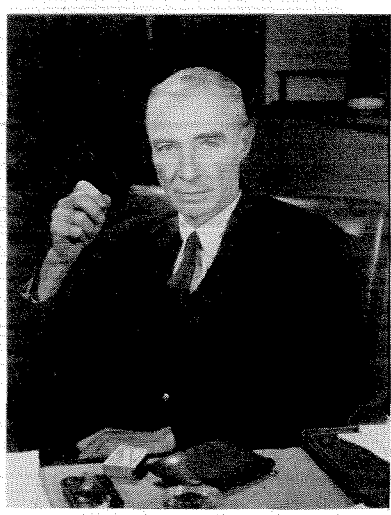
ENGINEERING AND SCIENCE

IN THIS ISSUE



ON THE COVER—J. Robert Oppenheimer, who came to the campus for five days this month as one of the Caltech YMCA's Leaders of America. Though most of his time was spent in informal discussion, Dr. Oppenheimer gave one formal address during his stay. On page 17—his "Talk to Undergraduates."

OUR OPPENHEIMER cover portrait was taken by Muriel Harvey, the wife of Thomas W. Harvey, administrative assistant in physics. The Harveys, who are both photographers, specialize in portraits, and in our December issue we ran a selection from their Caltech faculty collection. Apparently it wasn't *enough* of a selection, though, because readers have been asking for more ever since. So—on pages 22-27—a second installment of Harvey portraits. These are credited simply to "Harvey"—because not even the Harveys know which Harvey took which.

JAMES BONNER, professor of biology, writes about a fascinating new development in plant physiology on page 28. Dr. Bonner, who got his PhD from Caltech in 1934, was the first graduate student to get a degree in plant physiology here. After a year in Holland and Switzerland as a National Research Council Fellow, he returned to Caltech in 1935, and has been on the faculty ever since.

MARCH, 1957 VOLUME XX NUMBER 6
PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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STAFF

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Editorial Assistant....................Gerda Chambers
Student News....................Martin C. Tangora '57
Student Photographer....................David Groce '58

Published monthly, October through June, at the California Institute of Technology, 1201 East California St., Pasadena, Calif., for the undergraduates, graduate students and alumni of the Institute. Annual subscription $3.50 domestic, $4.50 foreign, single copies 50 cents. Entered as second class matter at the Post Office at Pasadena, California, on September 6, 1939, under act of March 3, 1879. Manuscripts and all other editorial correspondence should be addressed to: The Editor, *Engineering and Science*, California Institute of Technology.

BOOKS

THE DARWIN READER
edited by Marston Bates and Philip S. Humphrey
Scribner's, N.Y. $6.75

Reviewed by George W. Beadle
Chairman of the Division of Biology

Charles Darwin's life should be an excellent antidote to the despondency said to characterize Tech sophomores.

Here was a man who overturned the foundations of man's thinking about his origins and those of his fellow creatures on earth. His concept of organic evolution is one of the great ideas of all time. Yet, as a youth, he was regarded as a "very ordinary boy, rather below the common standard of intellect." His father once said, "You care for nothing but shooting, dogs and rat-catching, and you will be a disgrace to yourself and all your family."

Had there been a Caltech in his day, Darwin would surely have been denied admission. He says of himself that his power of sustained abstract thought was limited and that he could not have succeeded in mathematics. In spite of his prodigious productivity and success as a writer, he complains that he had great difficulty in this form of expression, tending frequently to put his first statement or proposition in "a wrong or awkward form." He was "singularly incapable of mastering any language" and could not "perceive a discord, or keep time and hum a tune correctly."

His professors of humanities must have made no lasting impression, for in his later years he could not endure to read a line of poetry, found Shakespeare so intolerably dull that it nauseated him, lost his taste for pictures, and was disturbed by music.

At 16, Darwin was sent to Edinburgh to study medicine. He found the lectures incredibly dull; he says the sole effect of Jameson's lectures on geology was a determination never to read a book on geology. He

CONTINUED ON PAGE 10


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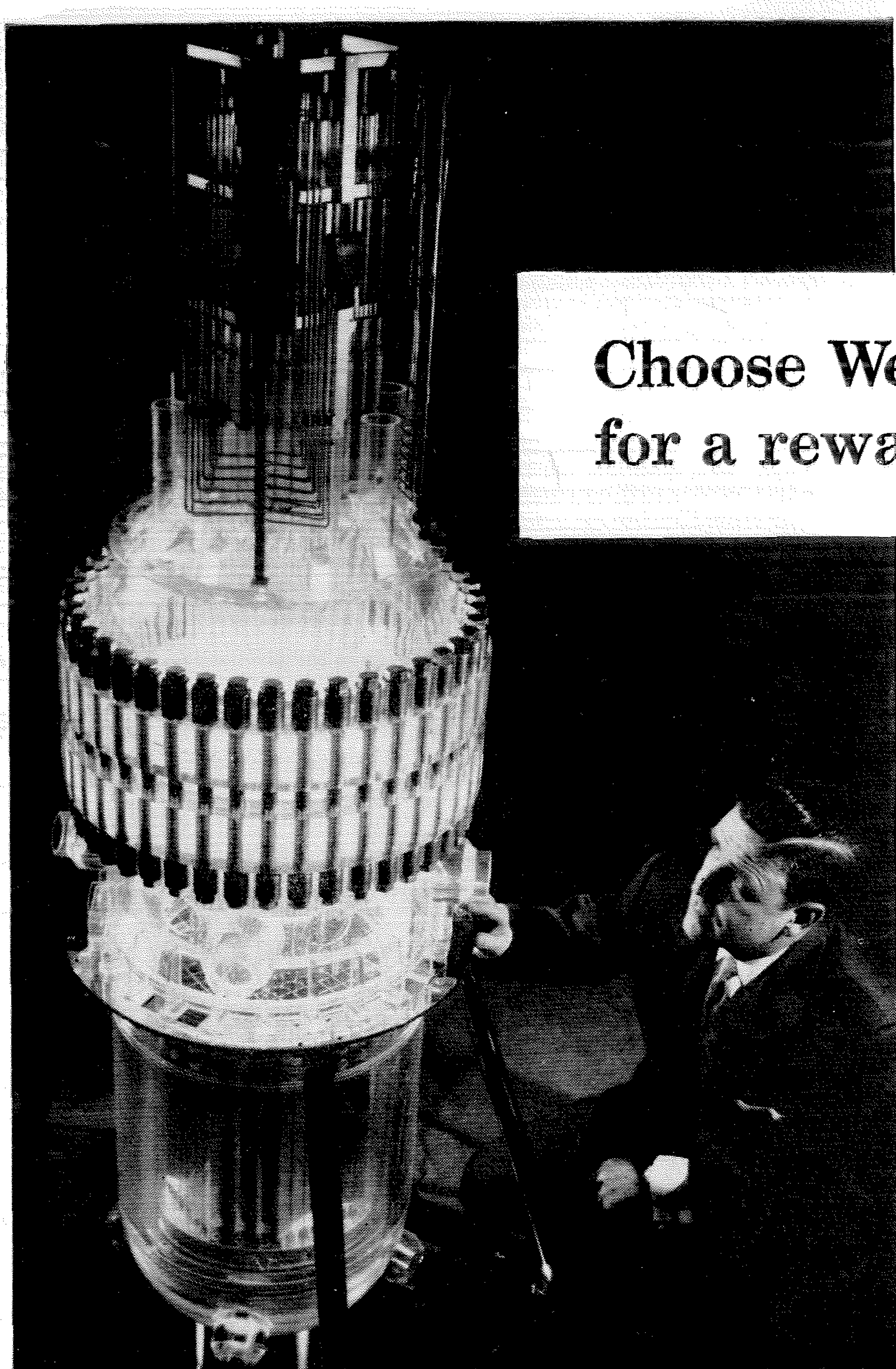

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recovered, however. Had his fame as a biologist not so eclipsed his other remarkable achievements, his work on the origin of coral reefs alone would have insured his place in geology's hall of fame.

Finding he had no heart for medicine, Darwin went to Cambridge to become a clergyman. For a time he was convinced of the "literal truth of every word in the Bible."

Little did he dream that he would one day provide the proof that it could not be, and that he would be responsible for jolting religious thought out of a complacency that had lasted for 17 centuries.

There followed a time-wasting phase of his college days, which he describes in the following words:

". . . I got into a sporting set, including some dissipated low-minded young men. We used often to dine together in the evening, though these dinners often included men of a higher stamp, and we sometimes drank too much, with jolly singing and playing cards afterwards."

To shorten the story, with the help of Professor Henslow of Cambridge, Darwin finally found himself and henceforth devoted himself completely to natural science. Soon after he signed as naturalist "without stipend" on the famous five-year voyage of the *Beagle*. He almost missed going because of his father's objections.

Three years after his return he had clearly formulated the theory of the origin of species through natural selection. With characteristic deliberateness, however, he did not publish it in full until 20 years later.

Darwin wrote voluminously and methodically. It was this attention to every detail that made the *Origin* at once so convincing and so time-consuming to read. Today, every informed biologist is supposed to have read this most important of Darwin's 20-some books. The fact is many have not. The words are so numerous for an idea that now seems so obvious and elegantly simple.

With the publication of *The Darwin Reader*, the task of reading Darwin is much lightened. The editors have so wisely and skillfully selected, arranged, abridged and annotated excerpts from Darwin's works that it is now possible to have, within a single 470-page volume, the meat of most of them. Short, informative and well written editorial comments provide continuity.

ELEMENTS OF ENGINEERING THERMODYNAMICS
by Rolf H. Sabersky
McGraw-Hill, N.Y. $7.50

Reviewed by Edward Zukoski
Assistant Professor of Mechanical Engineering and Jet Propulsion

THIS BOOK by Dr. Sabersky, associate professor of mechanical engineering at Caltech, is designed as an elementary text for a one-half year course in thermodynamics. Because of the time limit, the author has restricted the material to be discussed and confines himself to a

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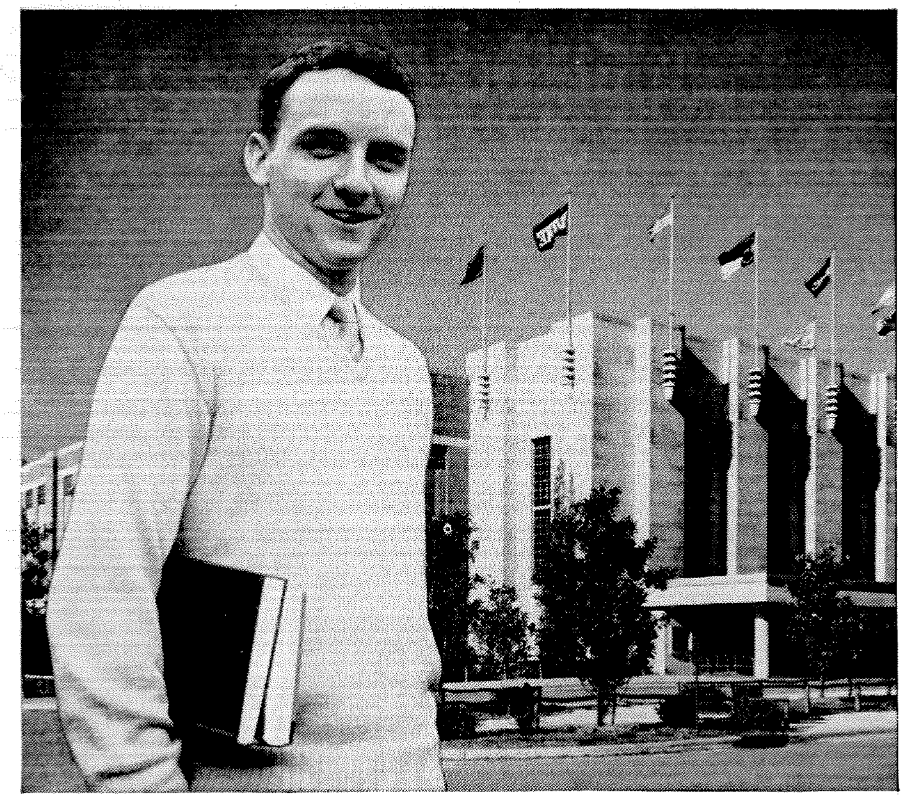
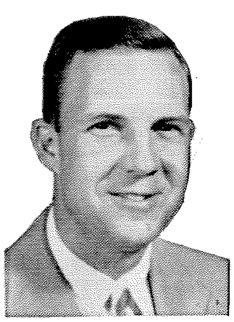


James B. Walker *received his B.S. in mechanical engineering from North Carolina State College in June, 1954, and was working toward his M.S. in the same field when he was called for military service.*

Jim Walker asks:

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



"Pick" Pickering answers:

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

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

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

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

H. M. Pickering, Jr., *received a B.S. in M.E. and E.E. from the University of Minnesota in 1940. He gained valuable technical experience at Hanford Works, in Richland, Wash., and in Du Pont's Fabrics and Finishes Plant at Parlin, N. J. Today, he is Assistant Plant Manager at Du Pont's Seaford, Del., plant, where nylon is made.*

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Books . . . CONTINUED

thorough discussion of fundamental concepts.

For purposes of discussion, the 23 chapters of the book may be grouped roughly into three sections: (1) the development of basic concepts; (2) discussion of general substances and their working cycles; and (3) application of thermodynamic laws to flow of compressible fluids.

Although the development of the concepts of temperature, internal energy, enthalpy and entropy follows a rather conventional pattern, the treatment is unusually thorough and the implications are carefully explored. The extension of the basic conservation laws to systems of particles in motion is made early in this section of the book.

In the second section, the properties of perfect gas and real substances are described. The deviations of real gases from ideal behavior are illustrated by a discussion of van der Waals gas and by problems involving the use of tabulated values of thermodynamic functions of real gases. The working cycles of a wide range of engines are presented and discussed in general terms. The cycles described include the Otto, Diesel and gas turbine cycle and also cycles using a condensable fluid. Some of the economic factors involved in the choice of a cycle for a particular application are also considered.

The one-dimensional flow of a compressible fluid is treated in the third section in considerably more detail than is usual in thermodynamics texts. The equations of motion are developed and applied to the description of pressure waves, the normal shock relations and flow in a convergent-divergent nozzle. With this background, some problems of gas turbine design are analyzed.

The last chapter of the book serves as an introduction to some of the concepts of combustion processes.

Because of the emphasis placed on the analysis of compressible flow problems, this book is particularly suitable as an elementary thermodynamics text for students interested in the study of fluid dynamics.

Few areas of engineering or science offer greater problems—or greater opportunity for achievement—than inertial guidance. At Lockheed Missile Systems' Research and Engineering Centers in Palo Alto and Sunnyvale, engineers and scientists are performing advanced work on all phases of inertial guidance and navigation.

New positions have been created for those possessing backgrounds in mathematics, physics, electronics, servomechanisms, flight controls, precision instrumentation and computer design. Inquiries are invited from those possessing strong interest in inertial guidance.

Positions are open in inertial guidance and virtually every field of engineering and science related to missile systems at Lockheed's Sunnyvale and Van Nuys Engineering Centers and Palo Alto Research Center.

Here R. G. Rickey (left), components specialist, discusses new accelerometer designs with E. V. Stearns, head of the Inertial Guidance Department.

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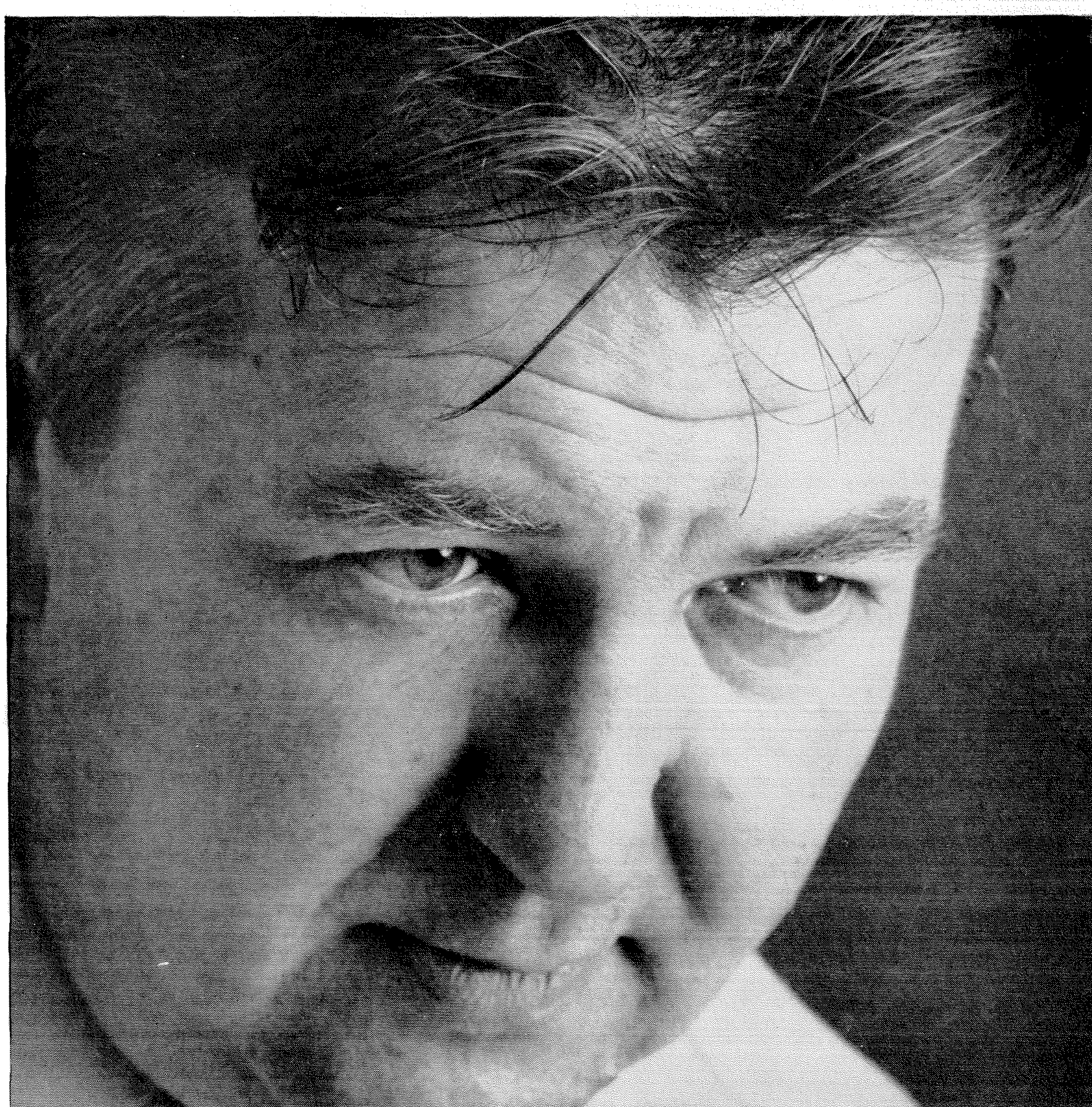

YAVNO

...on the second language

"Our first language is English. Our second is Mathematics. Not all of us are truly bilingual, but probably all are versed in a few concepts of Mathematics — that of a function, for example. The majority of us know those fields of mathematical analysis which developed with the physical sciences well enough to use them as the principal tools of our professions. A minority of us — the professional mathematicians — have pushed on to ground which may never become a public park, but parts of which are clearly exciting. Some strive to master electronic computers which already compress thousands of arithmetical operations into a second. Others, with the sharpest tools of modern Mathematics, carve out fields for use where human elements and decisions are paramount, and for use on problems which could be solved by enumeration, if life were long enough — life of the Universe, that is."

—*J. D. Williams, Head of the Mathematics Division*

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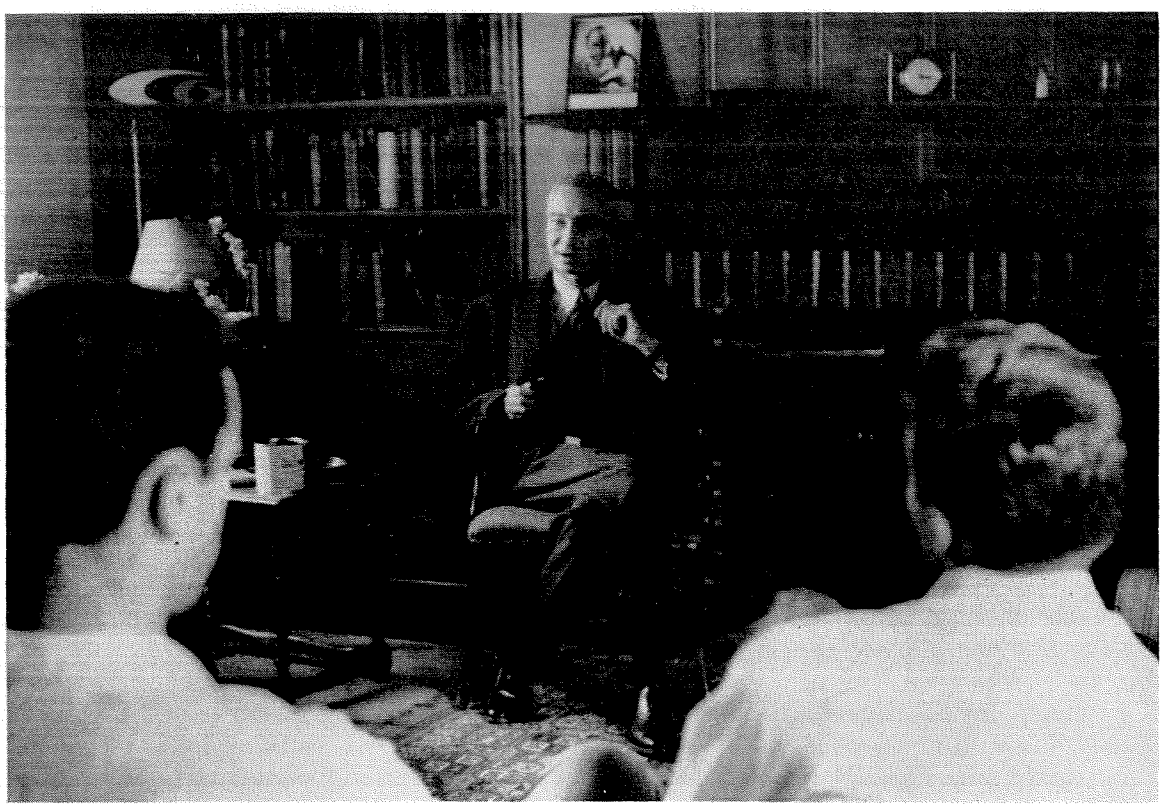


TALK TO UNDERGRADUATES

by J. ROBERT OPPENHEIMER

Dr. Oppenheimer, director of the Institute for Advanced Study in Princeton, New Jersey, came to the Caltech campus this month as the first 1957 visitor in the Caltech YMCA's Leaders of America program. From February 28 to March 5 he spent most of his time in informal discussions with students. His one formal address, "Talk to Undergraduates," was given in Culbertson Hall on the evening of March 4. A transcript of the talk appears on the following pages.

I HAVE SPENT enough time here so that not all of you are complete strangers to me; but this is the first opportunity I have had to say some things which, though formal, are nonetheless very much heartfelt. I thank you for asking me out; I think it an honor. Those of you who have met with me, and seen me struggling with questions to which I did not know the answers, must be aware of the fact that I have had many misgivings as to whether I rated the honor. I want to thank you for the very great friendliness, the very great frankness and the earnestness with which you have dealt with me. And I would like to thank you for adding a little to my understanding of the world we live in.

I have a few thoughts on the situation we face that I would like to talk about tonight. Of course, what I say is not only incomplete and partial, but there is a very special ground for some humility in what I do say. Between your generation and mine there are differences that neither of us is likely fully to understand. I am aware of this gulf and I don't underestimate it.

There is another reason for humility: What you have to deal with is partly the heritage of what the generations your senior have left you. I think we have no great reason for pride in the heritage. The problems seem to me very grave, and the measures and means for dealing with them and resolving them nothing to write home about.

Peculiarities of the time

Before talking about the specific problems of learning and ignorance—as they appear here, and as they appear in a larger sense for all of us—it may not be too bad to remind ourselves of some of the peculiarities of the time. It seems to me an extremely peculiar age. All ages are; but I am in some doubt as to whether there is any valid historical analog to this time.

I was reminded today of a story; and before outlining some of the traits of the mid-twentieth century, I may repeat it. It has a kind of moral, I think. A friend of mine signed up in the Army, after Pearl Harbor. He is a Greek philologist and philosopher, and the Army understood that he was a clever man and put him to work in Intelligence. Part of his job, in preparation for the invasion of Europe, was to interview men who had participated in the Canadian raid and in the evacuation from Dunkirk, and one day he talked to a fellow who had been the communications officer for his outfit. This fellow had come moderately late to Dunkirk and there were great masses of men on the beach waiting to be evacuated. So he dug down in the sand and turned on his radio and listened. There was a little bit of music —and that was all right—and then he got a BBC broadcast. The broadcast described how the ships were standing off to sea, waiting, and the men were waiting in long lines, and the Germans were approaching, and overhead there were dogfights—and the fellow said, "It was much too horrible; I had to turn it off."

So it is whenever we take an appraisal of our situation. One of the features of this time is that we live under a palpable threat of an apocalypse. I have talked with you enough so that you know that I don't regard this as inevitable; on the contrary, I think that for anyone who has an opportunity of working to avert it, that is a valid full-time job. It isn't like the apocalypse that was expected in the year 1000, but it is very much at the back of our minds in everything we do.

It is a strange time, too, in that never in the history of the world has there been as rapid a growth of knowledge, as rapid a growth in understanding, or as great changes. I suppose that, in the 18th century, men talked about how knowledge doubled every 50 years. I think we could make a case for saying that it doubled every 10 years now.

This creates problems of which I will talk mostly tonight. But it also creates problems of the use of that knowledge, of the vast powers that it seems to make available, of the choices. It creates a world of incredibly rapid change. Almost nobody can look back to a schooling with a feeling that it is entirely relevant to the problems that he is now dealing with. Almost everyone has to have the sense that he goes to school all his life.

In some ways, this situation, which I think is a natural continuation of the fluidity and openness of American society—an openness now not with regard to the physical frontier, but with regard to the frontier of knowledge—has given this country a strange destiny. I cannot believe that other parts of the world will not also very rapidly be caught up in changes comparable to those in which we live. They are not prepared for it; they have remained in relatively steady, relatively quiet, relatively enduring forms. And how we deal with this, certainly will not be an example that other peoples will inevitably or rightly follow. But how we deal with it cannot be irrelevant to the future of the whole world.

A characteristic irony

This is also a time when the very rapidity of change seems to me to underline the irony that is so characteristic of history—the irony which makes the event, the outcome, so different from the human purpose.

Think of the communist movement; it began in compassion, and now it is probably the least compassionate of any major political force the world has seen for a long, long time. Think of China, with its pattern of respect and love for the family and the past, its addiction to reflection, and almost private beauty. Think what the Chinese have embraced in the way of forced, quick, violent, brilliant change—and how little they are prepared for it. Think of India, if you will, and a government in India which is a direct consequence of Cambridge, of Oxford and of London—these symbols of two centuries of oppression. And think of us, who founded ourselves in independence, and who are inextricably stuck in the most monstrous kind of interdependence—both here, where the vastness of all our affairs makes the individual's wink invisible, and even interdependent with very remote parts of the globe. Think of the irony of the great weapons, which, developed to give a military answer to the problem of security, have assumed such proportions that they almost cannot be used, and have produced for the general staffs that evoked them a nightmare of almost total insecurity.

All these things—and there are many more— could easily, it seems to me, make in the times a kind of bitterness and a kind of feeling that the individual had better see to his own delight and to heck with society, to heck with virtue. That is not so different from the way it was in the decade when I grew up, after the first World War, where a kind of revolt was characteristic in the colleges, and in the arts. It was a revolt which said that what we have had from the past was not much of a guide for the future, a revolt where there was a hope of improvising something gay and new, where the bitter fruit of that terrible war seemed to call for a kind of new, fresh departure.

It isn't really quite like that now. I think that today, if I know you and your friends through the country, you hold very close to the ancient imperatives—the imperatives of Christianity, of our traditions, of our country. I think you are not after novelty and improvisation in art or politics or philosophy, or manners. I think that, even if the end of our time should come, you are quite content that we live out these days faithful to the gospels, faithful to the ethic, faithful to the sense of responsibility, which we have from times past.

These are some of the things that are in the background. Of course, the present problem of young people at college is the same everywhere. They are finding their way into an enormous cognitive jungle, the jungle of everything there is to know. They are finding their way into it with very little guide, either from synoptic kinds of knowledge, like philosophy, which say: This is important; this is unimportant; this fits in here; this fits in there—or from the state of the world, which doesn't, in any very clear or loud voice, say: Learn this; ignore that; learn this well; skip over that lightly.

Impossible choices

There is, in most places, the vast trouble of impossible choices. I have talked with and been among undergraduates—and school boys and graduate students as well—in some places around the country, and a typical agony is: "What do I do? Where am I headed?" The complement of that, of course, is to be told what to do, and in a measure, that is what goes on here. I think it varies from place to place, and there is no doubt that Caltech is far on one side of the spectrum—of the spectrum between openness and permissiveness on the one hand, and rather strict and specific guidance on the other; between knowledge as an end in itself, something to study because of the joy of it and the beauty of it—and knowledge as an instrument, as a way of getting on in the future. I think Caltech is very much on the instrumental side, and very much on the predetermined side.

But the sense of loss which I hear in you—I don't know whether it is exaggerated in our talk but I'm sure it's there—of the things which you are not studying; the sense of loss at all that you might be learning, and aren't; the slight fear that this might not be easy to make up at a later time; this is a much larger thing, a quite general part of human life. There is much more that one might know than any of us are ever going to know. There is much more to know than any of us are ever going to catch up with; and this is not just the trivial fact that we don't work hard enough; it is not the trivial fact that things are difficult to learn. It is that any form of knowledge really precludes other forms; that any serious study of one thing cuts out some other part of your life. Narrowness is not an accident of one place, but it is a condition of knowledge.

I think myself that, with the growth of knowledge—the immense perplexity, the pervasive mutual relevance of different things to each other—all we can do is to accept the state of affairs, to affirm it and to accept it deeply. It is not that some courses are not better than others and some worse, some even good and some evil; it is that, in the balance between ignorance and loss on the one hand, and knowledge and richness of experience on the other, we have to keep the affirmative love of the knowledge and the richness very close and never deny that most of what men can know, we don't know; that much of what man can know, nobody knows.

Of course, in a certain sense, this is trivial and people have always known it. When it comes to the will, the element of choice has always been clear. The fact that you had one course which precluded another; you could take a job, or you could continue to study; you could marry, or you could say goodbye; everybody knows that. But I think it has not been quite as clear how, in the very conditions of knowledge, choice is built in and exclusion is part of depth.

I don't want to try to derive this from anything in science because it seems to me quite deep and quite commonsensical, and very much a part of all our experience. But I do want to give three examples from three different areas in science which illustrate it rather sharply. One is from the physiology of perception, one is from the psychology of learning, and one is from physics.

The philosophers like to talk about sense data as though they were something that came to all men who were properly constituted, a replica, a picture, a sign of something outside; and all philosophers have always been very confident that the sense datum was something very solid to build on. But, in being able to perceive, we take a far more active part, and not necessarily a conscious one.

A simple experiment

There is, for instance, an experiment of great simplicity having to do with hearing. The nerves running from the hair cells in a dog's ear toward the cortex can be tapped, and one can see what kind of electrical impulses travel along them. And if you take a dog so "hooked up," you will soon learn to recognize the electrical pattern of the signal that comes along when the dog hears a bell ring. If you put a piece of meat in front of the dog, that signal disappears. The way this happens is that, along with the afferent nerve fibers, there are finer nerve fibers which, so to speak, tell the nerves what to do, what to hear and what signals to send. This is not understood in detail. But the coding which we always assume characterizes the human brain — the organization of material, the focusing of attention, animadversion, concentration, memory—this coding pervades the most primitive parts of the cognitive system, and the dog may or may not hear the bell. It isn't something that he fixes up inside himself; it is a question of what he is attuned to.

There are very similar experiments, having to do, for instance, with language—a whole series of them reported from the Harvard Cognition Project. It is astonishing what people will notice and what they will ignore. For instance, if you take some sounds that have some variations in them and say them, then an American who is attuned only to our language will hear differences—but only those differences which correspond to the way we spell and write, to our phonetic elements. Of course, we don't spell and write very accurately, but we recognize *a* as distinct from *e*, and *r* as distinct from *n* and so on. If you take a Navaho who doesn't know English, he will hear quite different things. He won't distinguish our vowels, but he will distinguish by the length of the vowel. You can teach the Navaho to notice the English differences and the American to notice the Navaho differences, but he doesn't normally do it. The possibility of communicating, of course, rests on the fact that we don't hear too much. You are hearing my talk, but only that part of it which really has meaning in English. All the rest of it—the rumble and roar that goes with it—you don't hear. It isn't that you hear it and ignore it.

Of the incredibly many examples, one of the most striking comes to anyone who tries to translate the words for colors from one language to another, even two languages that are Indo-Germanic. The English words for color distinguish spectrally what we call color, by the hue. The Greek words have to do almost entirely with depth and brightness, and you can't find a Greek word for blue. You can find one that sometimes means blue. All these questions of animadversion are extremely primitive.

An example from physics

And what is the example from physics? It is the one that I talk about much too much. Of course, if one is now learning atomic theory, one learns Schroedinger's equation in quantum mechanics, and it all seems very unphilosophical and practical. It is a wonderful way of describing atomic phenomena, and one tries to get the techniques and get it over with. But to anyone who lived with the development of this, it was quite a different story, because what one had to get through his head was something quite odd.

We are used to a world in which we can find out anything of interest about a large physical system without in any way questioning the means by which we can find it out. The classical examples are that we can tell where a planet is, and, by observing it successively, we can tell how fast it is moving. The question whether this observation could have any paradoxical features in it never arises. But in atomic mechanics, we had to learn that, although experiments in some ways like finding where a planet is, and in some ways like finding out its velocity, are indeed possible, and are indeed a part of describing what is going on. The kind of arrangement that is suitable for doing one of these experiments not only makes it impossible to do the other, but makes it logically contradictory to assume that the other quantity has a value, or has one of a number of values. In other words, we came to realize that, in the atomic scale, one can realize, by the way one goes about it in the laboratory, that there is some free choice. This is not free in the sense of an ethical problem, but just free for the physicist to decide what he is interested in or what he wants to study. Having made that choice, one has closed out the chance of doing the other thing, so that both are valid measurements, or so that he can even imagine that he has done both and that each has had a given result. If he imagines thus, and starts to draw the consequences, he will get a prediction for the future of that atom that has no relation to what he will find in the laboratory.

These are just three examples of the pervasiveness with which, in all scientific things, one meets again the fact that knowledge, by the very techniques, powers, and facts of its acquisition, by its organizing the chaos that is the world around us, precludes other knowledge.

A new picture of the cognitive world

This makes a picture of the cognitive world which, in many ways, is not the one we have inherited. It isn't as though we were in a room just looking at it, then, if we wanted to know some more, looking some more, exhausting all the properties of it, being able to talk about it all—as though we were in a temple and could go back over and over again, studying the peculiarities of the temple until there was nothing more to know, and then making a description of this room or this temple which was total and global.

It is much more as though we had deep, not always connected parts of knowledge—knowledge of physics, knowledge of life, knowledge of man, knowledge of history. Between these things that are known to any one of us, there is always potential relevance, so that one can never say, even of the most implausibly abstract kind of mathematics: This will not be relevant to psychology or physics. But the image that comes to my mind is not that of the chamber that can be exhausted, but of an essentially infinite world, knowable in many different ways; and all these paths of knowledge are interconnectable, and some are interconnected, like a great network—a great network between people, between ideas, between systems of knowledge—a reticulated kind of structure which is human culture and human society.

This means that I am very suspicious of statements that refer to totality or completeness; that I am very suspicious of our ability to have more than partial knowledge, in the very real sense that it can be supplemented and that it doesn't close. It means that I am very suspicious also of order which is hierarchical in the sense that it says that some things are more important than others— that some things are so important that you can derive everything else from them. These were great hopes of man, and philosophical systems are their monuments. I don't think that the prospects of their being realized look very good.

The collar

Now, one could take an attitude of real horror toward this and say that one can't live with it—that this is to offer man not knowledge, but chaos. I don't think that is right. We have all had the experience of seeing the relevance of something that we hadn't known before, of learning at all times in our lives something deep and new and wonderful that had been hidden before. We have all had the experience of what companionship and intercourse and an open mind can do; and I don't think the absence of global traits to our knowledge is a cause for despair. But I'd like to read you a poem that seems to me to fit a little, not only with this general situation, but perhaps even with the local situation. It is not a new poem; it is three centuries old and the language is archaic, and I can't be sure you'll like it—but I can say I like it. It is called "The Collar," and it is by a devout Anglican named George Herbert. Some of you may know it; it goes like this:

I struck the board, and cry'd No more;
I will abroad.
What? Shall I ever sigh and pine?
My lines and life are free; free as the road.
Loose as the wind, as large as store.
Shall I be still in suit?
Have I no harvest but a thorn
To let me blood, and not restore
What I have lost with cordial fruit?
Sure there was wine,
Before my sighs did dry it: there was corn,
Before my tears did drown it.
Is the year only lost to me?
Have I no bays to crown it?
No flowers, no garlands gay? all blasted?
All wasted?
Not so, my heart: but there is fruit,
And thou hast hands.
Recover all thy sigh-blown age
On double pleasures: leave thy cold dispute
Of what is fit, and not forsake thy cage,
Thy rope of sands,
Which petty thoughts have made, and made to thee
Good cable, to enforce and draw,
And be thy law.
While thou didst wink and wouldst not see.
Away: take heed:
I will abroad.
Call in thy deaths head there: tie up thy fears.
He that forebears
To suit and serve his need,
Deserves his load.
But as I raved and grew more fierce and wild,
At every word,
Methought I heard one calling, Child;
and I reply'd, My Lord.

Having spoken so, and tried to measure what the flowering, changing, rich, but only partially ordered world of the mind means for us, it may not be inappropriate to stress what seem to me a few of the things that will be useful in living with it. They are certainly not new things; they have always been useful.

The first is to have a kind of deep reverence, not, certainly, for the learned man or the stuffed shirt, but for learning, for knowledge and skill; and to hold tight to it, and not to be talked out of it by any superficial parody of what it is, the kind of thing we learn in school where we learn to do and create and understand, and where we learn really to act with the knowledge we get.

This is something that isn't easy to come by. It hasn't been easy for man; it isn't being easy now, and it is incredibly precious; and the world is full of it. Accounts of this—stories (whether in general education or in *Life* Magazine), short cuts, and synopses—miss most of the point. It is just the technique and the wonder of one's own ability to do it that is part of the value of it. And in ourselves and in other people this is, I think, to be held on to very tight. If you have learned how to be something, how to be a competent professional, you will know a great deal about what is good in this world. You will have a bond in common with every other man who is a scholar or a scientist.

The greatest of all protections against narrowness, and the greatest relief and opening, is comradeship, and that ability to learn from others of what their world is like. Learn from books for sure; learn from people, but learn with a kind of sense that every man enriches you and enlarges you if you only have the strength, the wit, the openness, the fortitude to learn what he is all about and what he knows.

The otherness of people

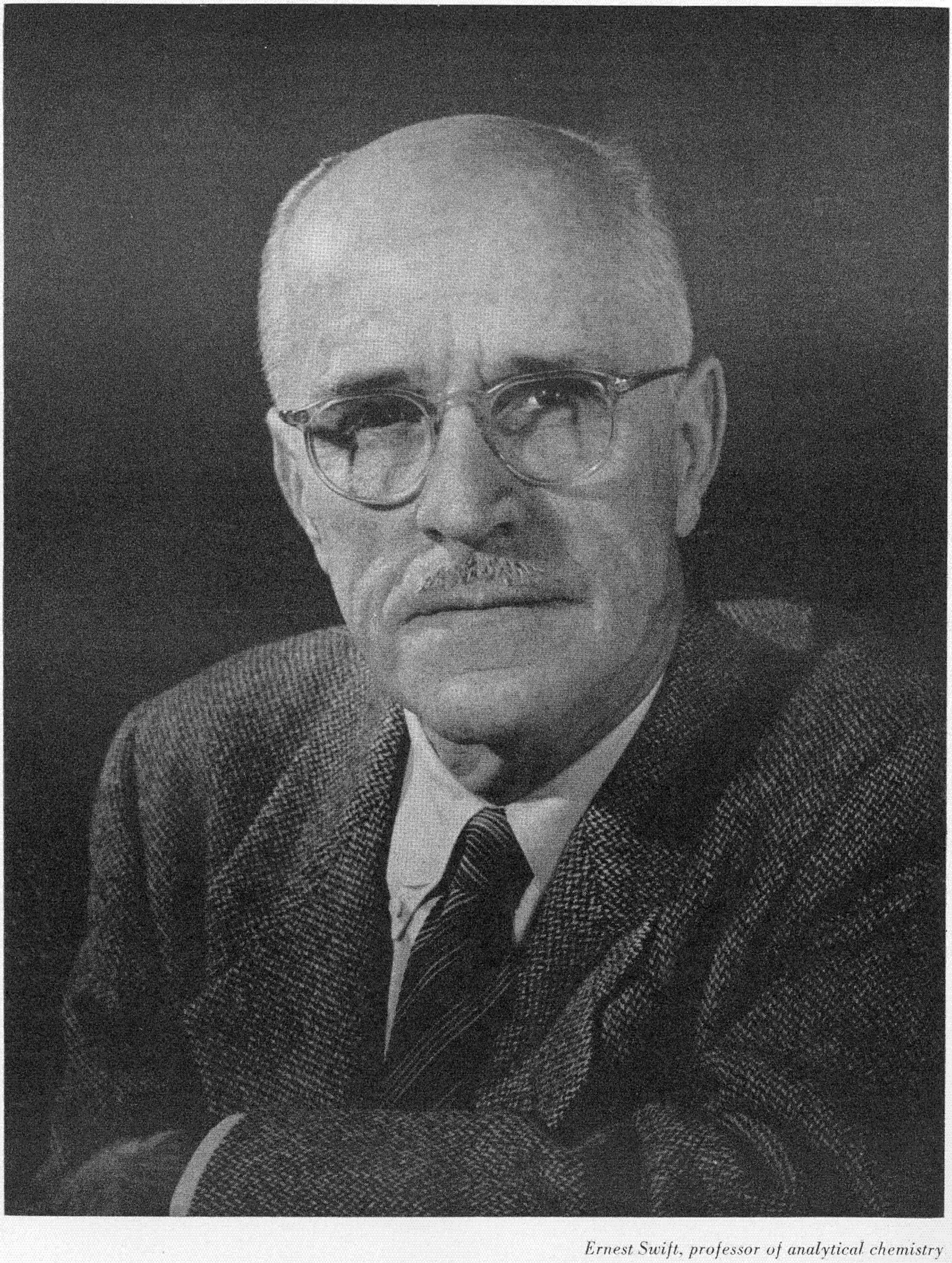
And very much we need tolerance. We are all incredibly different. I think sometimes that one of the unexpected fruits of biological research may be that we can, on occasion, be made to feel more like somebody else than we normally do, and so get some impression of the immense diversity in human experience. But, of course, as it is, we don't have that. Through art, through affection, we have some sense of a global kind of what other people are like, of what life means to them, of what makes them tick, and of what their learning and their understanding is. But an immense sense of the otherness of people, and the otherness of possible worlds and ideas is, I guess, the basis of tolerance. I don't mean, in any simple way, tolerance of evil in one's self, but rather a recognition that even two people, hearing the same words, living together, seeing the same things, have some measure of gulf between them; and a recognition that when we are dealing with remote peoples, remote traditions, we need to bring an overpowering humility to our estimate of what they are, and our measure of them.

I have the impression that if we, in this time and this age, manage properly to live with the wealth of knowledge, the wealth of change, the responsibility, and the traits of impotence, which these times dish up, we will really be quite something, and that maybe there will be places and people and times that come after who will have reason to be grateful to us.

II. A PORTFOLIO OF FACULTY PORTRAITS

by HARVEY

H. P. Robertson, professor of mathematical physics



Ernest Swift, professor of analytical chemistry

Harrison Brown, professor of geochemistry

William A. Fowler, professor of physics

Milton Plesset, professor of applied mechanics

Hallett Smith, professor of English
and chairman of the Division of Humanities

THE CHEMICAL CURE OF CLIMATIC LESIONS

Plant physiologists move into an exciting new field of research—in which climatic effects of plant growth are being chemically controlled.

by JAMES BONNER

IT APPEARS quite possible that we stand this year at the beginning of a modest new era in our understanding and control of plant growth and development. This possibility is indicated by a very small number of new facts which we have concerning the way in which plants sense and respond to temperature. These facts do not in themselves constitute a new era; actually, they constitute just a gleam in the eyes of a few people. But they have suggested a concept which will be increasingly explored in the years to come, and one which may well greatly extend our ability to cause plants to do our bidding.

An enormous amount of descriptive material concerning the effect of climate on plants has now been accumulated. We know a lot about the effects of heat and cold, the fluctuations of temperature, and other facets of climate upon crop yields and upon the ability of a particular plant to grow in a particular place. Work in the controlled-temperature conditions of the Earhart Plant Research Laboratory at Caltech has given us detailed and accurate information on the temperature optima for the growth of many species of plants, and on the way in which plant growth and yield varies with changing temperature. The facilities of the Earhart Laboratory have also made it possible to produce, at will, plants suffering from high temperature damage, from low temperature damage, and from other symptoms which plants suffer as the result of unfavorable climate.

But now that we know how to produce such climatic damage we may ask ourselves: What, actually, does a too-high or a too-low temperature do to a plant to cause such damage? What could we do about curing the symptoms?

That we ask ourselves these questions is important from the standpoint of increasing our knowledge of how living things behave. It is important, too, from an agricultural standpoint. We know that crop yields in many regions are limited, not by average climatic conditions, but by short periods of extremes of temperature. Yields of crop plants in the cooler parts of the temperate region are said to be frequently limited by short periods of excessive temperature during the summer. Crop yields in other regions may be limited by short exposures to excessive cold. It appears quite possible that the cure or prevention of such climatic damage may be an important factor in the expansion of world food production to its ultimate limit.

Suppose that we take a particular species of plant—peas, for example. The pea plant has a relatively low optimum temperature for its growth; perhaps 20°C. Suppose we now grow plants at 20°C. and at a series of higher temperatures. At a sufficiently high temperature—about 35°C.—the plants die; the leaves become yellow, then shrivel, and after a few days the entire plant expires.

This is not due to lack of water, of light energy, or of any mineral nutrient. These are all bountifully supplied to plants at all of the temperatures. Obviously, at the higher temperatures, most of the chemical reactions which govern the plant's performance will proceed more rapidly than at lower temperatures. Chemical reactions which are bad for growth processes—those which result in the destruction of essential metabolites, for example—will go more rapidly at the higher temperature, as will the reactions of synthesis which lead to the production of these essential metabolites.

It appears that, in particular instances, damage of plants at high temperature is due to the excessive destruction of particular chemical substances. This is so in the case of the pea plant. It was shown some years ago by Arthur W. Galston, then associate professor of biology at the Institute, that pea plants may be preserved from death at high temperature by the daily application to them of the purine, adenine.

JAMES BONNER, Caltech professor of biology, by his own admission, "roams around in the fields of biochemistry and plant physiology." In the course of his roamings he has managed to do outstanding research in both fields.

It was further shown, by appropriate chemical analysis, that at higher temperatures adenine is destroyed more rapidly than it is synthesized by the pea plant. The plant therefore rapidly becomes depleted in this important metabolite. Apparently, then, the response of pea plants to excessively high temperature has a relatively simple chemical basis. Death is due to exhaustion of a particular essential compound. The plant can be kept from dying by supplying it artificially with this compound.

The behavior of the pea plant at high temperatures does not constitute an exceptional case. It has recently been found that the duck weed, Lemna, behaves similarly. Lemna, grown under appropriate conditions, fails to survive temperatures higher than about 30°C. It can, however, be kept from dying and, in fact, caused to grow very well by the application of the nucleoside, adenosine.

The implication of this experiment, too, is that, under conditions of high temperature, Lemna does not possess the adenosine which it requires. It would appear that the chemical defect brought about by high temperature treatment of the duck weed is limitation in adenosine supply.

How general is this simple chemical interpretation of high temperature damage to plant growth? Preliminary experiments indicate that it may be of moderately wide application, but that the critical metabolites involved in different species may be quite various. Amino acids, vitamins of the B complex, and other substances may well prove to be of critical importance in the response of still other species to high temperature.

It may be noted that the high temperature behavior of peas and Lemna is very similar to that of the so-called temperature mutants of Neurospora, which have been studied so extensively at the Institute by the microbiologically-inclined geneticists—the Neurosporologists, as they are known in Kerckhoff.

In the temperature mutants we have organisms which will grow normally at one temperature and will fail to grow at a second higher temperature. Failure to grow at the higher temperature has been shown to be due to genetically-induced inability to make one or another essential metabolite at that temperature. Temperature mutants can be cured, as it were, of their temperature sensitiveness by supplementation with the appropriate metabolite. The higher plants thus far investigated in the Earhart program are not mutants in the sense that they have been made deliberately, but what we call the normal strains of these higher plant species behave as do temperature mutants produced by genetic machinations.

In the past 25 years a very extensive picture has been built up, in part as a result of work done at the Institute, of the growth of the plant as controlled and integrated by a series of particular and specific chemical substances — the plant growth hormones. These substances, each made in a specific organ and transported to other organs, have to do with keeping the growth of the various parts in tune with, and appropriate to, the growth of other parts.

The growth of small leaves into big leaves, for example, is controlled, in part, by a leaf growth hormone synthesized in the mature leaves and transported to the immature growing leaves. And for the pea plant, this leaf growth hormone has been shown to be the purine, adenine, and related substances.

Adenine is particularly limiting, then, to the growth of the leaves of the pea plant, so it is perhaps more understandable that adenine—rather than some other chemical substance—should be the one to disappear first in the leaves of the pea plant as the temperature is raised.

We know, too, a great deal about the root growth hormones, which chemically are vitamins of the B complex, and which are synthesized in mature leaves and sent down to roots, which cannot make these materials, but which need them in their growth.

Although we know a great deal about the plant growth hormones in general, we know most about those which have to do with control of the elongation of the stem—the auxins, of which indole acetic acid is the type example.

An exciting development in plant physiology during the past two years, however, has been the recognition of the fact that we really didn't know so much about stem growth as we thought we did, and that still a further substance cooperates with auxin in the control of cell elongation. This substance is gibberellin, which was discovered through the work of Japanese and British scientists, together with the work of former Caltech research fellows—Bernard O. Phinney and Anton Lang, both now at UCLA.

Gibberellin, like auxin, appears to be produced in the apical bud, according to the work of James Lockhart, a research fellow at the Institute. And gibberellin appears to be involved, too, in the response of plants to the temperatures in which they grow.

Take, for example, a biennial plant, which requires two years to complete its life cycle. Such a plant is Hyoscyamus, the henbane which produces, during its first season of growth, a fleshy root and a crown or rosette of leaves. Elongation of the flowering shoot fails to take place until after the Hyoscyamus plant has been subjected to a sufficiently long period of low temperature treatment. Hyoscyamus which over-winters outdoors, for example, promptly sends up a flowering shoot and flowers the following spring, when temperatures return to a sufficiently high level. Hyoscyamus which is kept continuously at high temperature fails to elongate its flowering shoot and does not flower.

The work of Anton Lang has shown that failure of Hyoscyamus to flower at high temperature is apparently due to a deficiency of gibberellin. Non-cold-treated Hyoscyamus plants promptly send up a flowering shoot and produce flowers if treated with minute quantities of gibberellin.

The implication of this experiment is that Hyoscyamus must require particularly large amounts of gibberellin in order to elongate its flower stock, that it cannot produce such quantities of gibberellin at high temperature, but that at lower temperatures, gibberellin may be accumulated. These inferences have not yet been confirmed by appropriate chemical analysis.

In a second case, that of the biennial rye plant, Dr. Harry Highkin, of the Earhart Plant Research Laboratory, has obtained an even more complete picture of the basis of cold requirement. Biennial cereals, such as winter rye or wheat, fail to produce a shoot and do not make flowers and fruits unless they are subjected to low temperature treatment. This low temperature may be given even in the seedling stage—in which case it is referred to as a vernalization treatment.

Too simple to succeed

A great deal of effort has been expended by plant physiologists over the years in trying to discover the chemical basis of the cold requirement of cereal seedlings of the winter varieties. But all this effort was to no avail, until Highkin performed his simple and elegant experiment. Highkin's experiment is, in fact, so simple that any well informed plant physiologist would have told him beforehand that it would be doomed to failure.

Highkin took winter rye seeds, subjected to an appropriate cold treatment, and allowed these seeds to leach in water. He then removed the cold-treated seeds and placed non-cold-treated winter rye seeds in the leachate. The latter, then, soaked up into themselves all of the substances which had leaked out of the cold-treated seeds. He then planted his non-cold-treated winter rye seeds at ordinary high temperature. The plants promptly sent up shoots and flowered as though they had been, themselves, cold-treated. Substances are evidently made during cold treatment of the cold-requiring seed which can be leached out and transfused into a non-cold-treated seed, but which cause the latter seed to develop as though it had been cold-treated.

It is, of course, just a step—intellectually—to the isolation and identification of the material made in cold-requiring seeds during cold treatment. Such isolation has not been achieved however; and we do not know the chemical nature of the substance involved. But similar work with cold-requiring pea varieties has indicated that the nucleoside, guanosine, can reproduce the effects of cold treatment.

In any case, it is apparent that, in particular cases, the requirement of a plant for low temperature treatment has a chemical basis. During the low temperature treatment, the plant accumulates a particular compound which is essential to, and responsible for, the subsequent characteristic growth behavior at high temperature. In both cases, the requirements for cold treatment may be replaced by application of the appropriate chemical.

Let us now consider a case of a plant grown under temperatures sufficiently low to restrict its growth, so that it grows more slowly than it would at optimum temperature. It was found some years ago that when the vegetative growth of Cosmos—an ornamental flowering plant — is restricted by low temperature, the growth rate may be increased by the addition of thiamine. Thus, for example, Cosmos plants were grown at a sufficiently low temperature so that their growth rate, as measured by the accumulation of dry weight, was decreased to about one half the rate characteristic of Cosmos plants grown at their optimum temperature. But when thiamine was applied in low concentration to the low-temperature-grown Cosmos plants, their growth was increased by about 50 percent; that is, growth rate was restored about half way to that characteristic of Cosmos plants grown at their optimum temperature.

In this case, it was possible to show by direct analysis that plants grown at the lower temperature are characterized by a lower concentration of thiamine in their tissues than is characteristic of plants grown at the optimum temperature.

Again, it would appear that the effect of low temperature in restricting growth of Cosmos has a relatively simple chemical basis. Although the reaction rates of many of the reactions leading to the production of the Cosmos plant must be decreased by low temperature, still the rate of thiamine production appears to be decreased even more than the general average. And so Cosmos plants which are grown at too low a temperature suffer from restriction in thiamine, and their growth rate may be increased by artificial application of this material.

Climate and chemistry

We have, then, some specific instances in which it is possible to show that climatic effects on plant growth are reducible to relatively simple chemical aberrations. These chemical aberrations can be remedied by appropriate chemical application. We do not yet know how general it may be that climatic effects are interpretable in simple chemical terms. It will be necessary to investigate this matter in a systematic fashion.

It will be necessary to find out, too, more about the chemical mechanisms involved. Why is it, for example, that adenosine is deficient in those plants grown at high temperatures? What is the enzymatic basis of this phenomenon? These are all investigatable matters.

It appears, then, that the effects of temperature on plant behavior may be mediated through chemical mechanisms. The interesting fact is that there are temperature-induced chemical defects in plant growth which can be remedied by the appropriate application of an appropriate chemical.

To forward these investigations, the Division of Natural Sciences and Agriculture of the Rockefeller Foundation has recently granted the Institute $112,000 to be used over a five-year period, for the study of what we like to call "The chemical cure of climatic lesions of plant growth."

at Pratt & Whitney Aircraft
in the field of Materials Engineering

The development of more advanced, far more powerful aircraft engines depends to a high degree on the development of new and improved materials and methods of processing them. Such materials and methods, of course, are particularly important in the nuclear field.

At Pratt & Whitney Aircraft, the physical, metallurgical, chemical and mechanical properties of each new material are studied in minute detail, compared with properties of known materials, then carefully analyzed and evaluated according to their potential usefulness in aircraft engine application.

The nuclear physics of reactor materials as well as penetration and effects of radiation on matter are important aspects of the nuclear reactor program now under way at P & W A. Stress analysis by strain gage and X-ray diffraction is another notable phase of investigation.

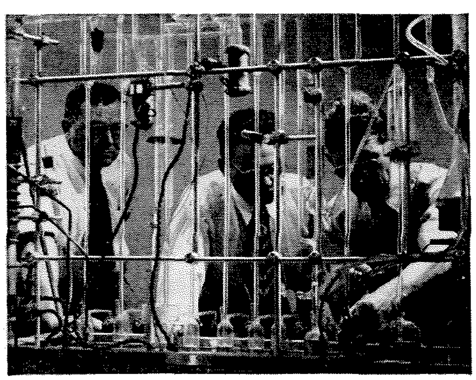
In the metallurgical field, materials work involves studies of corrosion resistance, high-temperature mechanical and physical properties of metals and alloys, and fabrication techniques.

Mechanical-testing work delves into design and supervision of test equipment to evaluate fatigue, wear, and elevated-temperature strength of materials. It also involves determination of the influence of part design on these properties.

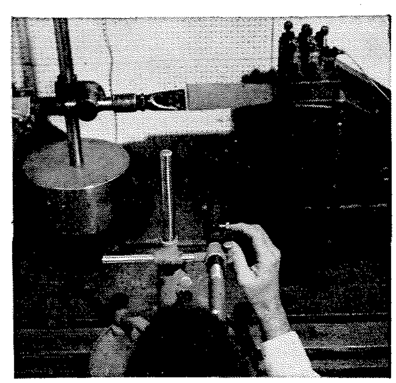
In the field of chemistry, investigations are made of fuels, high-temperature lubricants, elastomeric compounds, electro-chemical and organic coatings. Inorganic substances, too, must be prepared and their properties determined.

While materials engineering assignments, themselves, involve different types of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of mechanical design, aerodynamics, combustion and instrumentation — spells out a gratifying future for many of today's engineering students.

Engineer measures residual stress in a compressor blade non-destructively, using X-ray diffraction. Stress analysis plays important part in developing advanced aircraft engine designs.



The important effects of gases on the properties of metals have been increasingly recognized. Pratt & Whitney chemists are shown setting up apparatus to determine gas content of materials such as titanium alloys.



P & W A engineer uses air jet to vibrate compressor blade at its natural frequency, measuring amplitude with a cathetometer. Similar fatigue tests use electromagnetic excitation.

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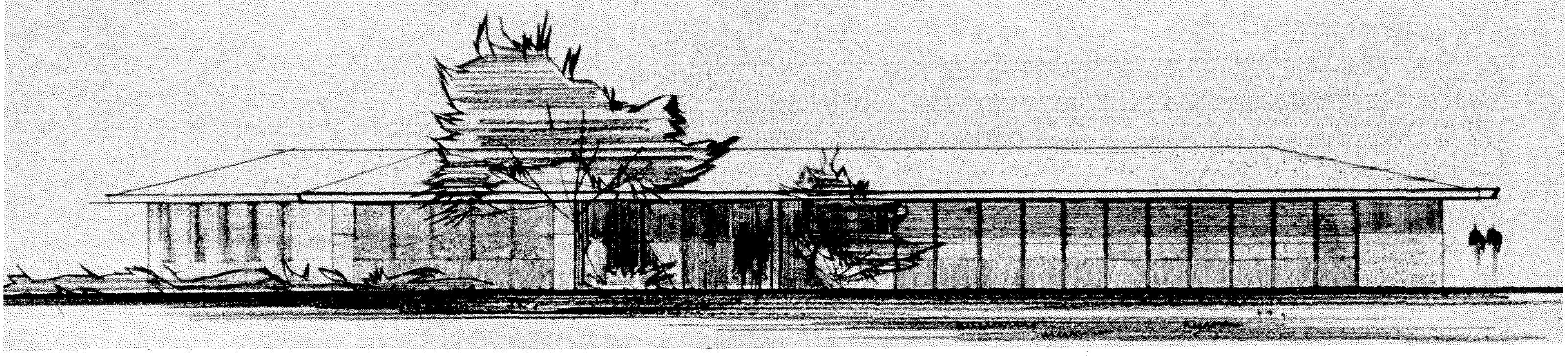


Architect's drawing of Caltech's new Archibald B. Young Health Center

THE MONTH AT CALTECH

Health Center

CONSTRUCTION ON Caltech's new Archibald B. Young Health Center gets under way this month, and the $200,000 unit should be ready for use by next fall. Located at 1239 Arden Road, the center will be adjacent to Tournament Park, and just south of Arden House, the residence of the Master of Student Houses.

Plans by Pereira & Luckman, Institute architects, call for a T-shaped building, with four two-bed wards and two isolation wards across the top of the T; and a kitchen, X-ray, physiotherapy and waiting rooms, two doctors' offices, three treatment rooms and a psychiatrist's office in the remainder of the building. There will also be a large lounge and convalescent room.

The building will be residential in character, to blend in with the surrounding architecture. It is named for the late Pasadena attorney and philanthropist who was first vice president of the Institute Associates at the time of his death in 1955.

Ben R. Meyer

BEN R. MEYER, chairman of the board of the Union Bank and Trust Company, and a member of the Caltech board of trustees, died on March 6 in San Francisco. Mr. Meyer, who was 77 years old, suffered a stroke while in San Francisco, the city of his birth, to attend a meeting of the directorate of the Pacific Lighting Corporation.

A resident of Los Angeles for more than 60 years, Mr. Meyer was originally in the wool trading business with K. Cohn & Company. His clients permitted their excess funds to accumulate with his company as a depository, to the extent that finally, in 1914, he and Kaspare Cohn founded the Kaspare Cohn Commercial and Savings Bank. He was vice president and director of the small bank, which eventually grew to become the Union Bank and Trust Company, 77th largest bank in the nation.

Known as "Uncle Ben" to his business associates, Mr. Meyer maintained a steady interest in civic, community and philanthropic affairs. At the time of his death, he was trustee of the Cedars of Lebanon Hospital and former president of the board there. For many years he was treasurer of the Community Chest of Los Angeles, and he was an honorary life trustee and treasurer of the Southern California Symphony Association. His association with Caltech began when he became a trustee in 1929, and his was one of the longest periods of service on the board.

Mr. Meyer is survived by his widow, Mrs. Ray Meyer, daughter of the late Kaspare Cohn.

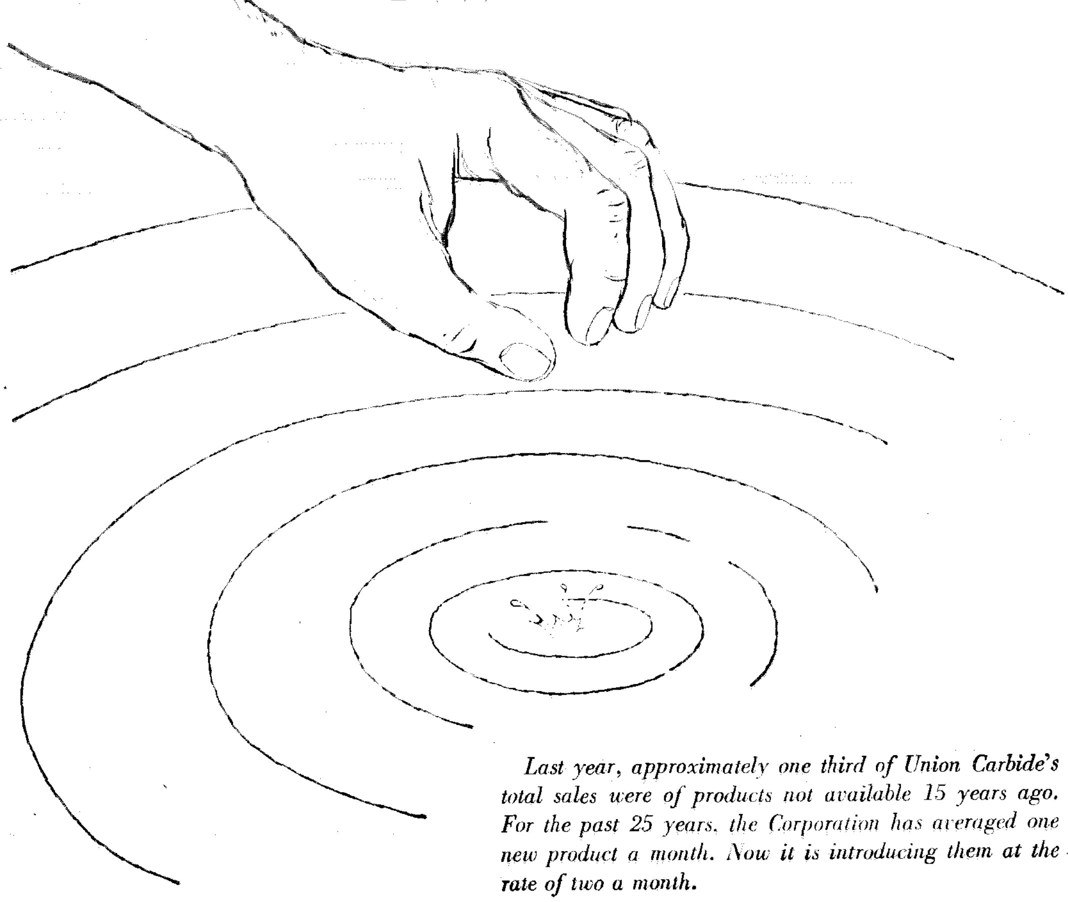
Honors and Awards

ROBERT L. DAUGHERTY, emeritus professor of mechanical engineering, has been appointed to serve an additional three-year term on the Los Angeles County Air Pollution Hearing Board.

ALEXANDER GOETZ, associate professor of physics, has been appointed scientific consultant to the Los Angeles Air Pollution Control District. His investigations of airborne particulate matter represent a new line of inquiry for the District.

LINUS PAULING, chairman of the chemistry division, has been made an honorary member of the American Association of Clinical Chemists.

ALFRED STERN, associate professor of languages and philosophy, has been invited by the University of Paris to teach a course in philosophy ("The Philosophy of History and the Problem of Values") at the Sorbonne during the coming spring term.



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It's a new RCA Victor Transistor Six, and this one you can really take along anywhere. It's smaller and lighter than the average textbook – and lots more fun.

You can carry it easily in pocket or purse. It weighs a mere 16 ounces, yet delivers a roomful of sound anytime you wish.

The RCA Victor Transistor Six is battery-powered and uses six long-lasting transistors. The cabinet is long-lasting, *too. It's the fabulous, guaranteed non-breakable* "IMPAC" case. Cabinet colors include antique white, charcoal and spruce green.

And note the price—now just $49.95!

This beautiful little bargain is typical of the extra value engineered into every product of RCA. For, almost without exception, these achievements in electronics begin at the David Sarnoff Research Center in Princeton, New Jersey. Here the scientists and engineers of RCA continually seek—and very often find—practical and dramatic new ways to bring you ever-better "Electronics for Living."

Tmk(s)®

Where to, Mr. Engineer?

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

RCA

RADIO CORPORATION OF AMERICA

Electronics for Living

ALUMNI NEWS

Board Nominations

THE BOARD OF DIRECTORS of the Alumni Association met as a nominating committee on February 26, 1957, in accordance with Section 5.01 of the By-Laws. Five vacancies will occur on the Board at the end of the fiscal year, one vacancy to be filled from the present Board and four members to be elected by the Association. Present members of the Board and the years in which their terms of office expire are:

Robert H. Bungay '30	1957	Richard H. Jahns '35	1957
W. R. Donahue, Jr. '34	1957	Chester Lindsay '35	1958
John R. Fee '51	1958	W. F. Nash, Jr. '38	1957
E. P. Fleischer '43	1958	John E. Osborn '39	1958
Richard W. Stenzel '21	1957		

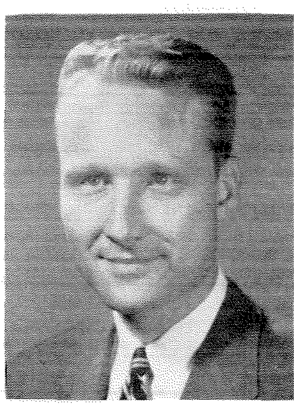
The following nominations have been made by the committee:

President—Willis R. Donahue, Jr. '34	(1 year)
Vice President—Edward P. Fleischer '43	(1 year)
Secretary—Donald S. Clark '29	(1 year)
Treasurer—George B. Holmes '38	(1 year)
Director—Frank C. Bumb '51	(2 years)
Director—L. Fort Etter '34	(2 years)
Director—John E. Fleming '46	(2 years)
Director—Nick T. Ugrin '34	(2 years)

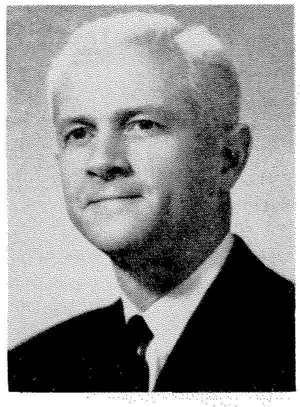
Section 5.01 of the By-Laws provides that the membership may make additional nominations for the four (4) Directors by petition, signed by at least twenty-five (25) members in good standing provided that the petition is received by the Secretary not later than April 15. In accordance with Section 5.02 of the By-Laws, if further nominations are not received by April 15, the Secretary casts a unanimous ballot for the members nominated by the Board. Otherwise a letter ballot is required.

Statements about the four Directors who have been nominated are presented below.

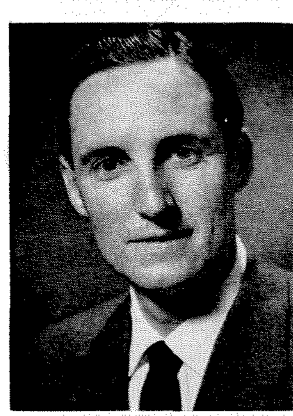
—*Donald S. Clark, Secretary*



FRANK C. BUMB received his BS in mechanical engineering in 1951 and returned to Caltech for his MS in 1952. He then joined the Consolidated Electrodynamics Corporation in Pasadena as an assistant engineer. Just recently he was named supervisor of the company's electromechanical group. His professional activities include active participation in the American Society of Mechanical Engineering, Sigma Xi, and Tau Beta Pi. He has served the alumni by working on the Seminar Day Committee in 1955, and, this year, as Alumni Program Chairman.



L. FORT ETTER received his BS in mechanical engineering in 1934 and his MS in 1935. He went to work for the Santa Fe Railway as an engineer in the engineering test department and, after four years, joined Preco Incorporated in Los Angeles. He is currently vice president of operations for this company, which produces specialty products in the road machinery, rail equipment and electronic fields. This year he is serving as chairman of Alumni Seminar Day.



JOHN EATON FLEMING received his BS in mechanical engineering in 1946 and followed this degree with an MBA in production management at Stanford in 1948. He then became administrative assistant for the General Tire and Rubber Company of California. In 1950 he joined the Clary Corporation in San Gabriel as production control supervisor, and last year he was appointed supervisor of financial planning. He has served the alumni as permanent secretary of the class of 1946, as a member of the 1954 Seminar Day Committee, and as chairman of the Picnic Committee in 1956.

NICK T. UGRIN received his BS in mechanical engineering in 1934 and went to work in the control laboratory of the Los Angeles Refinery of the Union Oil Company. He spent one year in the manufacturing department in various job categories and then transferred to the pipeline department. During World War II, he spent three years in the Navy, most of the time at staff headquarters in San Francisco, coordinating shipments of petroleum products for advance base movements and other military requirements in the Pacific. In 1953 he became assistant manager of the transportation and distribution department of Union Oil and he is now manager of the department.

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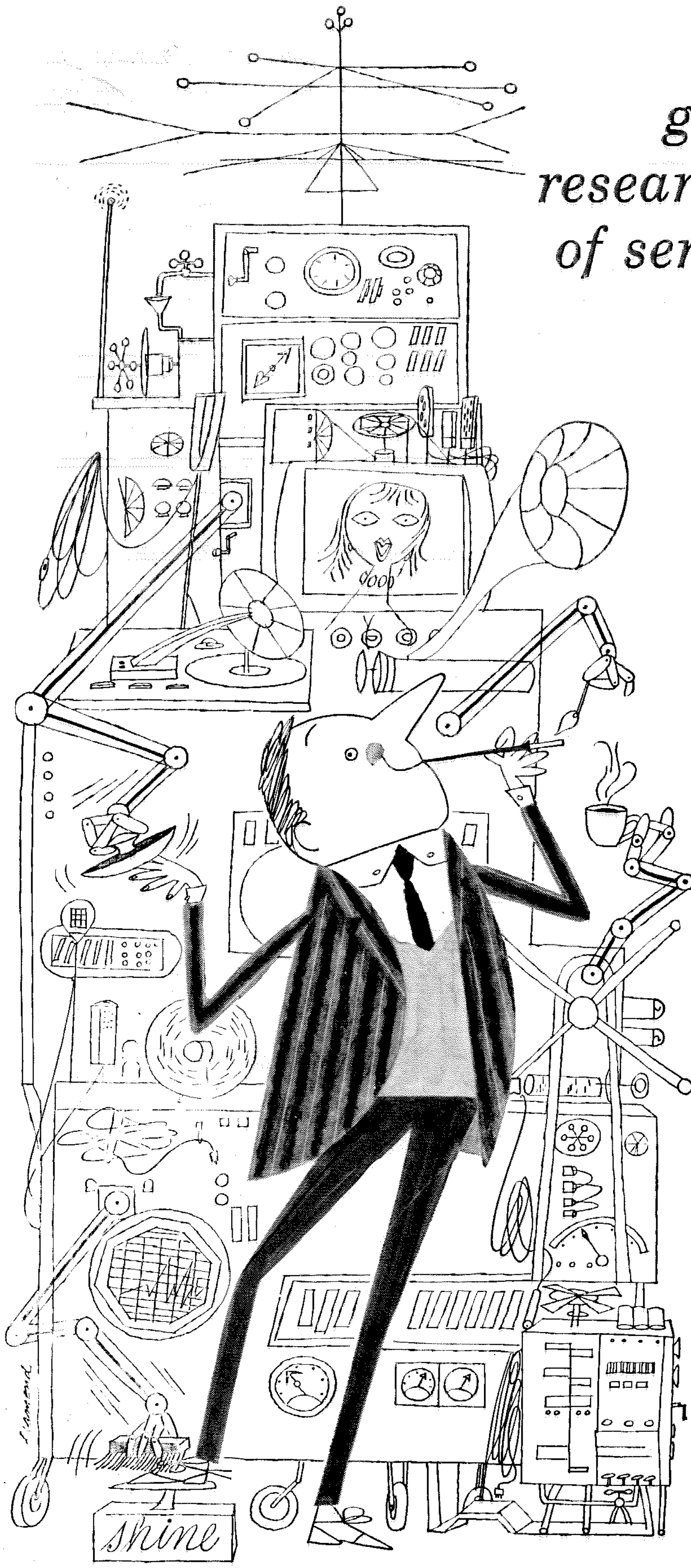


How to make the most
of your engineering career
ONE OF A SERIES

go where research gives you plenty of service

Many things can help—or hinder—your progress in engineering. One such is the kind of research available in the company you join.

This, by no coincidence at all, is another area in which Boeing can be of real help to you. Boeing backs its engineers with one of the most extensive arrays of research laboratories in the industry. In addition, electronic computing and data processing equipment gets you the answers you want—fast. So do such facilities as the huge Boeing Flight Test Center. And the Boeing wind tunnel, most complete and versatile privately owned tunnel in America. This outstanding facility, capable of velocities up to Mach 4, is at the full-time disposal of Boeing engineers. It has enabled Boeing to gain more wind tunnel time in the field of jet aircraft than *any* other company.

These facilities help Boeing engineers maintain leadership in advanced fields of flight. They help Boeing research engineers and scientists extend the boundaries of knowledge in many fields. They could help *you* get ahead.

At Boeing you'd enjoy many other advantages; a high starting salary, career stability, a liberal retirement plan and company-paid graduate study programs. There are *family* advantages too; a choice of three sections of the country, each with excellent housing and schools, shopping centers and abundant recreation facilities for the whole family!

NOW is the time to start planning ahead.
Consult your Placement Office, or write:

JOHN C. SANDERS,
Engineering Personnel Administrator,
Boeing Airplane Co., Seattle 24, Washington

FRED B. WALLACE,
Chief Personnel Engineer,
Boeing Airplane Co., Wichita 1, Kansas

BOEING

Seattle, Washington   Wichita, Kansas   Melbourne, Florida

No blue sky...just

to back up our belief that

you and Collins

We're going to build a proposition which we believe deserves your most serious consideration, if you are a mechanical or electrical engineer. This proposition is built on pure and simple fact—no high flown promises or broad generalities. Our proposition: you and Collins should get together. We present these facts to support it.

FACT NUMBER 1:
Collins Radio Company's sales have increased 10 fold in each of three successive seven year periods. 1933 sales were $100,000; 1940 sales, $1,000,000; 1947 sales, $10,000,000; 1954 sales, $100,000,000, and 1956 sales, $126,000,000. (Note graph.) This company *has grown, and is growing* at a phenomenal rate. Total employment is 9,000 of which 24% are research and development personnel.
You grow when the company you work for grows.

FACT NUMBER 2:
As shown in the graph at right, the employment of research and development personnel has increased steadily despite fluctuation in sales. Notice that even during periods of national sales regression Collins continued to strengthen its engineering staff.
Collins has based its growth on the solid foundation of stability in the engineering department.

FACT NUMBER 3:
At Collins, the ratio of engineers to total employees is extremely high, far higher than the average among established companies engaged in both development and production. First and foremost, Collins is an engineering company.
Engineering is king at Collins—never takes a back seat to production expediency.

FACT NUMBER 4:
Collins' reputation for quality of product is universally recognized. It has led to Collins' phenomenal sales record. At Collins there is no compromise when quality is at stake.
If you're the man we want, you'll get real satisfaction out of this quality-consciousness.

FACT NUMBER 5:
Electronics is Collins' only interest. In no way is it subsidiary to the manufacture of industrial or consumer products. Collins builds electronic equipment, not airplanes or vacuum cleaners. Every research, development and production facility is devoted to progress in electronics.
If electronics is your interest, you'll like the climate at Collins.

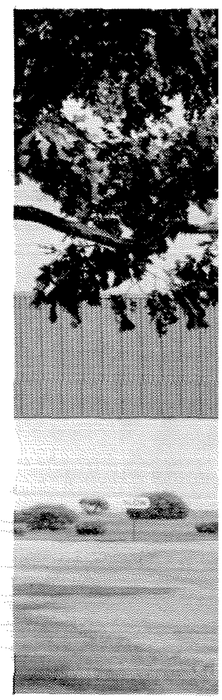
FACT NUMBER 6:
There is a limitless variety of fields and types of work for the Collins engineer. Recent Collins work in air and ground communication, and aviation electronics include developments in transhorizon "scatter" propagation; single sideband; microwave and multiplex systems; aircraft proximity warning indicator; aviation navigation, communication and flight control; broadcast; and amateur equipment.

There is big opportunity for your special talents.

Right now we are prepared to offer you a technical or supervisory assignment in one of many interesting fields. And the sky *is* the limit as far as responsibility and salary are concerned.

You will work in one of Collins' new research and development laboratories located at Cedar Rapids, Iowa; Dallas, Texas; and Burbank, California. Offices and subsidiary companies are located in New York; Washington, D. C.; Miami; Knoxville; Seattle; Hickman Mills, Missouri; Toronto, Canada; London, England; and South America.

All your moving expenses are paid. Company benefits are tops in the industry.



We repeat—if you are a mechanical or electrical engineer, you and Collins should get together. Take the first step now, for more information, write:

L. R. Nuss Collins Radio Co. Cedar Rapids, Iowa	Fred Aiken Collins Radio Co. 2700 W. Olive Ave. Burbank, California	Harold McDaniel Collins Radio Co. 1930 Hi-Line Drive Dallas, Texas

Disneyland Picnic

THE ANNUAL ALUMNI PICNIC will be held on Saturday, June 29, at Disneyland. A special area for the use of alumni will be set apart, with separate parking and entrance to the park. Caltech alumni will be one of the first groups to use the new picnic and play area now under construction, which will include tables, a baseball diamond, sand play area for the smaller children, and refreshment stands. Normal group prices will be charged—adults, $3.00; children from 12 to 17, $2.50; from 3 to 12, $2.00; and children under 3, free. Get a group together! Plan now to attend!

—*William Freed, chairman*

General Hans Kramer

GENERAL HANS KRAMER, professor of military science and tactics at Caltech from 1920 to 1924, died at Letterman General Hospital in San Francisco on February 15. Born in Madgeburg, Germany, in 1894, General Kramer attended the University of Michigan and in 1918 graduated from West Point. In 1932 he received his PhD in engineering from the University of Dresden in Germany. After his retirement from the U. S. Army in 1945, he entered business as a consulting engineer in San Francisco and was very active in Caltech's alumni chapter in that city. He had just been appointed consultant on the Feather River Project when he died.

1957 Directory

A NEW Caltech Alumni Directory has just come off the press and copies should reach all paid-up alumni by the end of this month. The new directory lists all names alphabetically, with home and business addresses, degrees and options—and contains a geographical listing as well. Richard Stenzel, '21, MS '30, was in charge of preparing the directory.

Among the Missing

THE ALUMNI ASSOCIATION is attempting to complete its file of Caltech publications and is still missing many early issues of the school's annuals. Has anyone got copies of the following publications which they would be willing to send to the Association?

1896 through 1912—THE POLYTECHNIC
1913 through 1920—THE THROOP TECH
1926 and 1927—THE BIG T

To the *creative* engineer...

AiResearch two stage lightweight gas turbine compressor provides pneumatic power for aircraft main engine starting and serves as auxiliary power source for a variety of ground and in-flight services.

The rapid scientific advance of our modern civilization is the result of new ideas from creative minds that are focused on the future. Our engineers not only have ideas but have the ability to engineer them into products.

That's why The Garrett Corporation has grown in both size and reputation to leadership in its areas of operation. That's why we are seeking more creative engineers to help us maintain and extend our leadership. If you fall in that category, you'll find working with us fulfilling in stimulation, achievement and financial rewards. In addition, financial assistance and encouragement will help you continue your education in the graduate schools of fine neighboring universities.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer, electro-mechanical equipment, electronic computers and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley

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DIVISIONS: AIRESEARCH MANUFACTURING, LOS ANGELES • AIRESEARCH MANUFACTURING, PHOENIX • AIRSUPPLY AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

More graduate engineers moving up in the GAS industry ... the nation's sixth largest

The Gas industry—the sixth largest in the nation—has a total investment of over $15 billion. Last year the industry set a new all-time record in number of customers, volume of gas sold, and dollar revenue. In fact, Gas contributed 25% of the total energy needs of the nation as compared with 11.3% in 1940. The Gas industry is a major force in the growth development and economic health of this country.

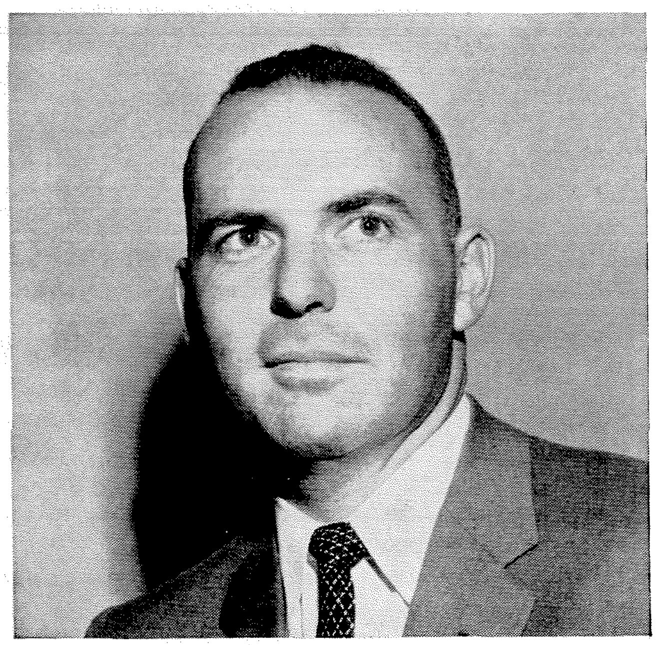
There are many opportunities for you in the Gas industry. The industry needs engineers, and does not overhire. You won't be regimented. There's always room for advancement. With utility companies and with manufacturers of Gas equipment, there's a future for you as an engineer. Call your nearest Gas Utility. They'll be glad to talk with you about your opportunity in the Gas industry. *American Gas Association.*

JOSEPH J. DRECHSLER
B.S. in Mechanical Engineering, 1948, Johns Hopkins University

Joe Drechsler, after 8 years with Baltimore Gas and Electric Company, is now Assistant Superintendent in a department with over 450 employees

After completing the company's Student Engineering Training Program, Joe spent one year in the Gas and Steam Testing Laboratory. He was then promoted through various levels of engineering and supervisory assignments, to his present job of Assistant Superintendent on April 1, 1956. This department has over 450 employees and is responsible for the installation and servicing of industrial, commercial and domestic gas appliances on customers' property, and the installation and servicing of gas and steam metering and pressure recording equipment.

ROBERT K. VON DER LOHE
B.E. in Industrial Engineering, 1948, University of Southern California



In just 6½ years with Southern Counties Gas Company of California, Robert K. Von Der Lohe has become Manager of Commercial and Industrial Sales

After two years with a construction engineering firm, Bob Von Der Lohe joined the gas company and began his steady climb to his current position. Starting as an assistant technician in 1950, Bob has moved up through the jobs of industrial sales engineer and staff representative-industrial sales, to his present post as Manager, Commercial and Industrial Sales. Bob does more than "sell" industries and commercial operations on the use of gas. He also supervises a staff which advises restaurant and hotel owners on ways to improve their gas operations and over-all productive efficiency.

PERSONALS

1925

Earl D. Stewart has been appointed associate technical director of Schwarz Laboratories, Inc. in Mount Vernon, N.Y. He was formerly chief chemist of the company.

1930

Roland F. Hodder has moved from Denver, Colorado, to Tulsa, Oklahoma, where he is now staff geologist in the foreign department of the Stanolind Oil and Gas Company. His daughter is a sophomore at Stanford and his son a sophomore in high school.

Edward E. Kinney, MS, retired from Michigan State College in East Lansing last December, after 36 years of service. He served on the faculty for 24 years as an instructor in electrical engineering, and since 1944 had been superintendent of buildings and utilities. Ed writes that 19 members of the Kinney family have attended MSU — including his son and daughter.

Nathan D. Whitman, Jr., MS '32, consulting engineer in Pasadena, writes that he's moved from San Marino to Arcadia, mainly to provide room for four cars and one horse. He was elected president of the Los Angeles section of the ASCE for 1957—and he did the structural design on Pasadena's Rosemead-Foothill Shopping Center, which was completed last year.

1931

Carl F. J. Overhage, MS '34, PhD '37, has just been appointed director of MIT's Lincoln Laboratory in Lexington, Massachusetts. He was formerly head of the aircraft control and warning division at Lincoln.

1932

Henry B. Pownall is now president of the Velda Corporation in Miami, Florida, and also president of Freezing Equipment Sales, Inc., in York, Pennsylvania.

1934

Kenneth A. Willard, MS, MS '35, has been made coordinator of the Southern California Industrial Research Center at USC's School of Engineering. In this capacity, he will establish and maintain liaison with industry in the fields of cooperative educational programs, access by industry to the University's facilities, industrial student training, and secondary school guidance service. A mechanical engineer, pilot, and meteorologist, Ken's special hobby these days is building and flying radio-controlled model airplanes.

1938

John L. Merriam writes from Jeddah, in Saudi Arabia, where he has been sta-

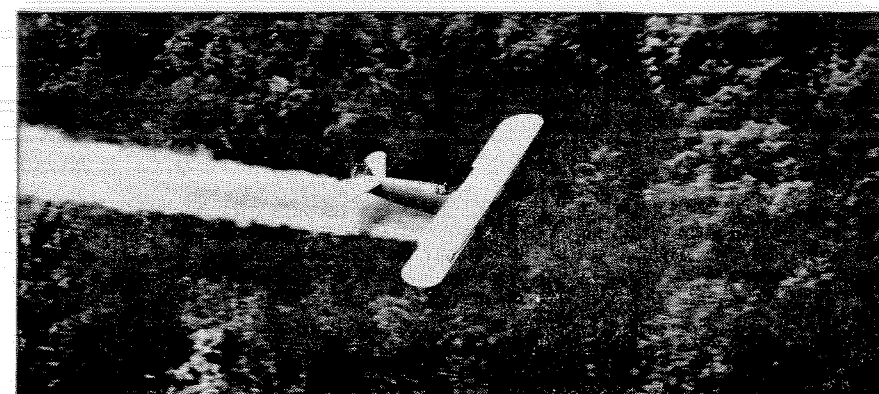
CONTINUED ON PAGE 50

FYI
FOR YOUR INFORMATION

Allied Chemical

DIVISIONS Barrett, General Chemical, National Aniline, Nitrogen, Semet-Solvay, Solvay Process, International

- *farming forests*
- *chromyl chloride*
- *aluminum chloride*



Farming Forests

As Joyce Kilmer put it, "Only God can make a tree," but we are not immodest in saying that now science can make it grow better and faster.

This is the revolutionary concept of silviculture: treating a tree as a crop—for its cellulose content. Its purpose is to make available more and cheaper pulp and paper products.

Forestry has long been held back by the concept that a tree will grow, if it just has enough water. For years we have practiced extractive forestry by cutting down our natural, virgin forests for wood products. When this area is restocked, or when it is farmed and then returned to the growing of trees, the growth is inferior, because plant foods — nitrogen, phosphorous, potassium — have been lost from the soil.

The solution to this problem is simply putting food back into the soil, but most foresters have felt that giving trees nutrients is generally impractical.

To determine exactly how practical it is to fertilize trees, Allied Chemical's Nitrogen Division sponsored a five-year study at North Carolina State College. This pioneering work, just being completed, indicates beneficial effects of plant food on Loblolly pine.

Other recent studies have revealed that fertilization produces a 40 to 65% increase in tree growth, cutting years off the growing cycle of pulp wood. By speeding a tree's growing time, the forester gets a faster turnover of capital and shortens the time the tree is exposed to danger from fires or pests.

Growth is the most dramatic indicator of forest fertilization. But there are many more advantages: an increase in sap and nut production, and in the quality and quantity of seeds; a healthier tree, better able to stave off fungus and pest attacks; a better root system and thicker foliage, making the tree more efficient.

Aerial fertilization is an important economy, for dusting planes can "feed" hundreds of trees in a day.

What is believed to be the first aerial application of a complete fertilizer to a forest recently took place at Rutgers University Dairy Research Farm at Beemerville, N. J. The test, on an 11-acre stand of red pine, was by Rutgers' Forestry Department and Allied's Nitrogen Division.

Fertilizers currently being used in forest studies are ARCADIAN 12-12-12—a balanced, granular (nitrogen-phosphorous-potash) combination, ARCADIAN UREA 45—a high analysis, pelleted, 45% nitrogen fertilizer, and ARCADIAN nitrogen solutions.

In conjunction with its field studies, Nitrogen Division is also sponsoring the first world-wide bibliography of forest fertilization with a grant at the College of Forestry of New York University at Syracuse.

This definitive work contains over 600 references, and the important point is that most of them relate studies which show a favorable response to forest fertilization. The Allied Chemical-New York University bibliography demonstrates that it is technically feasible to fertilize our forests. The Allied Chemical-North Carolina test demonstrates that it is economically feasible.

ARCADIAN and SOLVAY are Allied Chemical trademarks

Chromyl Chloride

A new chromium chemical—with many unique properties—has been developed in a high grade of purity by Allied's Mutual Chemical Division.

Chromyl chloride ($CrO_2\ Cl_2$) is a volatile liquid, characterized by its cherry-red color, soluble in carbon tetrachloride and similar solvents. In undiluted form it is a strong oxidizing and chlorinating agent, reacting so vigorously with many substances as to cause ignition.

In suitable solvents, many controllable and selective reactions may be carried out between organic materials and chromyl chloride. It is a starting material for making chromium organic compounds, some of which have unique and useful properties as surface coatings and bonding materials.

Until recently, the researcher needing chromyl chloride was required to prepare it himself. Mutual Chemical has since put this interesting chemical in pilot plant production.

Aluminum Chloride

We can only suggest the variety of uses to which aluminum chloride ($AlCl_3$) can be put. It is, for example, a catalyst in chemical synthesis; it promotes reactions in the production of dyestuffs and intermediates, insecticides and pharmaceuticals; most recently, it is finding use for the first time in aluminum plating.

The older and perhaps more often thought of application is in the Friedel-Crafts reaction. SOLVAY anhydrous aluminum chloride is produced as a high quality crystalline solid and is shipped in a variety of granulations.

Creative Research

These examples of product development work are illustrative of some of Allied Chemical's research activities and opportunities. Allied divisions offer rewarding careers in many different areas of chemical research and development.

ALLIED CHEMICAL
61 Broadway, New York 6, N. Y.

Personals . . . CONTINUED

tioned for the past year: "I'm within a couple of months of finishing my contract with the Ralph M. Parsons Engineering Company who sent me here as senior irrigation engineer for the Ministry of Agriculture. I took this job after 17 years with the Soil Conservation Service in Southern California.

"Here in Saudi Arabia, our group of five specialists is starting a Division of Water Resources. It is a unique satisfaction to be the first one to do something . . . I've investigated several irrigation and drainage problems and have things about ready to go. It's a real disappointment not to be able to follow them into construction but I have to be back in the States by fall. With two children—daughter Elizabeth in junior high and son Sandy in high school—one year out is about the maximum.

"They've been doing their work by correspondence, and doing very well with their mother's guidance . . . but over here there is no one their age to play with, and social life gets pretty dull with just adults, even though life in Jeddah is rather exotic—with such things as the Red Sea to skin-dive in, and Moslem pilgrims to observe."

Howard S. Seifert, PhD, senior staff member of the Ramo-Wooldridge Corporation in Los Angeles and former member of Caltech's Jet Propulsion Laboratory, has been reappointed for the third year to the Subcommittee on Rocket Engines of the National Advisory Committee for Aeronautics.

1939

Jose P. Ortiz, MS, is general director of Public Works and Communications in the state of Vera Cruz in Mexico.

1940

Douglas B. Nickerson has been appointed chief engineer of Hydro-Aire, Inc., in Burbank, California. He's in charge of the company's 130-man engineering department and will be responsible for all design, research, and development activities. Doug has been with Hydro-Aire since February, 1952. The Nickersons and their three children live in Flintridge.

Harrison A. Storms, Jr., PhD '41, is now chief engineer of the Los Angeles division of North American Aviation, Inc. He was formerly manager of research and development. He's been with the company since 1941. The Storms live in Rolling Hills and have three children — Patricia, 14; Harrison, 12; and Richard, 11.

Joseph F. Manildi, MS '42, PhD '44, was recently appointed associate director of the Electronic Instrumentation Division

CONTINUED ON PAGE 54

of the Ramo-Wooldridge Corporation in Los Angeles.

1942

Alvin R. Piatt, project manager at Librascope, Inc., in Glendale, California, died on December 20, of leukemia. He had been ill for almost four years but had worked regularly at Librascope, where he had been employed since 1947. He is survived by his wife, Glenna, and a son, Michael, 6.

1944

Joseph H. Chadwick, Jr., research engineer in the marine instruments engineering department of the Sperry Engineering Corp.'s marine division, received the Captain Joseph H. Linnard Prize at the annual banquet of the Society of Naval Architects and Marine Engineers on November 16 in New York City. The prize was given for the best paper contributed to the society's 1955 *Transactions.*

Rudolph W. Hensel is now chief of the Propulsion Wind Tunnel at the USAF's Arnold Engineering Development Center in Tullahoma, Tennessee. Prior to this, he served for six years as chief of the data analysis section of the Southern California Cooperative Wind Tunnel at Caltech.

Philip B. Smith writes that "after six years at the University of Sao Paulo in Brazil, I am moving on. We have completed a very good Van de Graaff accelerator which is beginning to produce some physics. My decision to leave is principally due to the realization that while it is possible to produce something here, the efficiency of production is at most 1%. That does not mean that I have not learned a great deal, however. What is worse is that, in the last few years, the Brazilian policy toward foreigners has become distinctly unpleasant. It is now, since 1953, impossible for a foreigner to have a regular job here (this does not refer to short time contracts) without revalidating *all of his diplomas, from high school up.* This means about five years wasted, in practice.

"I am leaving this month for Holland. There I will work for a year or so with Professor P. M. Endt in the State University of Utrecht."

Howard H. C. Chang is now with the engineering division of the Rand Corporation in Santa Monica. He was formerly with the General Electric Microwave Laboratory in Palo Alto. Howard is now the father of a 16-month old daughter, Cecily Chin-Yu.

1946

Robert C. James, PhD, associate professor of mathematics at Haverford College in Pennsylvania, has been appointed professor and chairman of the mathematics department of the new Harvey Mudd College, one of the Associated Colleges of Claremont, which will open next September. Bob taught at Harvard University and the University of California prior to joining the faculty of Haverford in 1951.

1947

Ernest Pritchard, MS, AeE '48, chief of the data analysis section of Caltech's Southern California Cooperative Wind Tunnel in Pasadena, announced the arrival of a son, Jon Clark, on December 12.

1948

Col. John D. Holm, MS, has been assigned as acting Sixth United States Army Engineer at the Presidio in San Francisco. This new post gives John administrative responsibility for engineer activities in

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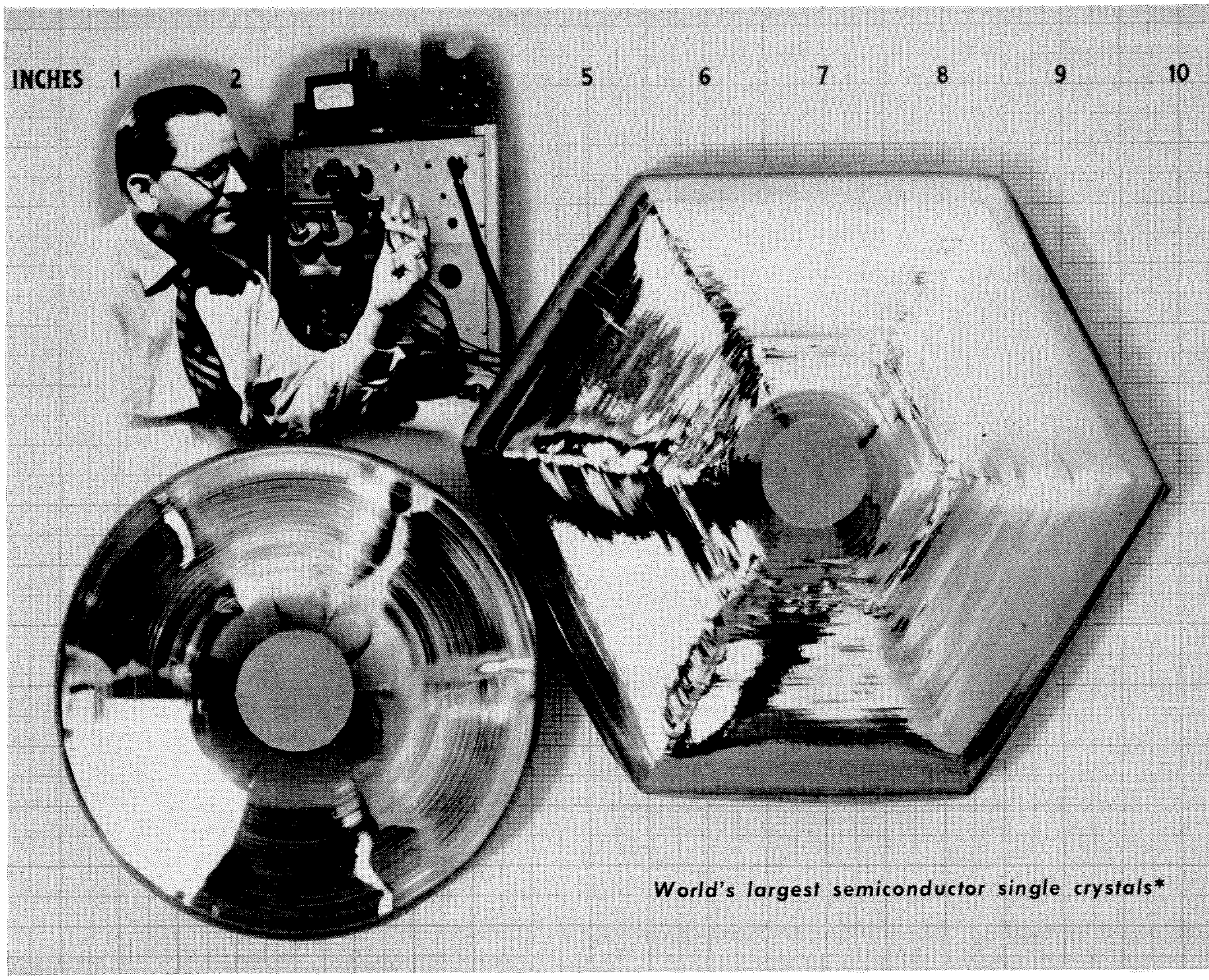

*World's largest semiconductor single crystals**

Highlights of your future with Honeywell

Campus-like Honeywell Research Center in Hopkins, Minneapolis suburb

Preview your career with a summer internship

Dr. Finn Larsen, Director of Honeywell's Research Center, M.A., Physics, 1941, Drake; Ph.D., Iowa State, 1948.

"Honeywell is now interviewing students for its summer intern program."

"We believe a man makes a much better choice in his career if his decision is based on actual work experience. And, at Honeywell, the experience can be matched exactly to his individual needs and interests.

"This is made possible by Honeywell's wide diversification in the field of controls. Honeywell makes more than 12,000 different systems and controls. They are precision products whose development and manufacture require extensive use of all kinds of engineering skills. And they are used in virtually *every industry known today*. Thus, the man who enters Honeywell's summer program gets a real working knowledge, not only of controls, but of many related industries.

"Many of Honeywell's 14 separate divisions will offer assignments under the summer internship program. The location and name of each division and activity is listed at the bottom of this ad."

Terms of program

Honeywell's program is geared to students one year from graduation in any branch of engineering, chemistry, mathematics, physics, business administration or accounting.

Assignments will be made in Design and Development, Industrial Engineering, Quality Control, Quality Analysis, Production Coordination, Personnel Administration, Financial Control, Marketing and Market Analysis.

There are also special assignments in the Honeywell Research Center for graduate students in Physics, Chemistry or Engineering who are one year from completion of their work.

If you are enrolled in this program you will work at Honeywell from mid June to early September, approximately 12 weeks. Included in the weekly schedule will be discussions and meetings, as well as practical work assignments.

Applications being accepted now!

In order to give maximum benefit to the members of this program, Honeywell must limit the number enrolled. If you wish to apply for an assignment, send your name, address, school, the course in which you are enrolled, plus the number of years completed to:

Dr. A. Lachlan Reed
Director, Industry Education Relations
Minneapolis-Honeywell Regulator Company
Dept. TC29A
Minneapolis 8, Minnesota

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the eight western states of the Sixth U.S. Army area. John has been at the Presidio since September, 1955, when he and his wife and their daughter, Donna Irene, arrived there from Texas.

1949

Rafat Mirza, MS, writes from Manchester, England, that "after I left Caltech, I worked with Sir Robert Robinson for my doctorate at Oxford. Until I received it in 1951, I had the good fortune to be able to travel through France, Switzerland, Germany, Italy and all over Britain on my motorcycle.

"After a brief stay in Hyderabad in 1953, I returned to Switzerland to do postdoctorate research with Professor Prelog at the Swiss Federal Institute of Technology in Zurich.

"The next year was spent at Harvard working with Professor Woodward. It was a great experience to see a master-mind at work and the fine training in semi-micromanipulation learned with Koepfli and Niemann made work a pleasure. After two years of postdoctorate work in the States, I returned to England.

"I'm doing full-time research in heterocyclic chemistry here at the Imperial Chemical Industries. My wife and I (I got married last year) spend our time in the mountains—climbing and taking pictures. We miss the California sunshine. Here we have six months of winter—followed by six months of bad weather."

Jack L. White reports that his National Research Council Research Associateship in the Metallurgy Division of the Naval Research Laboratory in Washington, D.C., has been renewed for the second year.

Carl A. Price has been appointed Milton Research Associate in Medicine at Harvard Medical School and will be affiliated with the Peter Bent Brigham Hospital. Carl received his MA in 1951 and his PhD in 1952 from Harvard University.

1950

Floyd B. Humphrey, PhD '56, a member of the technical staff at the Bell Labs, reports the arrival of a daughter, Victoria Irwin, on December 9. The Humphreys make their home in Madison, New Jersey.

1951

Robert F. Connelly is now sales manager of the aircraft and chemical divisions of the Bray Oil Company in Los Angeles. He's been with the company for four years, except for six months spent recently as the western representative for Emery Industries, Inc. The Connellys announced the arrival of a son, Neil Dwight, on Thanksgiving Day—which makes a total of five; four sons and one daughter.

Edward E. Zukoski, MS, PhD '54, was appointed assistant professor of jet propulsion at Caltech on January 1. He had been a resident engineer at JPL since 1954.

Cdr. Arthur D. Struble, Jr., AE, is now class desk officer for the Navy's nuclear seaplane, attached to the Bureau of Aeronautics. In preparation for the assignment, Art attended the Oak Ridge School of Reactor Technology. The Strubles, who have four children, are living in Arlington, Virginia.

Oliver H. Gardner has been appointed general manager of Walter R. Cole & Co. in Oakland, California, a steel plate and tank fabrication firm. He was formerly division manager of Jacuzzi Brothers, Inc.

1952

James La Fleur is the new president of Kemsco, Inc., and makes his headquarters at the firm's Los Angeles engineering and production division. He was formerly with the Garrett Corporation, and was chief engineer of Wall Cryogenics, a division of Paul Hardeman, Inc.

1953

David Wittry, MS, who is doing graduate work in physics at Caltech, reports an addition to the family — a boy, born last August.

1955

Lt. Jack W. Rocchio received his silver pilot wings last month in graduation ceremonies for Class 57-I at Goodfellow Air Force Base in Texas. His next assignment will be at Clark Air Base in Luzon, Philippine Islands.

Oreste W. Lombardi, who is doing graduate work at the New Mexico Institute of Mining and Technology at Socorro, New Mexico, announced the arrival of a daughter, Margaret Ann, on February 4.

Lt. Frank C. Michel recently received the silver wings of an Air Force jet pilot at Laredo Air Force Base in Texas. Frank was employed by the Firestone Tire and Rubber Company Guided Missile Division before he joined the Air Force.

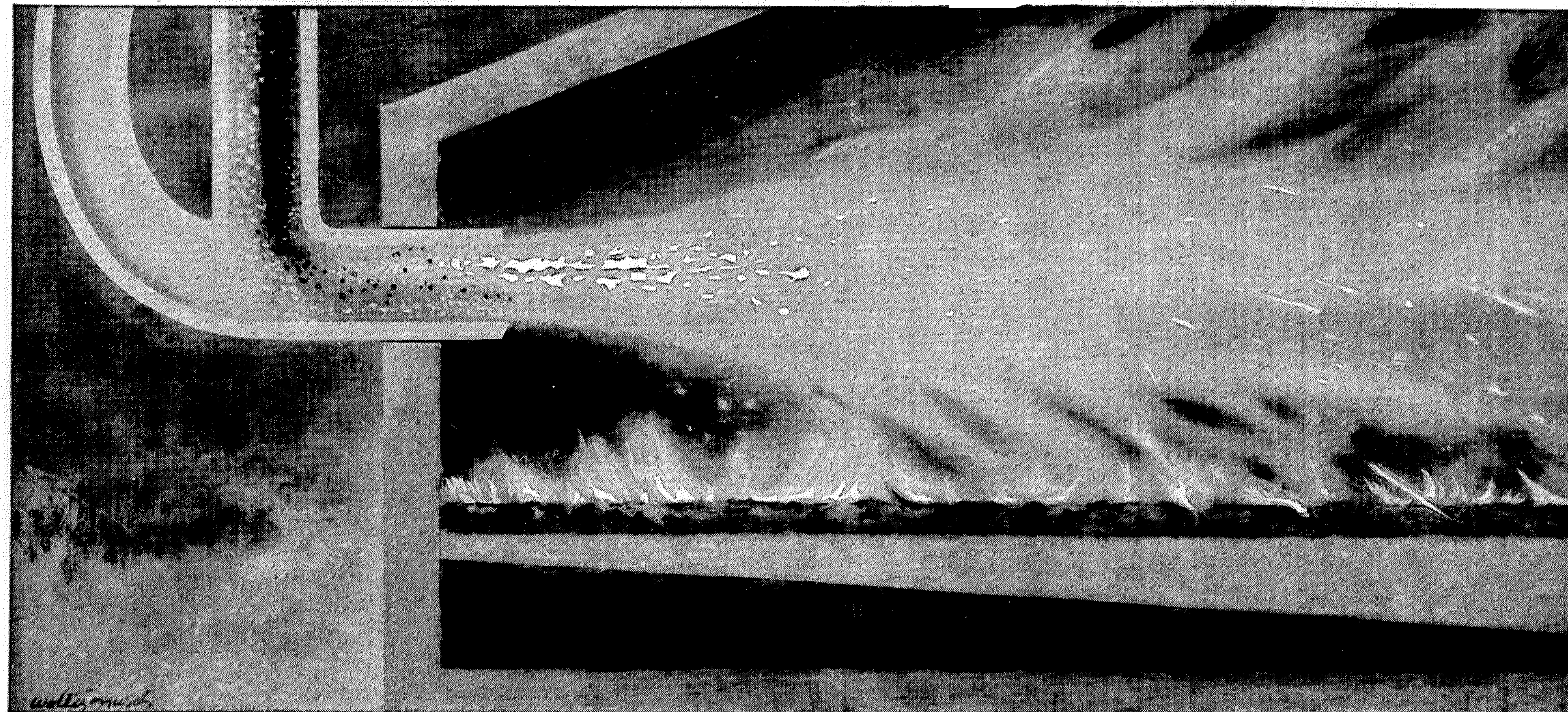
1955

Lloyd E. Best, MS, is now a geologist with the California Company in New Orleans, Louisiana.

Bruce O. Noll, MS, is acting instructor in the department of physical sciences at the University of California in Santa Barbara.

1956

Charles A. Norman is a geology trainee at the Continental Oil Company in Ponca City, Oklahoma.



An artist's inside look at 1000-ton-a-day oxygen flash smelting furnace of Inco-Canada at Copper Cliff, Canada.

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TWENTIETH ANNUAL ALUMNI SEMINAR - SATURDAY, APRIL 6, 1957

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

MORNING PROGRAM

9:30-10:20 A.M.

One of the following:

A. VIRUSES AND CANCER

Harry Rubin, Senior Research Fellow in Biology

It has been demonstrated repeatedly that certain viruses can cause cancer in animals. Very recent developments in the techniques of laboratory biology now make it possible to study the relationship between viruses and cancer in a precise way. Dr. Rubin will discuss the questions that have been raised in the field of viruses and cancer and the prospects for answering these questions with the new tools and knowledge now available.

B. FLOODS! ARE WE PREPARED?

Norman H. Brooks, Assistant Professor of Civil Engineering

The danger of loss of life and property from floods has been greatly increased by man's encroachment on river flood plains. Although the southern California area has not suffered severe flood damage within the past two decades, threat of disaster is present every year. Studies of flood behavior have led to construction and design of improved control projects and to new techniques in the forecasting of flood levels. Flood damage and the operation of flood control facilities will be vividly illustrated with photographs taken during recent disastrous floods including those which occurred in northern California in December 1955.

10:20-10:50 A.M.—COFFEE TIME

Served in the patio between Arms and Mudd

10:50-11:40 A.M.—

One of the following:

A. LIFE AT A QUARTER MILLION g's

Jerome Vinograd, Research Associate in Chemistry

The centrifugal field associated with fast spinning rotors provides a new world in which objects may increase in weight by a quarter of a million times, a force field equivalent to that found on white dwarf stars. Dr. Vinograd will discuss the phenomena associated with modern ultracentrifuge investigations.

B. BROADCASTS FROM THE STARS

John G. Bolton, Senior Research Fellow in Physics and Astronomy

In the past ten years, radio observations have made great contributions to the study of the sun, external galaxies and interstellar gas. The number of "radio" observatories is rapidly approaching that of conventional observatories. A large observatory with two 90-foot radio telescopes is being built for the Institute near Big Pine in the Owens Valley. A description of this project and the aims of the research program will be given.

11:55-12:45 P.M.—

One of the following:

A. NEW CARS AND NEW POLITICS

James C. Davies, Associate Professor of Political Science

The American public is more interested today in new cars than new politics. In the midst of world crises we are turning away from politics. This political lethargy can last too long. The violent rebirth of anti-white feelings in Asia and Africa may make our faces turn red even if the non-white world does not. Professor Davies will discuss the significance of our politics to our world position.

B. REVOLUTION IN AERONAUTICS

Clark B. Millikan, Director, Guggenheim Aeronautical Laboratory, CIT

Speeds previously attained only by bullets have recently become commonplace for manned aircraft and complex guided missiles. This remarkable change has been made possible by the development of power plants considered exotic 10 years ago. Revolutionary solutions have been found to almost insurmountable problems encountered in the fields of aerodynamics, structures, materials, guidance and control. These solutions suggest that even more spectacular flights than those now being attained will be possible in the near future.

1:00-2:00 P.M.—LUNCH—Student Houses

AFTERNOON PROGRAM

2:15-3:45 P.M.

THE NEXT HUNDRED YEARS—A SYMPOSIUM

In 1956 a team of faculty members of the Institute arranged a series of discussions with leaders of American industries. Conferences were held with board members and top executives of about thirty of our largest corporations. The future of the earth's natural resources in relation to man and his technology was discussed. The Alumni Seminar is fortunate in being able to present this exciting and thought-provoking profile of the future.

Speakers:
James F. Bonner, Professor of Biology
John R. Weir, Associate Professor of Psychology

Chairman:
Chester M. McCloskey, Director, Industrial Associates

The interrelationships between man and his resources in terms of raw materials, products, manpower, brainpower, and processes have recently been systematically explored. In the light of the facts revealed, an attempt is made to forecast the future of our industrial civilization—beginning with the years just ahead, in which steps will be taken that affect us far into the future. What is the future likely to be? How rapidly can we expect industrial civilization to spread throughout the world? How large will human populations grow and how rapidly? What are the available raw materials which man can use? Can agricultural productivity be brought abreast of world requirements? Are our technical manpower resources adequate for the inevitable evolution? The factors involved will be brilliantly analyzed by this select panel.

3:45 P.M.—COFFEE TIME

Served in patio between Arms and Mudd

OTHER EVENTS

4:15 P.M.

Tour through Southern California Cooperative Wind Tunnel, 950 South Raymond. Tour is limited to 150 people and will take about one hour.

OR

For those who prefer the out-of-doors, the swimming pool will be open from 2:00 to 5:00. Bring your own suit and towel. Aqualungs and fish-spears will be prohibited.

EVENING PROGRAM

Dinner Hour: 6:30 P.M. (Bar opens 5:30)

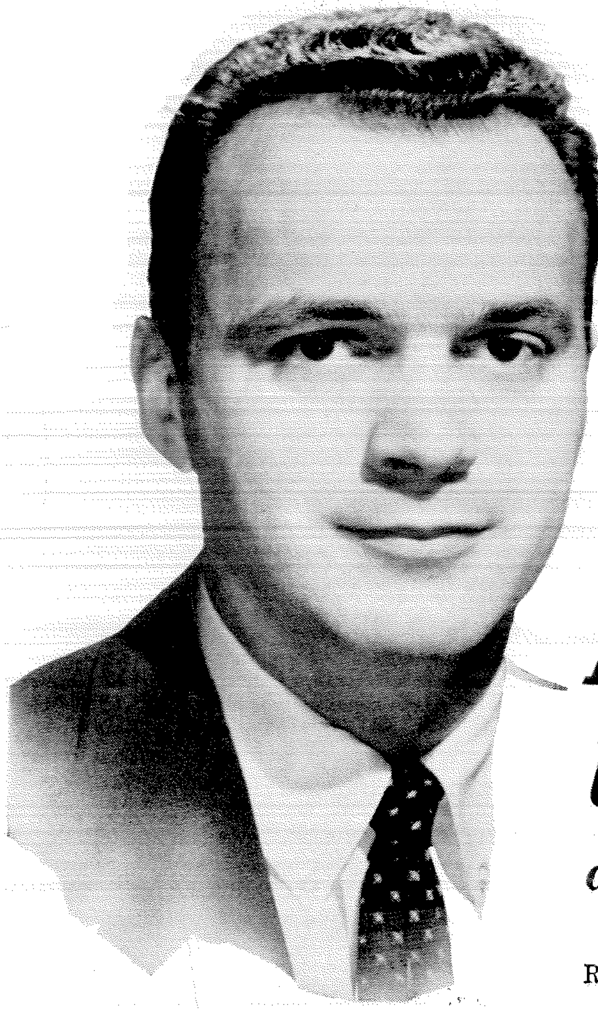
Elks Club, 400 W. Colorado Street, Pasadena
Dress—Informal

AFTER DINNER

Introductions by L. Ford Etter '34, General Chairman, Alumni Seminar Day. Remarks by Albert B. Ruddock, Chairman, Board of Trustees, California Institute of Technology.

Guest Speaker—RAY E. UNTEREINER
His Subject—"CALIFORNIA UTILITIES AND THE COMMISSION"

Many alumni who have heard Dr. Untereiner know that he is a very entertaining speaker. He has been on leave from the Caltech faculty since October, 1954 to serve as a Commissioner of the State of California Public Utilities Commission working in your interest. We are fortunate that his plans allow his return to address us on this occasion.



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CALTECH CALENDAR

ALUMNI EVENTS

April 6 — Alumni Seminar
June 5 — Annual Meeting
June 29 — Annual Picnic

ATHLETIC SCHEDULE

VARSITY TRACK

March 30
Caltech at Whittier

April 6
Caltech at Redlands

April 13
Westmont and Pasadena College at Caltech

VARSITY SWIMMING

March 28
Caltech at Redlands

March 29
LACC at Caltech

April 3
Caltech-UCLA-Santa Monica at Santa Monica

FRIDAY EVENING DEMONSTRATION LECTURES

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

March 29
The San Andreas Fault— Its Significance in California's Past and Future
—by Dr. Clarence R. Allen

April 5
Mass Spectrometers and Isotope Dilution Analysis
—by Mr. Charles McKinney

April 12
Nuclear Power
—by Dr. Milton Plesset

April 19
Science of Dry Fly Fishing
—by Dr. William W. Michael

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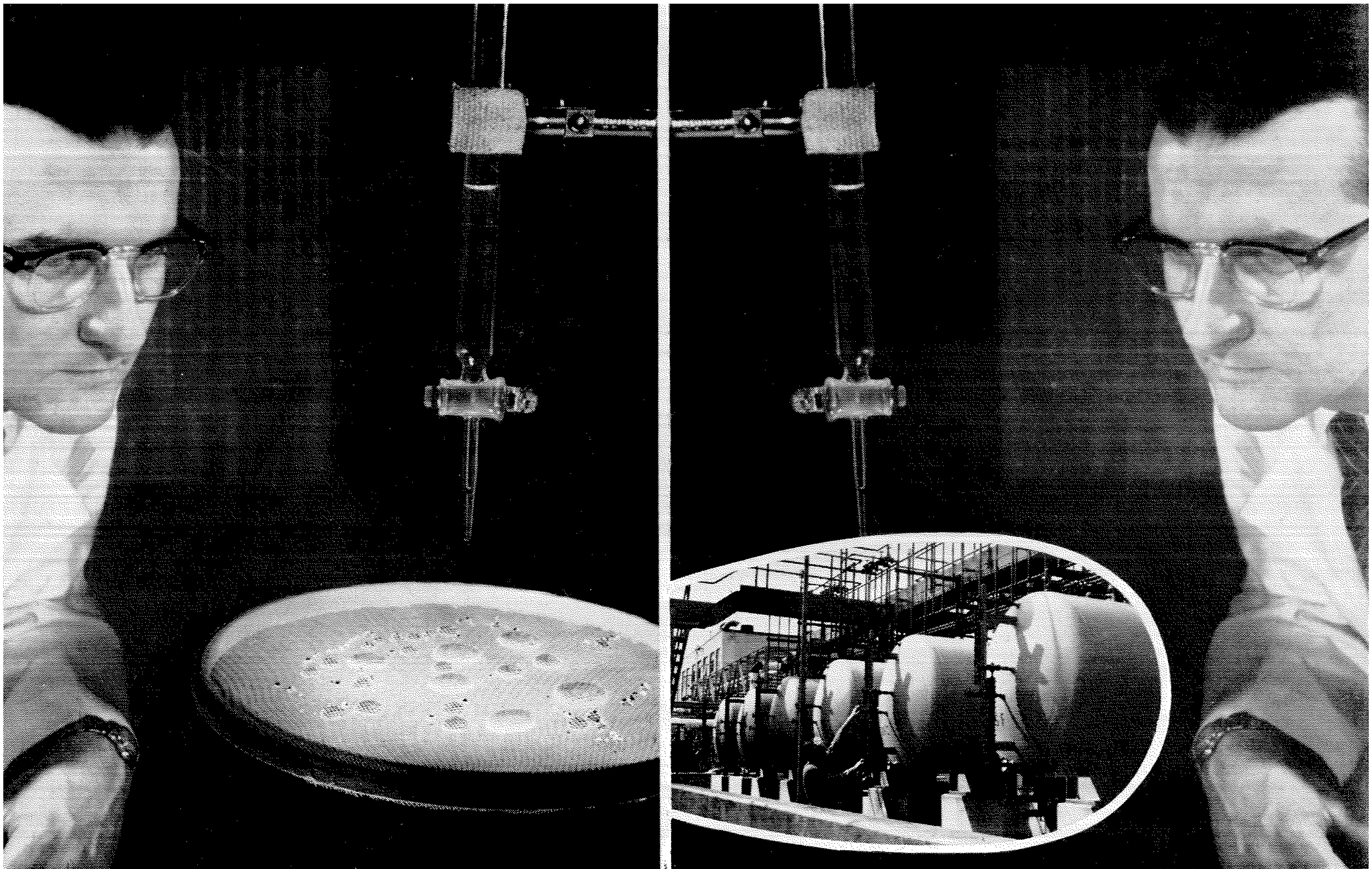

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