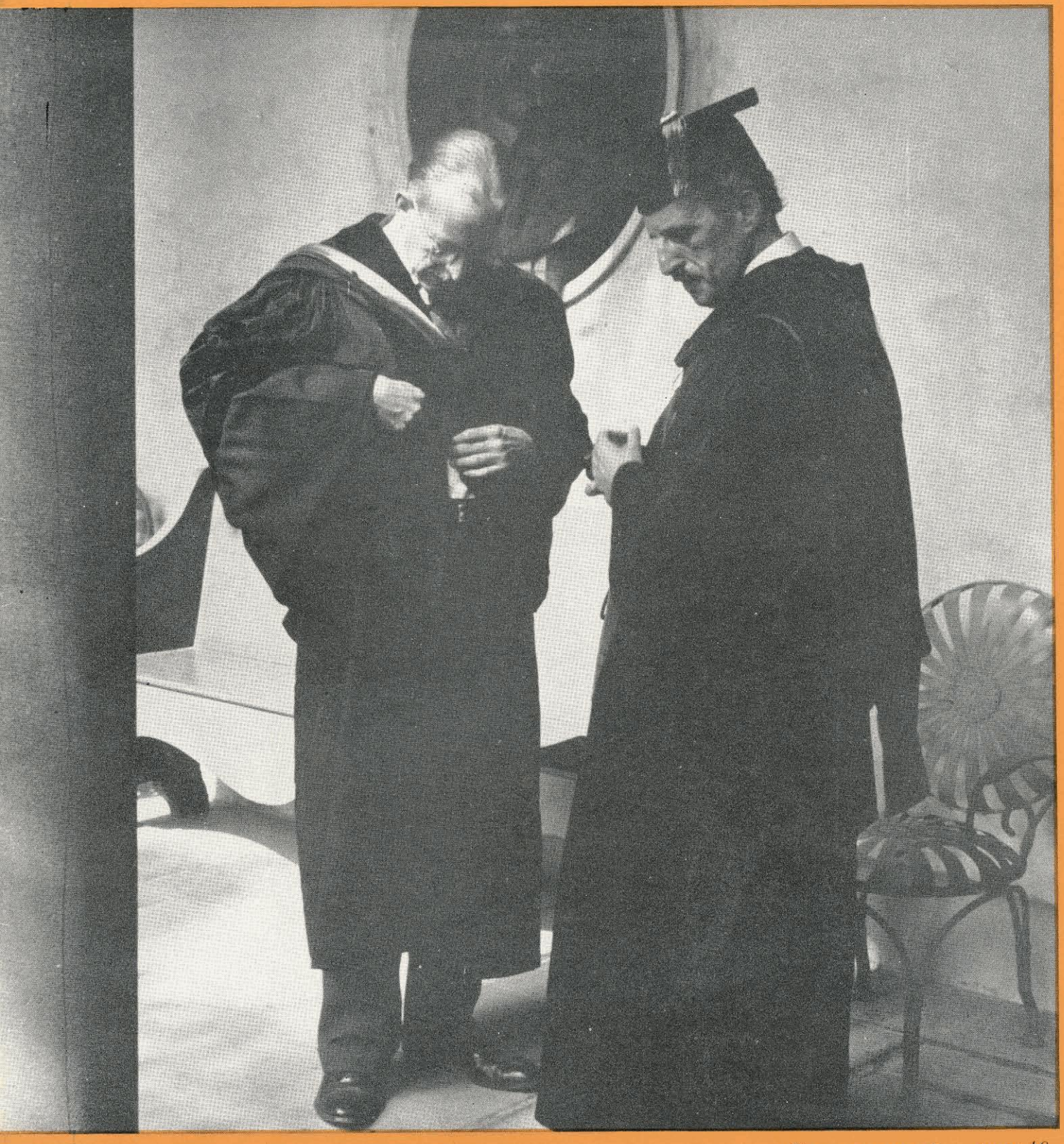
ENGINEERING | AND | SCIENCE

JUNE/1955

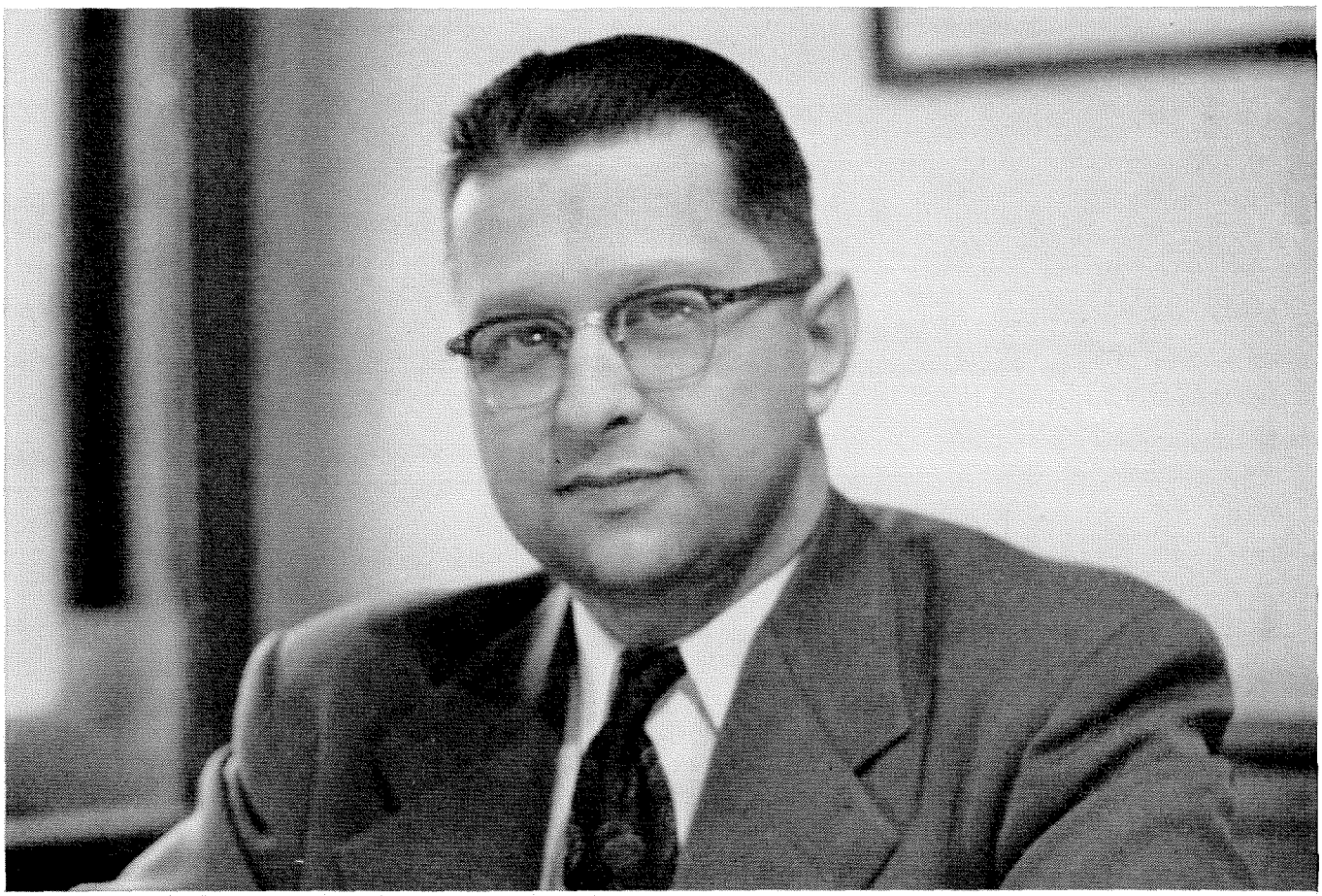


Commencement . . . page 10

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Mitchell B. Wozniak, class of '43, speaks from experience when he says,

"U. S. Steel offers many opportunities in a great variety of engineering fields"



• Mitchell Wozniak, a 1943 Chemical Engineering graduate, came to United States Steel in February 1948 – after five years divided between post graduate work and military service. He began as a process engineer at the Clairton Works on the Coke and Chemical Division Staff. Then, after several advancements, was appointed to his present position – General Supervisor of Technical Control for the Coke and Chemical Division–in 1953.

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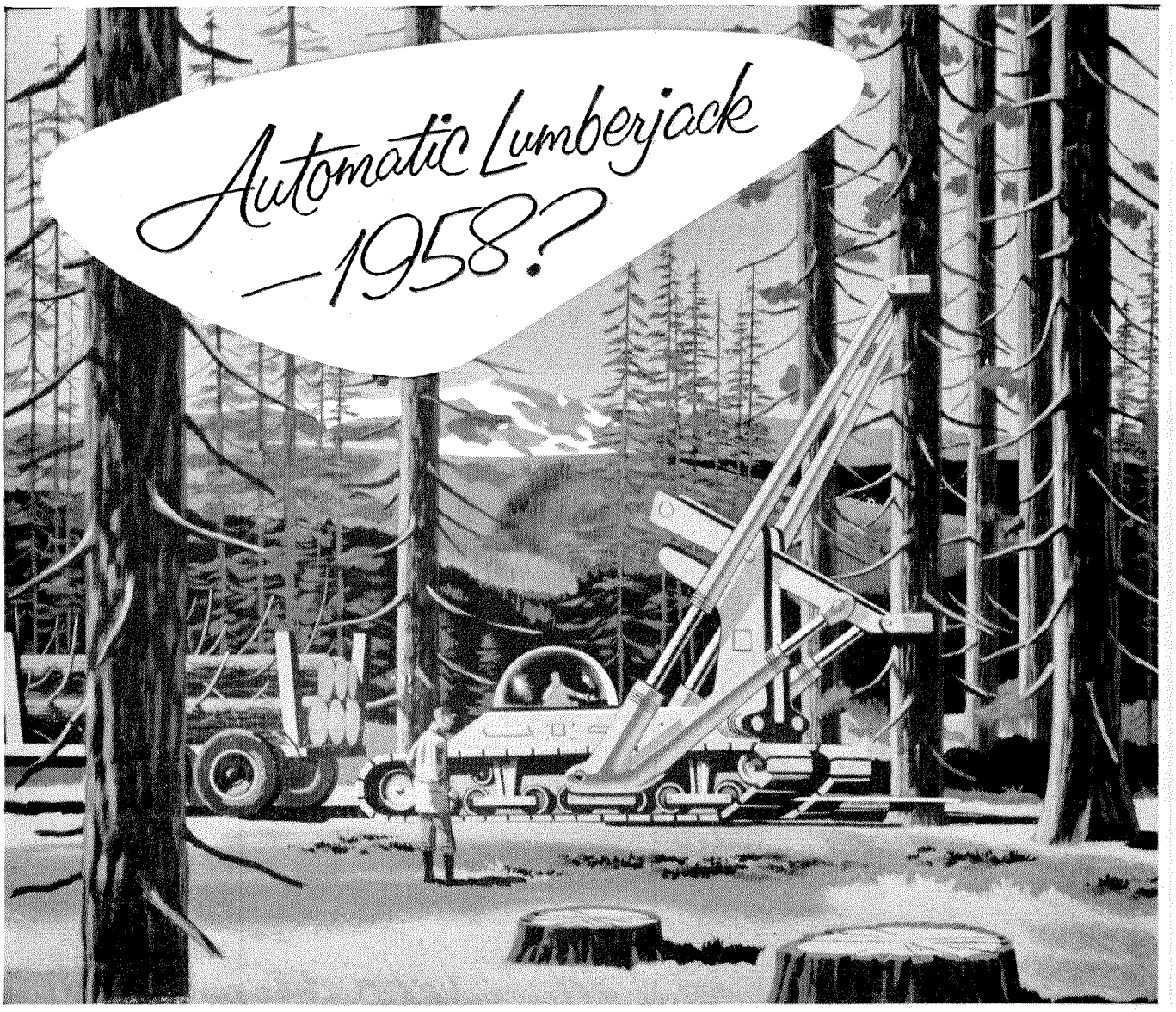

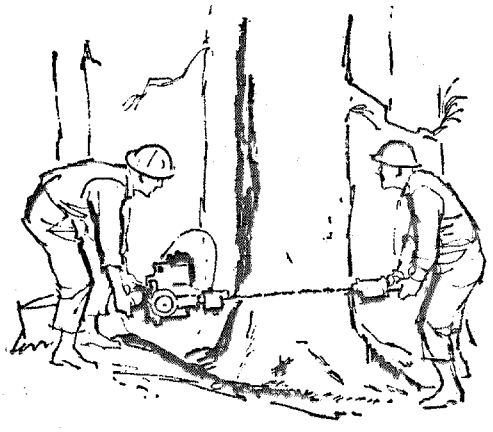

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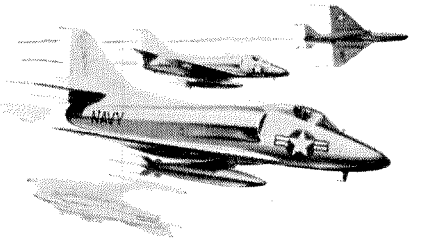
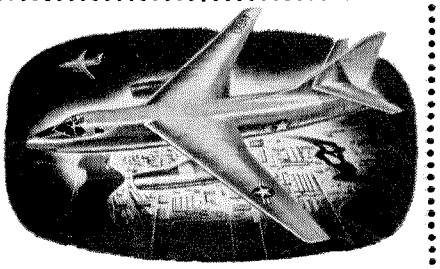
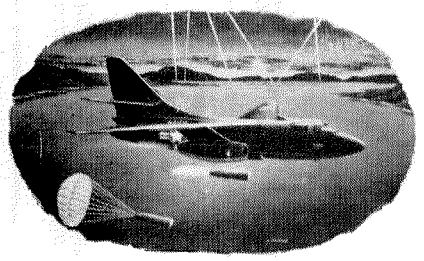


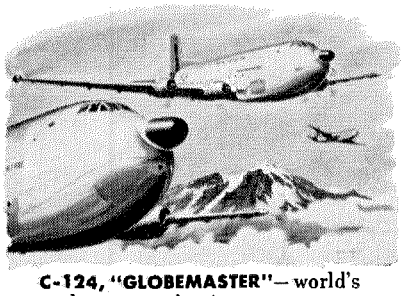
A4D, "SKYHAWK"— smallest, lightest atom-bomb carrier



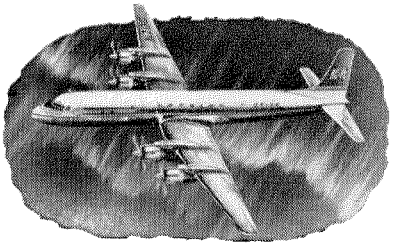
RB-66 — speedy, versatile jet bomber



A3D, "SKYWARRIOR"— largest carrier-based bomber



C-124, "GLOBEMASTER"— world's largest production transport



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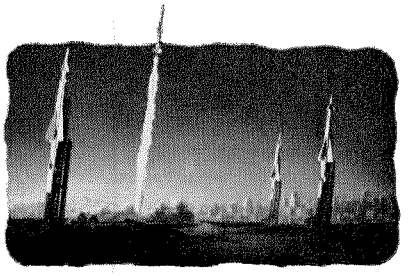

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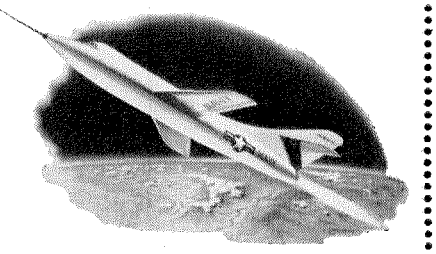

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ENGINEERING AND SCIENCE

JUNE, 1955 VOLUME XVIII NUMBER 9

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

IN THIS ISSUE

On our cover this month, two faculty members (Dr. Richard M. Badger, Professor of Chemistry, and Dr. Alfred Stern, Associate Professor of Languages and Philosophy) are making some last minute adjustments on their academic costumes before lining up in the academic procession for Caltech's 61st Commencement ceremonies. You'll find some more pictures of this year's Commencement on pages 10 and 11, and on page 7 is the text of the Commencement address, "Not They, but We."

Clarence B. Randall, this year's Commencement speaker, is chairman of the Board of the Inland Steel Company. Author of several books *(A Creed for Free Enterprise* and *Freedom's Faith)* dealing with the role of business and industry in America today, Mr. Randall organized and headed the Commission on Foreign Economic Policy which drew up the tariff plan presented to Congress in 1953. Since that time he has served as a foreign economic consultant to President Eisenhower.

On page 14 you'll find the text of the warm and discerning tribute that President DuBridge paid to Albert Einstein at the Einstein Memorial Service held last month at UCLA, sponsored by the University of California, Caltech, USC, and the Los Angeles Jewish Community Council.

PICTURE CREDITS

Cover	Walter Girdner
pps. 7, 10, 11	Walter Girdner
pps. 12, 13	Gordon Glattenberg '58
pps. 16-18	Walter Girdner

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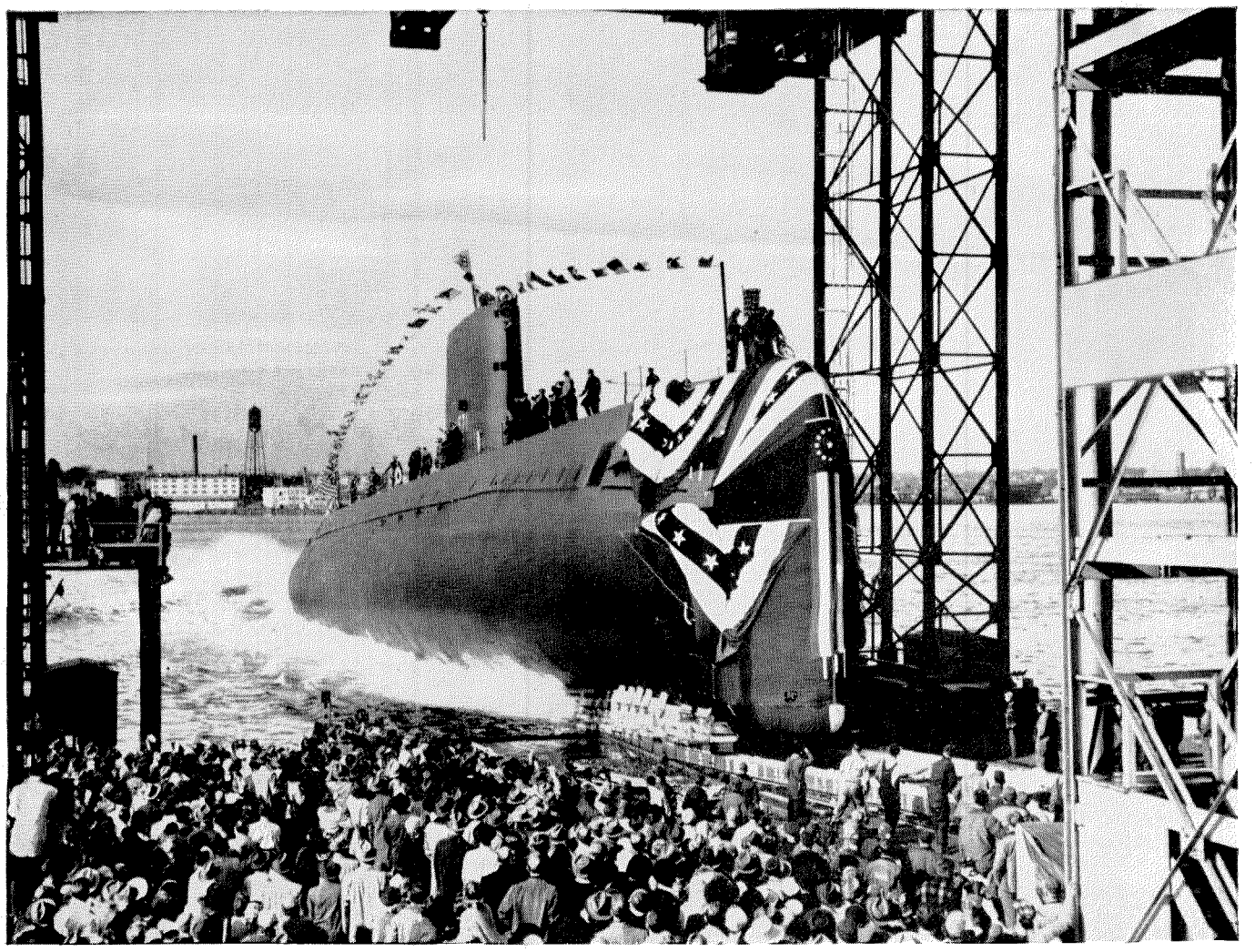

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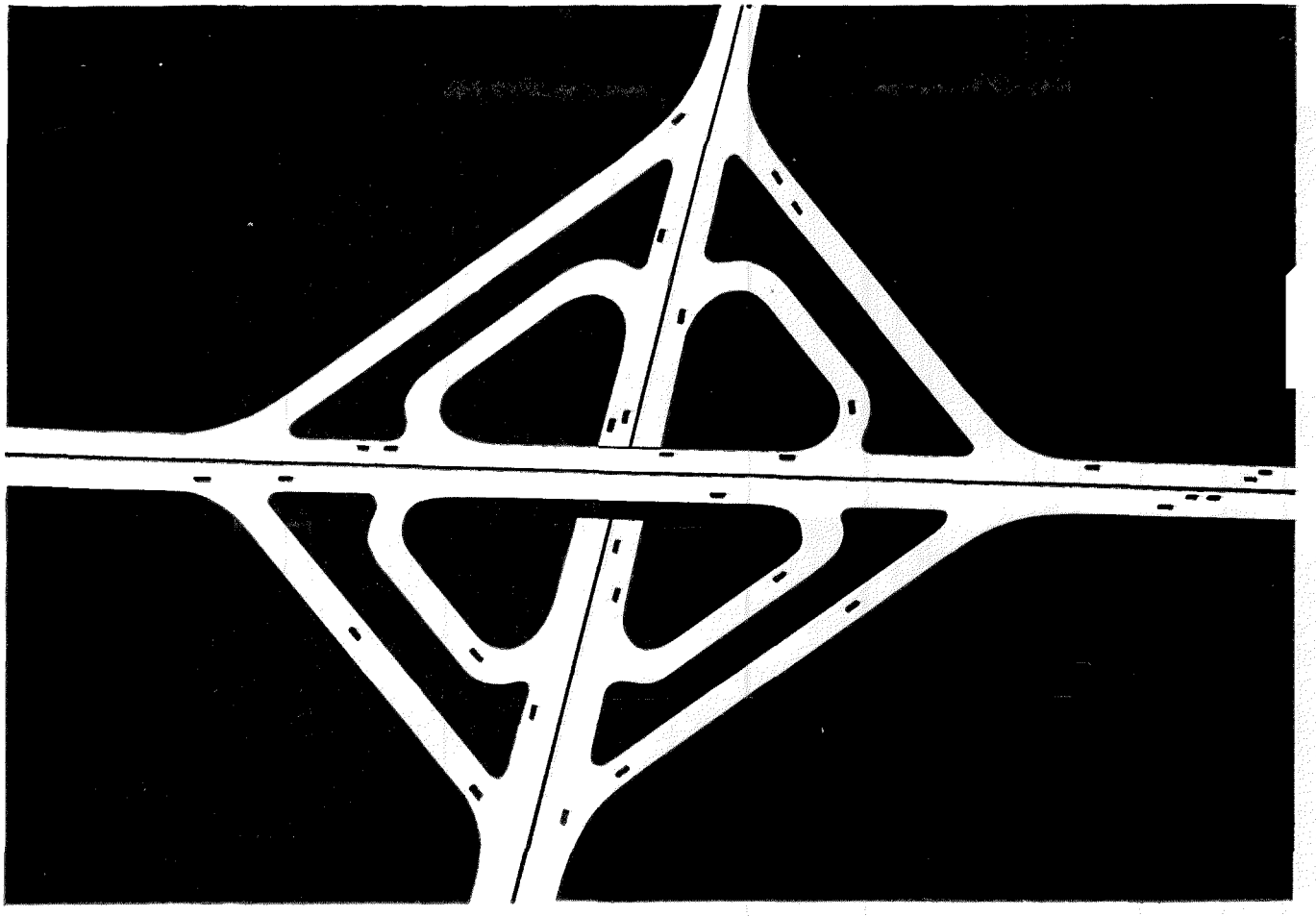

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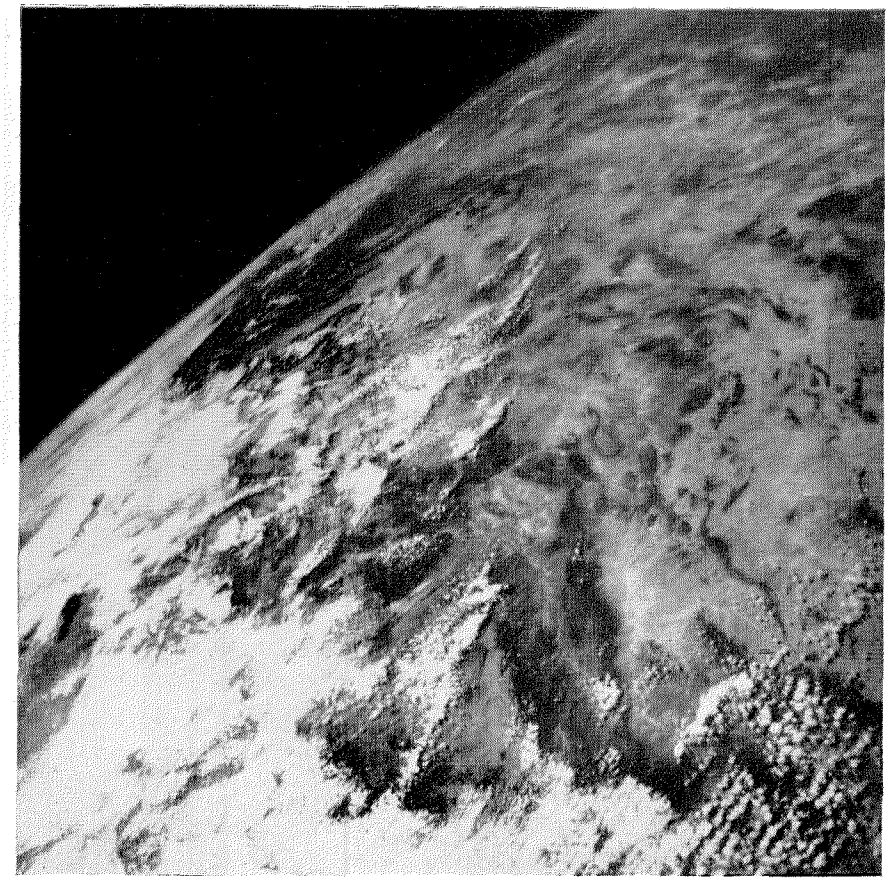

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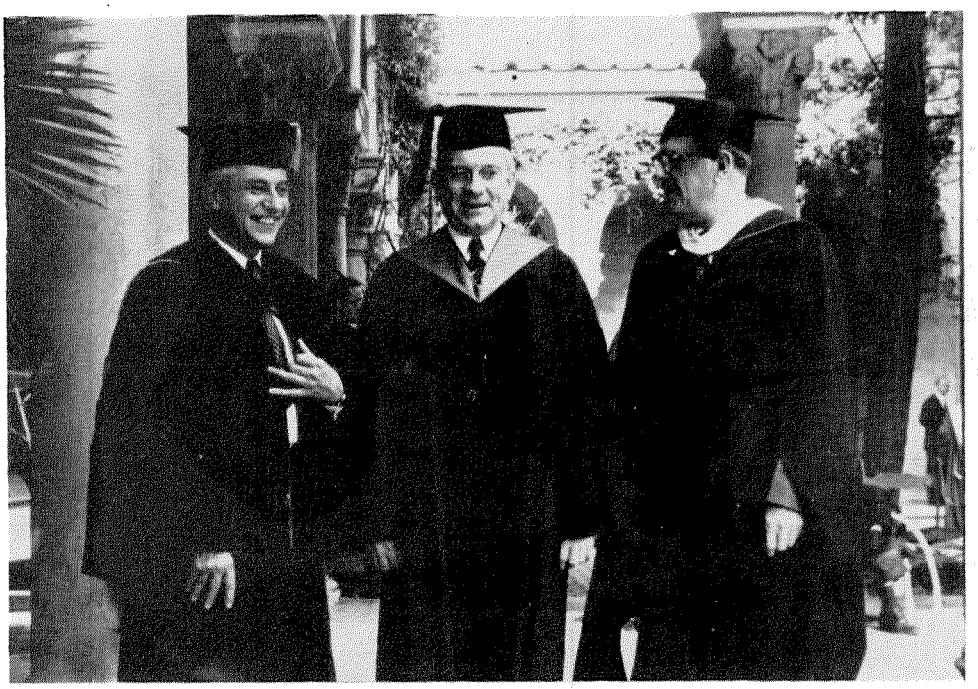


President DuBridge, Commencement speaker Clarence B. Randall, and Albert B. Ruddock, chairman of the Caltech Board of Trustees, at the 61st Commencement.

NOT THEY, BUT WE

The educated man, and his responsibility to society

by CLARENCE B. RANDALL
Chairman of the Board,
Inland Steel Company

I love Commencements. For a few brief moments we set aside the crises of the world and just like each other. Everybody is proud. The university is proud, and the parents are proud, and the graduates are proud though a little relieved; and I'm proud, so we're going to have a grand time together.

I like also to be here to witness the growing movement of partnership between business and industry. Time was when the professors and the business men didn't speak altogether in friendly tones, one with the other. That is gone and we recognize that today we hold in trust, we in business and they in education, the preservation of our heritage, and we propose to go forward together, each supporting the other.

I suppose the one thing we all have uppermost in our minds this afternoon is the significance of higher education, so I'm going to talk about that. Having been interested in education for years and served on boards of institutions, I've been trying for a long time to make up

my mind,—what is it, an educated man?—and because no one seems to have a definition, I offer one.

I have come to the conclusion that the educated man is a man who understands himself, the world in which he lives, and senses his responsibility towards that world. And I propose to list a few of the qualities of the educated man as I see them. Many there are, I am sorry to say, who possess diplomas such as will be distributed today, who cannot in the full sense of the word be treated as educated men. Not from Caltech. Perhaps from Harvard. And many there are who have never had the privilege of crossing a campus, who are in every sense educated.

The educated man

What are some of these qualities? First of all, to my way of thinking, the educated man is a man who has mastered one subject—who has addressed himself to a specific task and come completely inside it. That, your diploma certifies you have done. Now I care not, when I recruit young men for the steel industry, what that subject might be. It may be disconcerting to you young men, but I say that we in industry do not seek to employ you for what you know, but for your capacity, your proven capacity, to learn. And if a young man joins my company in the production of steel I don't care whether he's a metallurgist or took honors in the Greek classics. (That's a plug for myself—that's what I did.) But what I do care about is whether he has demonstrated that he can take a subject and lick it.

But that's only the beginning. The occupational disease, my friends, as men train in the sciences, is that they never can get outside and above the subjects in which they were trained. And the educated man must have a flexibility of mind. He must be able not only to master a subject, but to leave it. He must have the intellectual courage and facility to undertake to master a subject for which he was not trained.

You young men—as you come into industry, to the professions, it will be a very short time after your graduation before you will find that you are required to do things that you never undertook before. And so I say the educated man must have the ability to tread with confidence on unfamiliar ground.

And then the educated man must be able to deal, not only with facts, but with ideas. He must deal with the abstract as well as the concrete. Those of you who are trained in the scientific method will find there are problems in the world that cannot be solved by quantitative measurement or analysis. And therefore the educated man must deal not only with the specific but with the abstract. Among those abstract subjects, the educated man must deal today with the problems of human behavior.

You, the scientists, have pushed back the frontiers of our technical knowledge beyond the wildest flight of imagination, but in so doing you have given us a dreadfully complicated world. And the problems that men struggle with today in public life or in industry arise not from our ignorance of the laws of nature, but from our lack of understanding of the human soul. The problems that we struggle with in industry are those of human behavior, and the educated man must come to have insight into the problems of human behavior.

He must first of all know himself. He must understand the impact that he makes upon those about him, and be sensitive to the unexpressed criticisms of his conduct by observing the reactions of others to himself.

Going beyond that, he must understand how to deal with groups. If he is to supervise others he must come to know that not all problems may be solved by the mind, because they are problems that stem from emotions. You gentlemen have taught us in the steel industry how to deal with stress in metal. We need to learn how to deal with stress in human beings. And the educated man of today must be capable both of understanding the physical laws and of understanding those that deal with the human heart.

The educated man, then, must understand how to communicate ideas to his fellows—by which I mean he must be able to write and speak the English language intelligibly. Now if I may suggest some minor criticism of our friends in science, it is that they speak to the world in their own idiom. They use their own patter. Sometimes we haven't the foggiest idea what it is about. Now if a man is to communicate ideas intelligently he must seek the idiom employed by those to whom he addresses himself. When a diplomat goes into a foreign country today, the first thing he does is to learn the language of that country. And people who are to communicate ideas must speak in the language of those to whom the ideas are addressed.

The age of ideas

This is the age of ideas. This is the period when men try avidly to capture the minds of others, and no idea today, however true, is effective if it remains locked up in the mind of an inarticulate scholar.

And then the educated man today must have a plan for his life. I once saw a ship whose motors were running at full speed but whose rudder had been disabled and it was a sorry sight. And nothing is more tragic than to find a man of brilliant mind, with great intelligence, who doesn't know what he's going to do with it. This means an understanding of the human soul, and the relationship of the human soul to the infinite world above and about us. Today you have reached a goal. Life consists of forming goals and seeking to achieve them. And the word "commencement" means to me today that you have reached a goal, and by so doing have brought to yourselves the necessity of establishing the next goal.

Now a man might have these and all of the other qualities that you might suggest and still not be educated. I think of the type of man of great intelligence who devotes his life solely to the cultivation of his mind for the enjoyment that that gives himself. And I say that that is the same sort of sin that a man commits who devotes his

life to making money and employing it solely for sensual pleasures.

The cultivation of the mind as such is not education. It is putting the cultivated mind at work in the modern world that is the final attribute of the educated man.

That was the great tragedy of the middle ages. The scholar, the learned man, found life intolerable. The world so frustrated him that he withdrew from the world and with the spirit of asceticism merely enjoyed for himself the cultivation of his mind. And that spread darkness throughout the world for centuries.

Today we live in a free society; we are the blessed of the earth in our freedom, and one of the great privileges of our free society is to receive the sort of education that you have received. It has come to you through *the imagination, the sacrifice, the determination of those* in the years behind who have formed this great institution. And for each privilege that we receive from a free society there must be a counter-balancing discharge of obligations to society. If we are to enjoy the benefits of freedom, we must measure up in full to its responsibilities and meet them; and so the educated man is rightly expected to exercise leadership in the world about him.

The antidote to self-interest

I hold the same belief about the business world from which I come. America has the strongest economy and the highest standard of living in the world because of our system of free enterprise. And that is sparked by the incentive of self-interest; but the antidote to self-interest by the business man is the voluntary assumption of responsibility toward society. And I am sorry that it is true that my brethren do not all hold that creed.

There are men who crop the fields of free enterprise and do nothing to restore the soil. There are men of high responsibility in the business world who live out their entire careers without sharing the responsibility for perpetuating the society that makes free enterprise possible.

I had the privilege a week or so ago of hearing a very distinguished address by Dr. DuBridge, in which he traced the history of science. And he pointed out that until Copernicus came, man believed the entire universe revolved about us, and that Copernicus taught the world that it was not so—that our earth revolved about the sun.

I know men in the business world today who ought to meet Copernicus. They still do not know that the whole world does not revolve about themselves, nor about their company.

Now, *what does the young man do—the educated* young man—to take his place in this sphere of responsibility? First of all, from the moment he goes to work he determines to have other interests in life than just the job. Now, the job is a major thing, and should be in any man's life, but the young man who lets the job absorb all and dominate every part of his life begins to atrophy; and when he reaches my age—standing as I do in the overhang of senility—he suddenly is a problem to his associates, to his company, and to his family because he says, "If I should retire, what will I do?"

I know nothing as tragic as for a man to reach retirement age without ever having found anything in life that would afford unfinished business to him, after he closes his desk. So the first thing is to find some enthusiasm dealing with the world about you—to help fill your life over and above the job. You do this by working in your church; you do it by working with your schools; you do it by working with your community fund and the social agencies at the community level. And then as your life develops you broaden that. You have a part in forming sound political conditions about you. You enter into the affairs of your state. And then when your mature years come, you are ready to serve your country.

I have had the pleasure for two years of dividing my time between business and government, and I have learned much about the ways of business men and the ways of bureaucrats. And nothing disturbs me more than to come back, and at the Club or on a Pullman car—at about the third drink—to hear a man say, "Why don't *they* do so and so?" I have tried sometimes to get some of these enquirers after 'they' to join in and become part of 'we'; and it is not always easy to find that the self-appointed critic of government policy will come down and spend his own time and money to make the sacrifice to set it right.

"They" is "We"

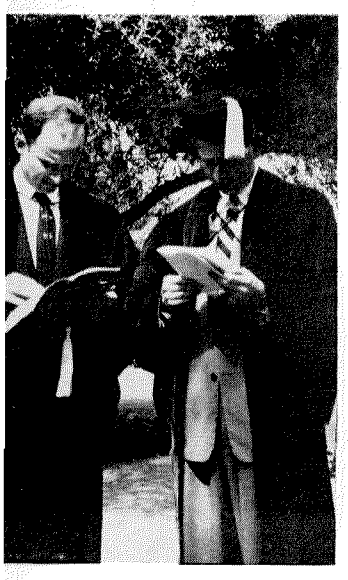
In this you will see the meaning of my title today. I say to you most solemnly: There is no group of able, talented men with great leisure, waiting to answer the call of their country. No, my friends, there are no 'THEY'; there are only 'WE'. And if this great heritage of ours is to be preserved, it requires the effort of all of the people all of the time—and that means *you* and *me*.

I look forward to the day when young men—perhaps between the ages of 30 and 40—will take their regular turn at serving government either at the state or the national level, for a period of two years. We ask young men to die for their country; why should we not ask young men to live for their country?

I look forward to the day when great corporations will encourage their young men to enter the public service and help bear the sacrifice, in order that the young men may bring back to business the understanding of the problems of government, and take to government an understanding of business.

The leadership of our country in the years that lie *ahead rests with just such people as are gathered here* today. What we so proudly enjoy and oftentimes accept without thinking through has been wrought for us by the courage, the dedication, and the unselfishness of those who have gone before. We must not accept it passively. Ours is the greatest heritage in the world, and to pass on this torch to the age that lies ahead requires the constant daily effort of men like you and me.

That, my friends, is the challenge today to the educated man.



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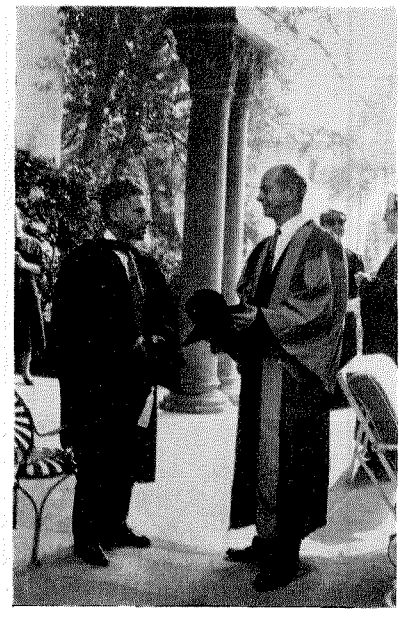
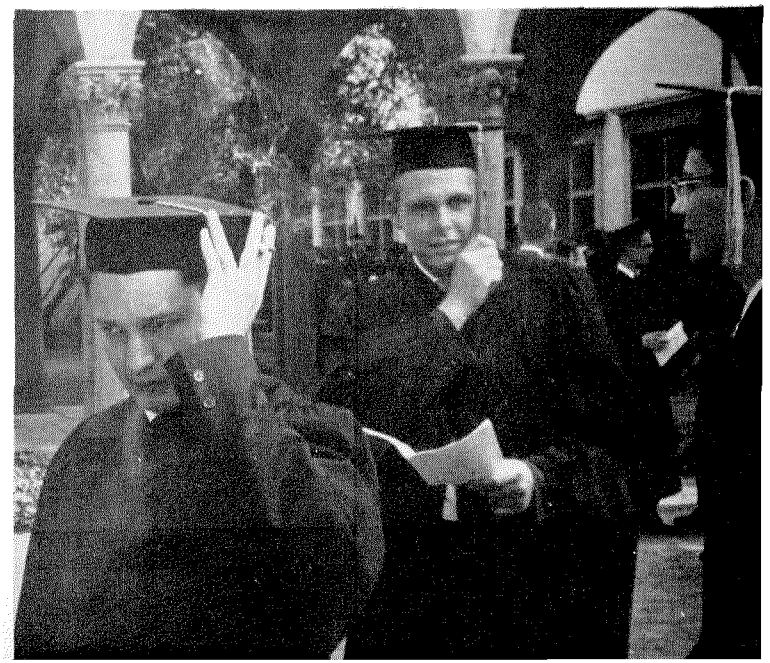
1955



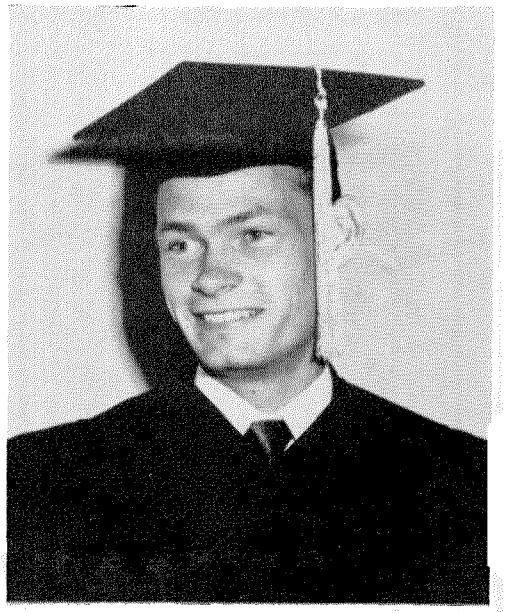


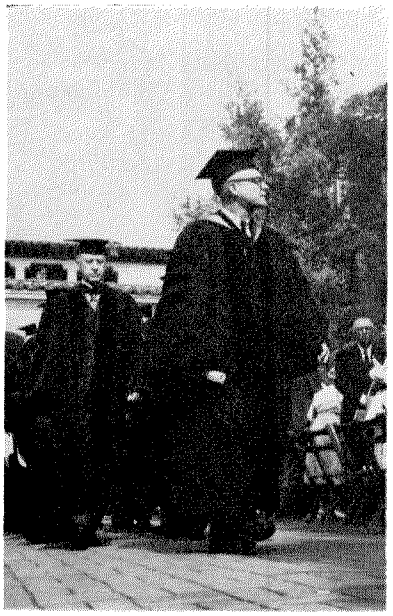
AT THE 61ST ANNUAL COMMENCEMENT on June 10, degrees were awarded to 321 students—126 Bachelors of Science, 101 Masters of Science, 19 Engineers, and 75 Doctors of Philosophy.

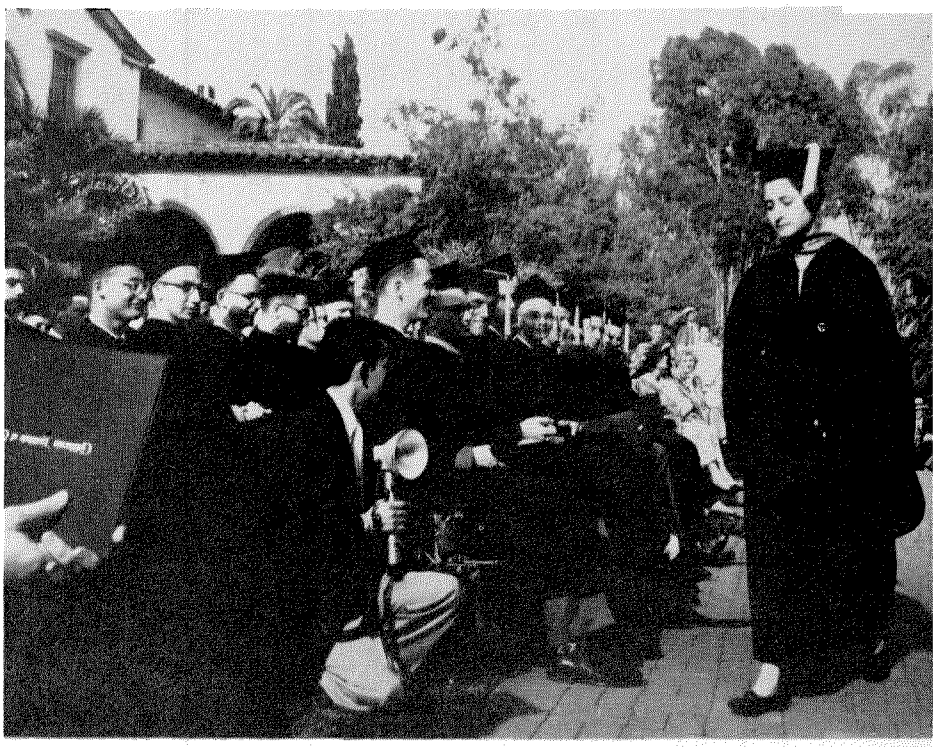
Included in the pictures on these pages are three distinguished graduates. At the right is Rodney W. Supple, winner of the Frederic Hinrichs, Jr. Memorial Award as the outstanding member of the class of 1955.

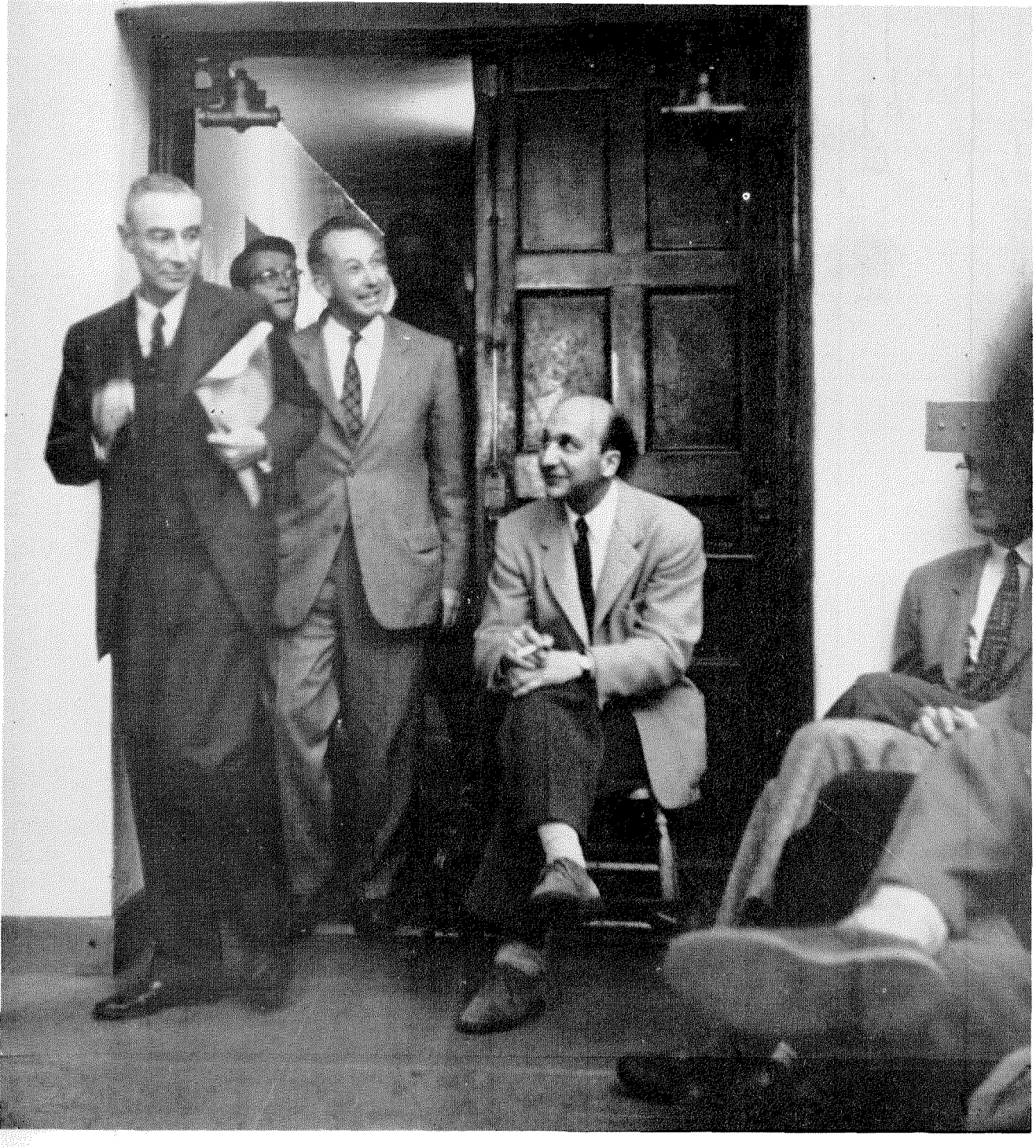
At the right, center, is Dorothy Ann Semenow, the first woman to receive a graduate degree from Caltech—shown leaving the platform with her PhD in chemistry and biology.

At the top of page 10 is Edwin J. Furshpan—shown as he was about to receive his doctorate in animal physiology and embryology —winner of the annual Thomas Hunt Morgan Award as the outstanding graduate in biology.

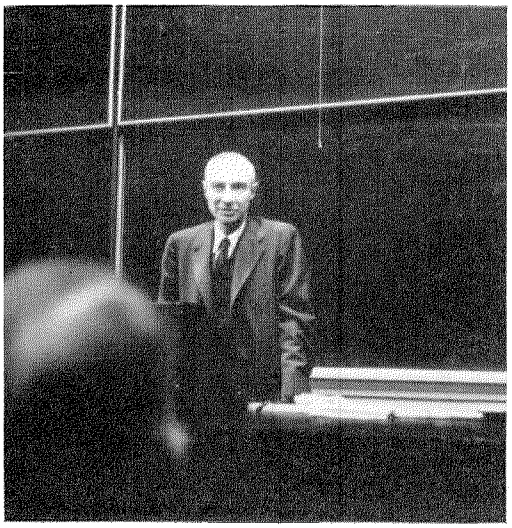


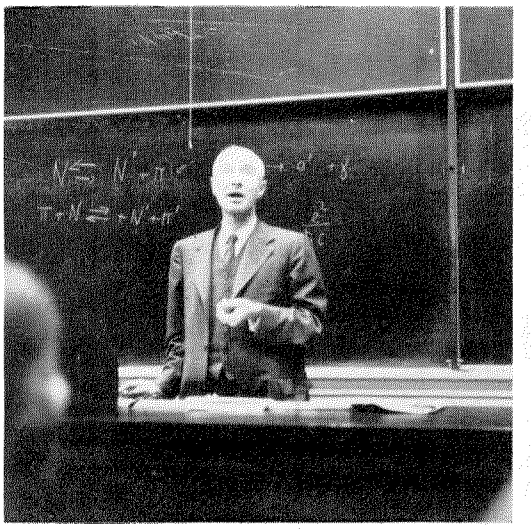


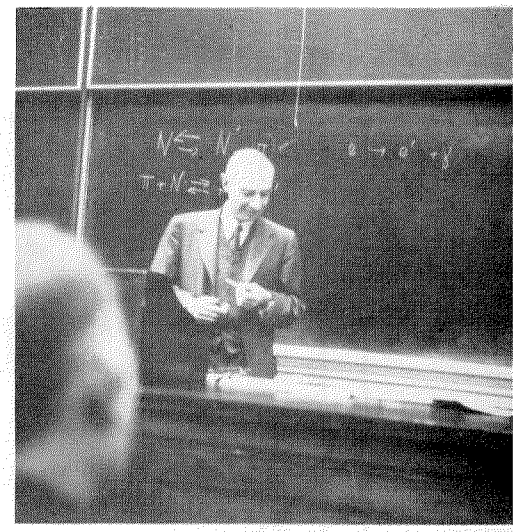


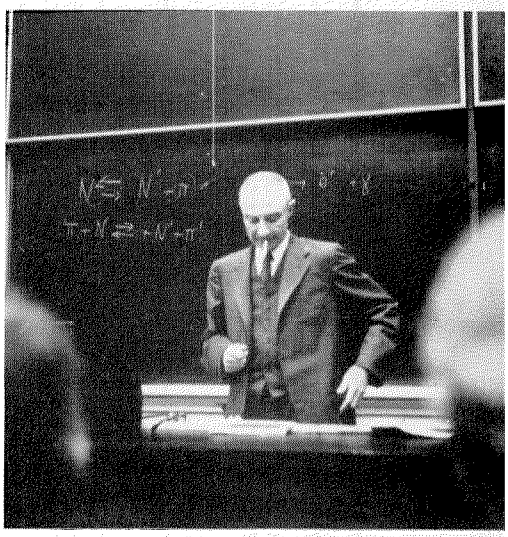


VISITING LECTURER

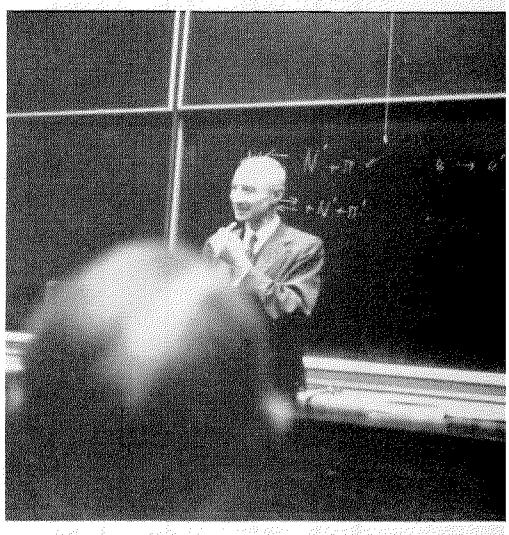


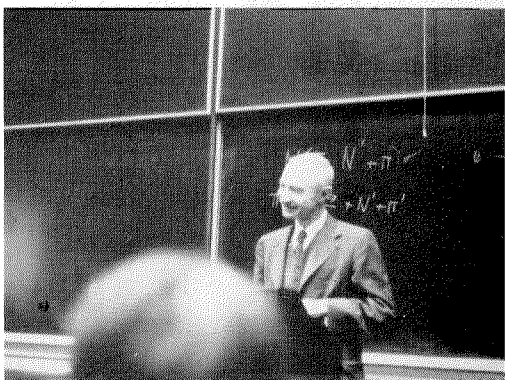






DR. J. ROBERT OPPENHEIMER, director of the Institute for Advanced Studies at Princeton, and former member of the Caltech faculty, visited the Caltech campus for a week last month—during which time he conferred with members of the physics division, and delivered two lectures which jammed 201 Bridge to the rafters, even though they were concerned with the rather specialized subject of the pi-meson theory. The pictures on these pages were taken during one of these lectures by Gordon E. Glattenberg, a member of the Caltech class of 1958.





A TRIBUTE TO ALBERT EINSTEIN

by L. A. DuBRIDGE

A tribute presented at the Einstein Memorial Service held at the University of California in Los Angeles on May 18, 1955, sponsored by the University of California, the California Institute of Technology, the University of Southern California, and the Los Angeles Jewish Community Council.

TO DESCRIBE and to evaluate Einstein as a scientist is at once a very easy and a very difficult job. It is easy to say that Einstein towers far above any scientific figure of the 20th Century—a statement I believe to be true. It is even easy to say that he is the greatest figure in science since Isaac Newton—a statement I also believe to be true.

But, even though we see the towering peaks of Einstein's achievements, we are still too close to them to be able to evaluate them accurately. Einstein's work, without question, marked a turning point in the history of physics. But the full significance of that revolution will be more clearly visible 100 years from now than it is today.

Nevertheless, we do already have a perspective of 50 years since Einstein did some of his most important work in 1905 when he was only 26 years old. And, with this perspective, the towering nature of his contributions is already clearly evident.

In 1905 Einstein addressed himself to solving a riddle which had first been posed by the famous experiments made by A. A. Michelson and his co-workers beginning in 1889—experiments which, incidentally, brought the first Nobel prize in physics to the United States. Michelson attempted to measure essentially the velocity of the earth through the "ether"—the ether being that intangible medium which was assumed to be spread through all space and which accounted for the propagation of light. It seemed obvious that the earth's velocity through this medium could be determined by measuring the difference in the speed with which light travelled in two directions—say parallel and at right angles to the earth's motion. This was simply analogous to measuring the current in a river by comparing the speed with which a rowboat could go upstream with its speed when going across.

The shattering result of this experiment was that there was no difference in speed whatsoever. The velocity of the earth relative to the ether was zero—and remained

zero—in spite of the fact that everyone knew that the earth was dashing along in its orbit about the sun at a speed of 1100 miles per minute.

Now this was but one of many experiments in the fields of optics and electricity which revealed contradictions with accepted theories. And a variety of attempts had been made—most successfully by H. A. Lorentz in Holland—to account for the troubles. However, in 1905 the mysteries still remained.

It was then that Einstein came along with the breath-taking proposal that we take Michelson's experiment seriously and take as a basic postulate of physics that the world is so constructed that the velocity of light in free space is an absolute universal constant whose value is always the same regardless of circumstances under which it is measured.

The consequences of this and the other postulates of special relativity were far-reaching. Many puzzles in physics were at once clarified; the concept of the ether was eliminated; a new concept of the significance of time was introduced, and also there followed the idea that the mass of a body was a function of its speed—a relation which had already been accepted for charged particles, and which now was extended to cover all matter. It was this relation which led to the idea of the equivalence of mass and energy, the basic idea of atomic energy.

Today the theory of special relativity is such an inherent part of physics that it is hard for us of this generation to imagine what physics could have been like without it. It is like asking what physics was like without Newton's laws of motion or of gravitation.

Quantum theory

Twentieth Century physics as contrasted to 19th Century "classical" or Newtonian physics is characterized by two major and far-reaching ideas; namely, relativity and quantum theory. I have already indicated how Einstein was responsible for relativity. I must now point out that he also had a major responsibility for the quantum theory.

The basic postulate of quantum theory was first enunciated by Max Planck in 1900. This was the idea that when light energy is produced it is emitted, not continuously, but in lumps or packets or "quanta." Now Planck, though he found that with this assumption he could solve his problem, really did not believe it, and, indeed, spent several years trying to show how to get along without it, or at least how to minimize its universality. In the end he had to give up.

Again it was Einstein who made the bold proposal that we believe in Planck's quanta and that we assume that light travels in these energy packets and that light is always emitted and absorbed in lumps—the energy of each unit being equal to Planck's constant multiplied by the frequency. Once this idea was accepted, a whole array of phenomena were explained and the basis was laid on which Niels Bohr a few years later built the first satisfactory theory of the structure of the atom. Today we realize that the quantum idea is absolutely basic to all physics.

So, in the one year 1905, the youthful Einstein by bold leaps of his constructive imagination laid the foundations for the two major new concepts of modern physics. If Albert Einstein had passed away in 1906 at the age of 27, he would still be remembered as one of the great figures in physics. But of course he did not stop there. He went on to develop further ideas in both relativity and quantum theory, making many contributions of great significance which I cannot take time even to mention.

General theory of relativity

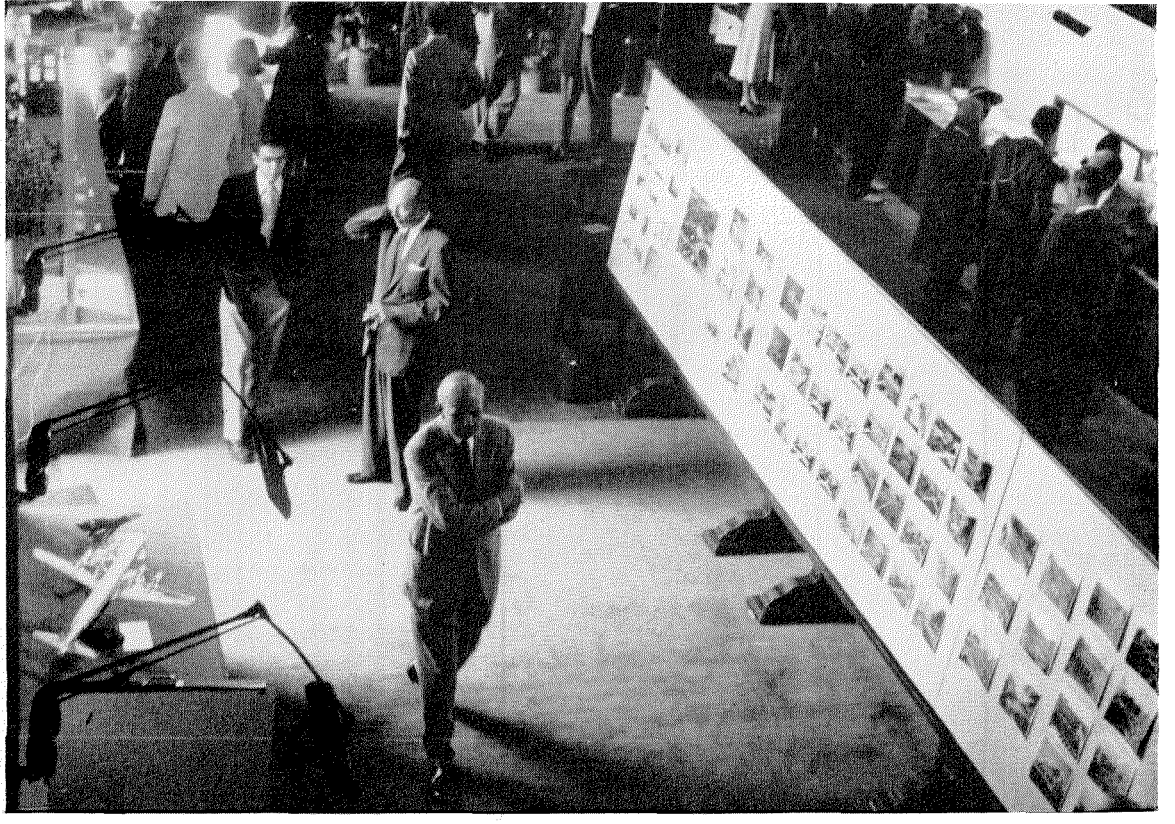
But possibly the greatest and most characteristic achievement of Einstein, the idea which is of such profundity that we know of no other living mind that might have conceived it, was the theory of general relativity first propounded in 1916. This is clearly not the appropiate place, nor is the speaker the appropriate person, to describe the theory. If you wish a simple sentence to characterize the two theories of relativity, it is this: Special relativity deals with physical conditions encountered when observations are made on bodies moving relative to each other with a constant velocity; general relativity deals with cases in which the velocity is changing, in which there is acceleration. Since the most commonly observed cause of an acceleration is what we term the force of gravity, Einstein was led directly to a new theory of gravitation. And since the measurement of acceleration itself depends on measurements of space and time, general relativity propounded a new concept of space-time.

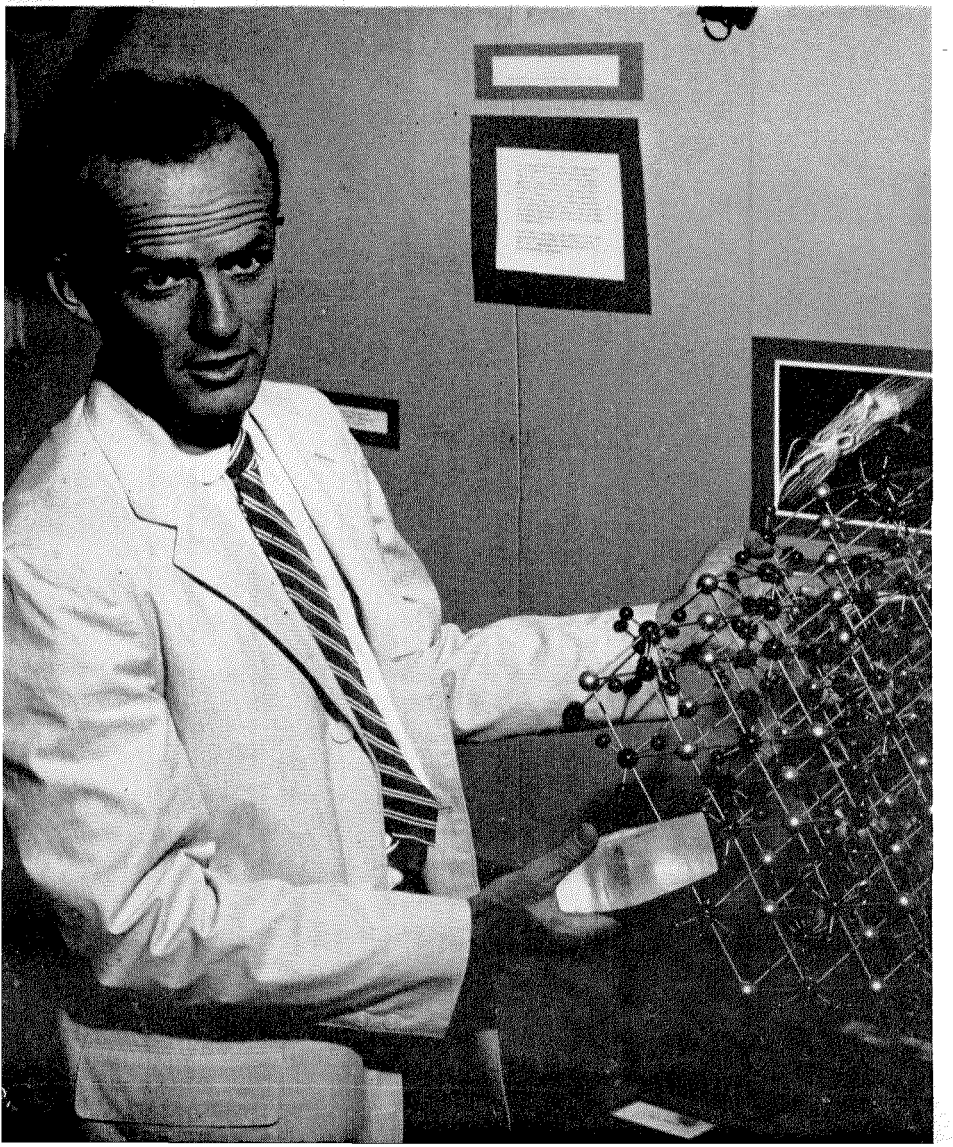
The full consequences of general relativity have not yet been worked out, but no aspect of it has yet been found which is contrary to experience. Einstein himself spent the next 35 years of his life in completing the theory and in trying to tie together the new ideas about gravitational fields with the quite different set of ideas relating to electromagnetic fields. But the achievement of a unified field theory is still apparently a far-off dream which may have to await, for its fulfillment, the birth of another intellect comparable to that of Albert Einstein.

And so today all scientists unite in saluting one of the great minds of the ages—one which ranged with originality and profundity from the unimaginable minuteness of the atomic nucleus to the unimaginable vastness of the universe.

This will suggest why it is that the scientists stand in awe of a mind so great. But scientists also salute the human qualities of this great man. He was a man of simplicity, of gentleness; a man with a great heart who never performed a selfish deed, who never expressed a thought that was not motivated by the most sincere and generous concern for the welfare, the freedom and the happiness of some individual human being—or, more likely, of the whole human race.

His monument lives in the structure of science and also in the hearts of men.

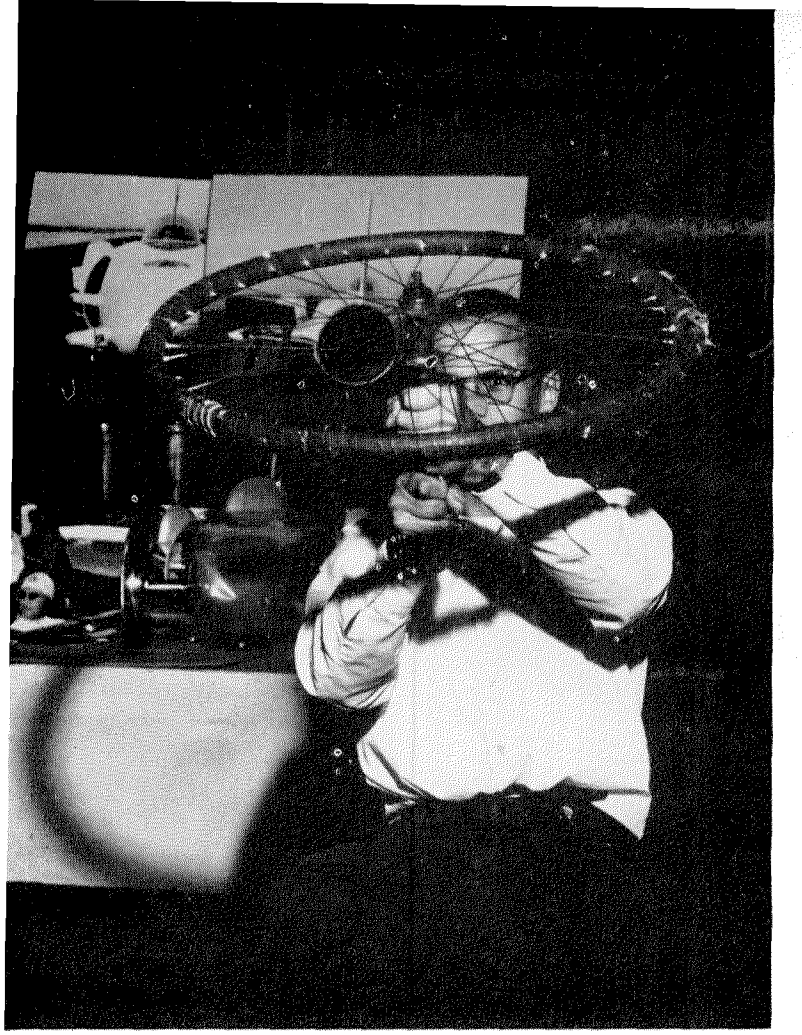




ASSOCIATES' PARTY

ON MAY 18 the California Institute Associates held a spring party on the campus. Starting with a tour of scientific exhibits which had been set up in the Dabney gardens and lounge, the party moved on to Kerckhoff to hear an informal colloquium on some of the important discoveries of science by President DuBridge, Biologist George Beadle, Geochemist Harrison Brown, Physicist Richard Feynman, and Chemist Linus Pauling. To finish off the afternoon, Associates and their guests had a chance to meet the students and staff members who had arranged the exhibits, at a reception on the lawn of the President's house.

Dr. Gunnar Bergman, Assistant Professor of Chemistry and Mechanical Engineering, explaining how X-ray studies make it possible to determine the arrangement of atoms in a solid substance like calcite.

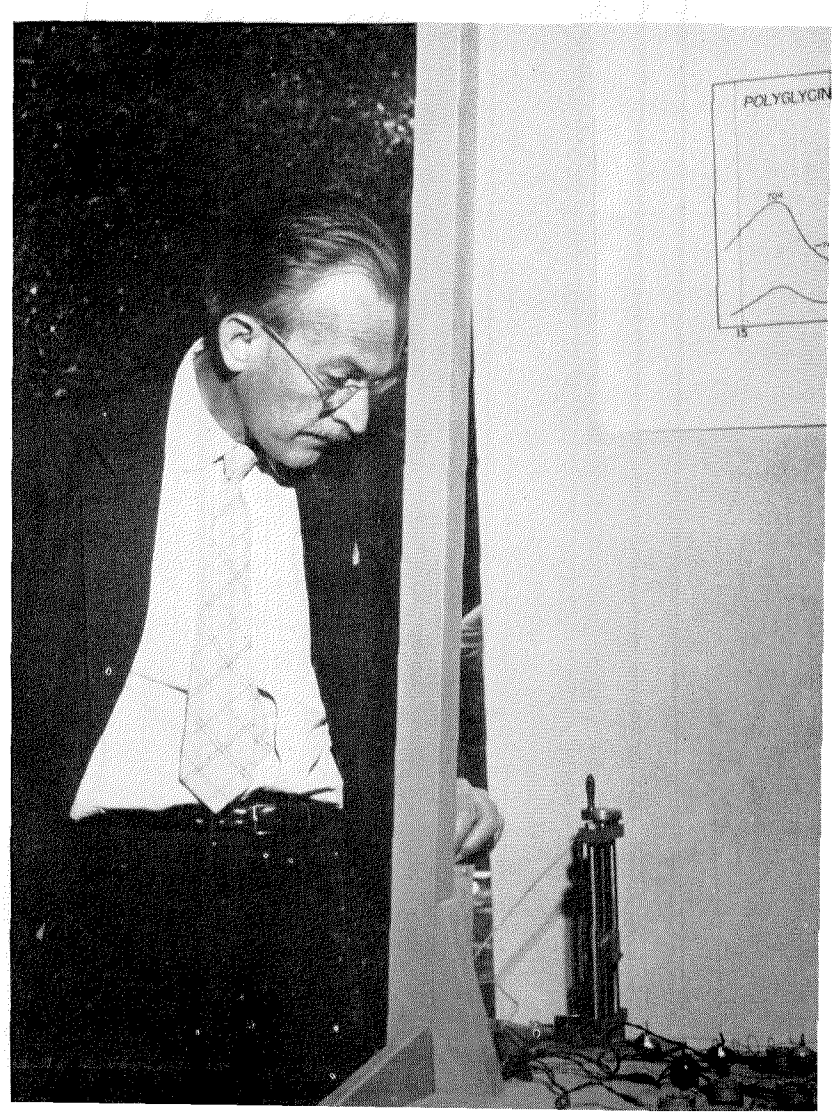


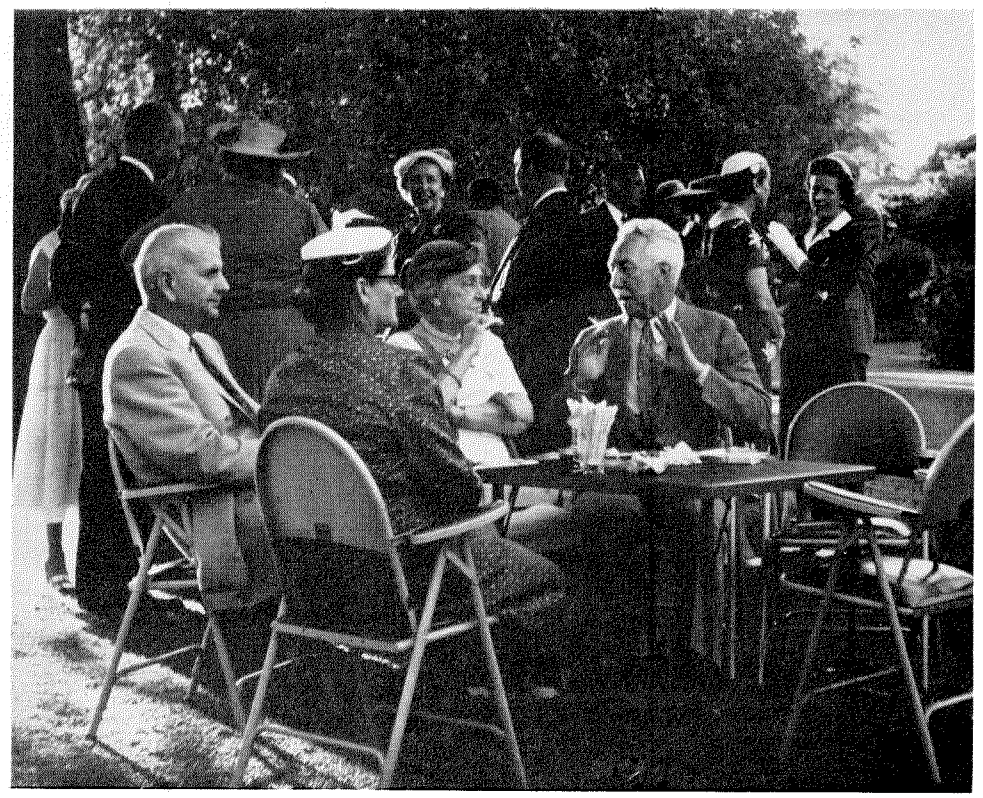
Above: Jumping ring exhibit illustrate the force of two opposing electro-magnets

Left: Student on spinning stool demo strates the principle of the gyroscope.

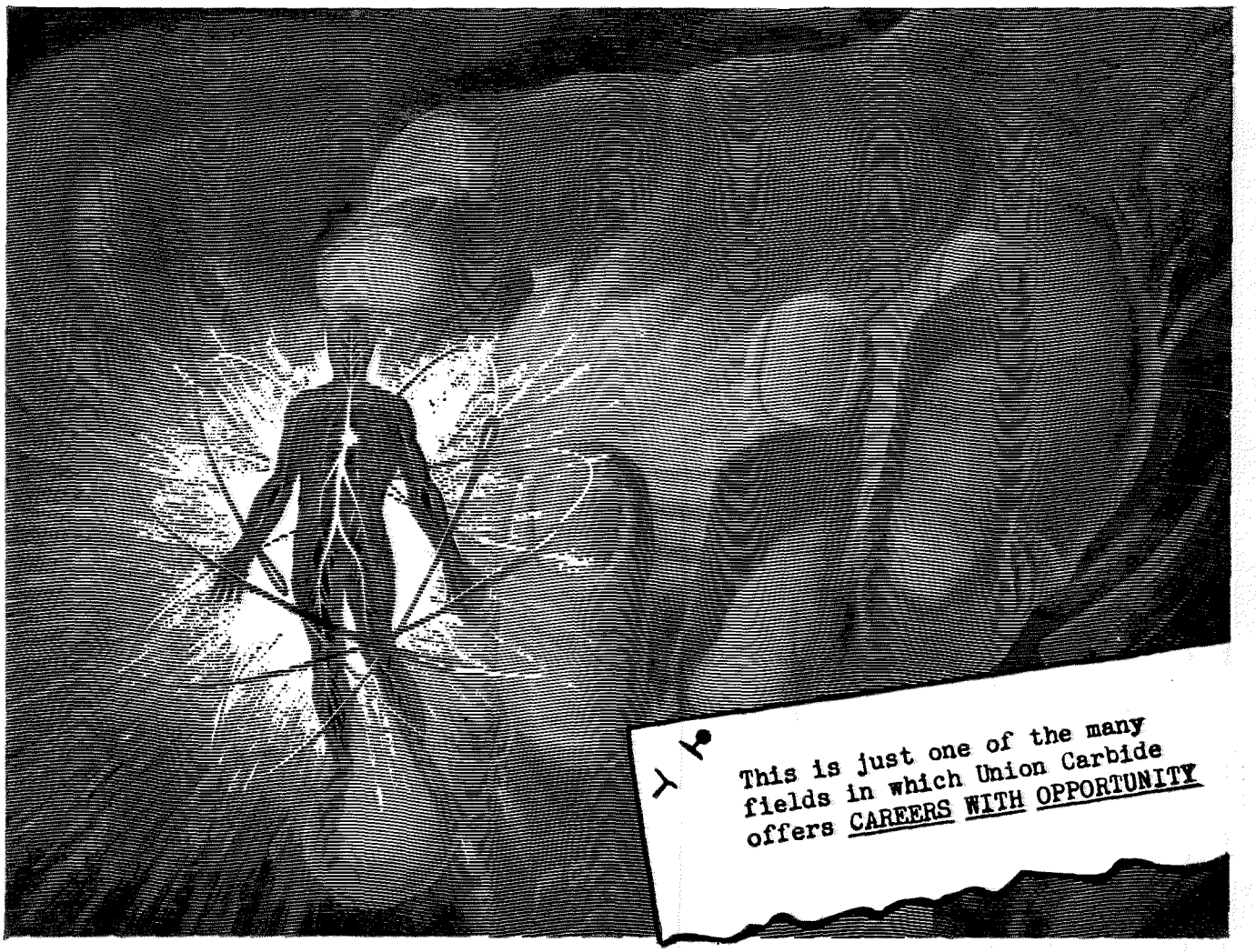
Right: Dr. Richard M. Badger, Professor of Chemistry, demonstrates the vibration of molecules and their absorption of light.

Below: Visitors examine one of the 40 exhibits in Dabney lounge and gardens.





The Associates' spring party winds up with a reception on the lawn of the president's house.



Your health will be better since doctors can now use

the voice of the atom

DOCTORS have long wanted to learn more about the human bloodstream—how it supplies nourishment . . . defends against disease . . . becomes diseased, itself.

THAT WISH IS REALITY today, because atomic energy has given a voice to certain of nature's elements. When these elements are exposed to the powerful radiation of splitting atoms, they become radioactive, themselves, and are called *radioisotopes*. The radiation they give off can be detected and heard with special instruments.

Now doctors introduce isotopes of iodine, iron, sodium, or other elements into the bloodstream. Their course can then be followed to determine the location and nature of the trouble. Isotopes are also becoming increasingly important in actually treating ailments.

ISOTOPES are being used in similar fashion by industry and agriculture to analyze materials, measure wear, control processes, and to help answer mysteries of how plants absorb nourishment from the soil and how it affects their growth and health.

THE PEOPLE OF UNION CARBIDE operate, under Government contract, the Oak Ridge National Laboratory, the Nation's chief source of radioisotopes, as well as the huge atomic materials plants at Oak Ridge and Paducah.

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TURNING POINT

THE SOPHOMORE set his bags down against the wall of the station and walked over to the tracks, looking to the south for some sign of the train.

Choo-choo, he thought happily to himself, choo-choo, and in forty and a half hours I'll he home, two thousand miles away from Pasadena and three months removed from Tech. Choo-choo.

There wasn't any sign of any train. His spirits dampened, he walked back the other way, and then stopped to look toward the east, not toward Mecca but in the direction instead of the Caltech campus, which lay only a mile or two away, over the buildings and down the quiet streets.

Why should I be so glad to get away? he asked himself. You'd think a college kid would hate the summers, would be already anxiously awaiting the beginning of the new year. College years were the brightest of all, and college life was the liveliest of all, and the best—that was the way you were supposed to look at it.

Actually, he wasn't as glad as all that to be going home. He was looking forward to the reunion with his high-school friends (who were scattered in colleges all over the Middle West) and he was looking forward to his job as a relief from the nine-month ordeal of classes. But he certainly was going to miss student house life, and Caltech life, with all its little peculiarities which he was coming to respect.

He tried to evaluate his sophomore year. Socially, he'd shown some improvement, he decided, but not nearly enough. He'd still feel backward at home in the company of his friends who had gone the route of co-education; but he had made strides.

Nothing he had done during this spring term had worked out quite right, the Sophomore realized, but nothing had been a complete failure. He hadn't dated enough, he hadn't horsed around enough, he hadn't studied enough—but somehow he felt that now he was more fun-conscious, more social-conscious, and even more study-conscious than he'd been a few months back.

It suddenly occurred to him that just now, standing on the station platform and evaluating his sophomore year, he hadn't given much more than a passing thought to his academic side.

That was characteristic at Tech, he thought. You just don't worry about the academic side when you're at Tech. You can count on that to take care of itself; your real responsibility is to develop your other sides, to try to keep pace in every other way with the students at other colleges whom you are outdistancing in a scholastic way.

We take it for granted, he thought, following the idea along, that we're learning. Emphasis on studying disappears; emphasis on grades becomes more obvious, for the simple reason that *you know* you're learning but only grades can communicate that fact to other people, people who don't know Caltech.

The thing is, the Sophomore decided with a sudden rush of feeling, that what you *don't* know can really hurt you. You *can't* be sure when you're at Caltech that you're learning to live with other people, that you're learning the enjoyment and appreciation of life that is really the most important aspect of an education.

What a splendid rationalization! he smiled to himself. Or maybe it's the *truth.* But anyway, it was a good operating hypothesis. It was Caltech's responsibility to make him a good scientist or engineer, he decided, and it was his own responsibility to make himself a good citizen and a well-rounded human being.

Well, Caltech was coming through. There was no getting around it; he knew a hell of a lot more now than he'd known a year back. Science had lost its glamor for him, but he still felt at home with a technical education.

And if *he* wasn't coming through with his part of the bargain, well, by gosh, now was the time to start. Three summer months at home, among people I know, in places I know, learning what I want and how to get it. That ought to he the turning point.

Pretty logical turning point—half way through his college days. It *did* seem like the Big Fork in the Great Highway of Life, and he was determined to return to Pasadena in the fall far more alive, far more alert, far more *conscious* than he'd ever know how to be before.

Down the tracks to the south, a glint of steel heralded the approach of the streamliner, and the Sophomore—now a Junior—stopped philosophizing, and began to hum a tune.

"Sweet Chariot," he murmured to himself, "comin' for to carry me home."

—*Marty Tangora '57*

EYE-EXAM for a BATTLESHIP

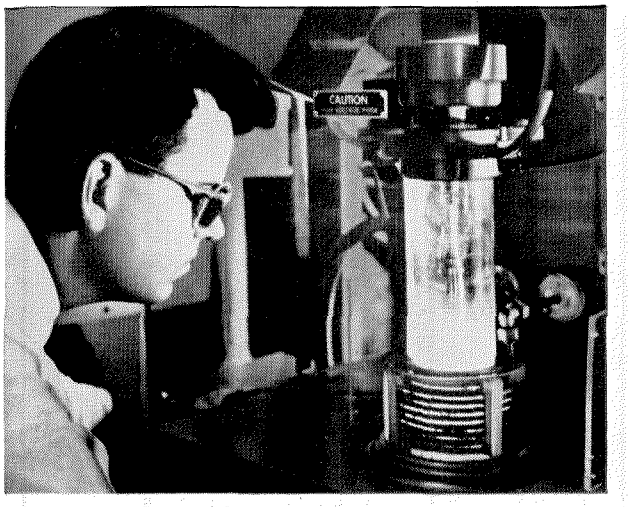
Western Electric field engineers supervise installation of complex electronic equipment made for Armed Forces

Marco Polo had nothing on Western Electric's field engineers. They travel the world to advise on use, installation and maintenance of the electronic equipment we produce for the Armed Forces . . . like radar bombing systems, anti-aircraft fire control systems, and the Nike guided missile control system.

Western Electric is called upon to make these things because of its vast experience with highly complex electronic equipment as the manufacturing unit of the Bell System. It's a job that presents an unending challenge to our engineering staff.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM



Western product and development engineers are responsible for turning out some 50,000 different items annually for the Bell System – everything from tiny transistors to giant bays of electronic switching equipment. Shown is one stage of transistor manufacture.

ALUMNI NEWS

Annual Meeting

A RECORD NUMBER of 373 alumni met at the Elks Club in Pasadena for the Annual Banquet and Meeting on June 8. President DuBridge reported to alumni on developments at the Institute during the past year—and announced that for the second consecutive year the Alumni Association would make a gift of $15,000 to the Institute in support of an Alumni Scholarship Endowment Fund. The gift adds to a fund whose income will be used to provide four-year tuition scholarships for worthy undergraduates.

Speaker of the evening was Robert L. Minckler, president of General Petroleum Corporation and Caltech trustee, who talked on "Progress in Management."

C. Vernon Newton '34 took over as president of the Alumni Association. New vice-president is William F. Nash, Jr. '38. Donald Clark '29 and George B. Holmes '38 remain as secretary and treasurer.

Newly-elected members of the Alumni Board of Directors for two-year terms are Robert H. Bungay '30, Richard H. Jahns '35, Willis R. Donahue '34, and Richard W. Stenzel '21.

Reunion classes this year included 1915, 1920, 1925, 1930, 1935, 1940, 1945 and 1950.

The class of 1920 celebrated its 35th anniversary at the Alumni Banquet, with a turnout of 11 members—nearly a third of the class. Those present gave the following rundown on what they are doing today, 35 years after leaving Tech:

James R. Black	General Traffic Manager, Pacific Telephone Co., Los Angeles
Virgil H. Best	Machine design and construction, self-employed
R. H. Duguid	Retired after 34 years with the Pacific Electric Railway
E. Victor Hounsell	Staff Engineer—Pacific Telephone Company, Los Angeles
Theron C. Hounsell	Electrical Engineering Associate, Dept. Water & Power, L.A.
Harvey W. House	Laboratory Director—Nat'l. Clay Pipe Mf'rs. Assoc., Los Angeles
Mark A. Sawyer	Protection Engineer, Pacific Telephone Company, Los Angeles
R. Carson Smith	Realtor, Santa Ana, California
George O. Suman, Jr.	General Superintendent, Tidewater & Assoc. Oil Co., Ventura
Ernest H. Swift	Professor of Analytical Chemistry, Caltech
George K. Whitworth	Deputy City Attorney, Dept. of Water and Power, Los Angeles
Robert Knapp	Professor of Hydraulic Engineering, Caltech.

National Academy

THREE CALTECH ALUMNI were elected to the National Academy of Sciences this spring, bringing alumni membership in the organization to 24. The new members: Paul H. Emmett, PhD '25, John R. Pierce, BS '33, MS '34, PhD '36, and Saul Winstein, PhD '38.

Paul Emmett, who has been a Senior Fellow at the Mellon Institute since 1944, was graduated from Oregon State College in 1922 and received his PhD at Caltech in 1925. After a year as instructor in chemistry at Oregon State College, he spent 11 years as a chemist at the Fixed Nitrogen Laboratory of the U.S. Department of Agriculture. From 1937 to 1944 he was Professor of Chemical Engineering at Johns Hopkins University.

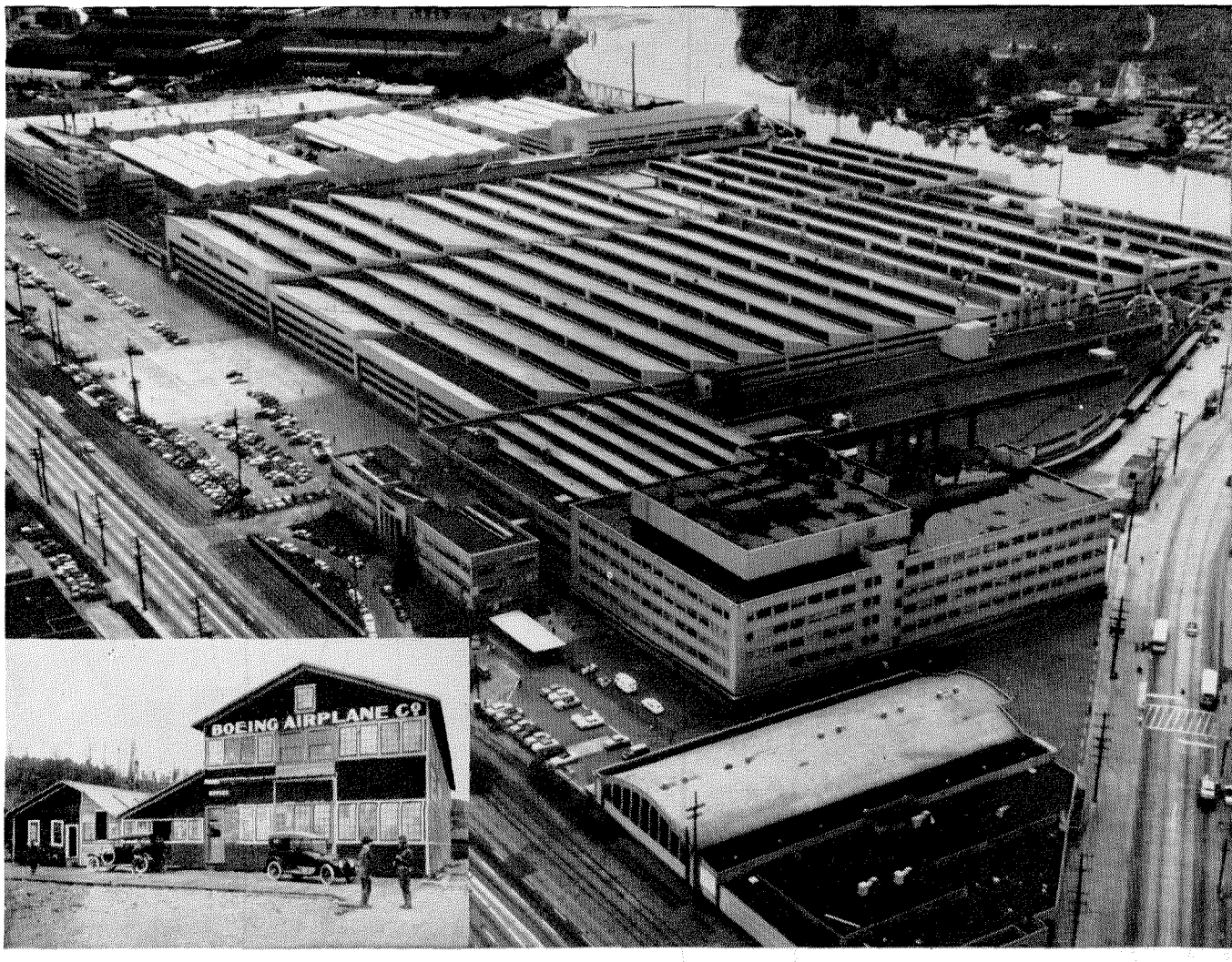
His researches in physical chemistry related to catalysis and surface chemistry have gained wide recognition for Dr. Emmett, and his studies of low-temperature (physical) absorption supplied the missing piece of "key" information needed by catalytic chemists for some 20 years—a method of determination of surface areas. This discovery led to the now famous Brunauer-Emmett-Teller (BET) method.

John R. Pierce joined the Bell Telephone Laboratories as a member of their technical staff immediately after receiving his PhD in electrical engineering in 1936, and he is now Director of Electronics Research at the Labs. In 1942 he received the Eta Kappa Nu Award for being the most outstanding young electrical engineer of the year, and he also received the Morris Leibmann Memorial Prize of the Institute of Radio Engineers.

Dr. Pierce's research has been in the field of electron dynamics and in the interaction of time varying fields with electron beams. He is probably most widely known for his development of the traveling wave tube idea into a useful device, which has led to some of the most significant new developments that have occurred in microwave electron tubes since the end of World War II.

Saul Winstein was born in Montreal and came to the United States at the age of 10. He was graduated from UCLA in 1934 with highest honors, and received his PhD from Caltech in 1938. He has been a member of the UCLA chemistry department since 1942, his special field being studies of rearrangements of molecules.

During the war he was director of research on a gov-

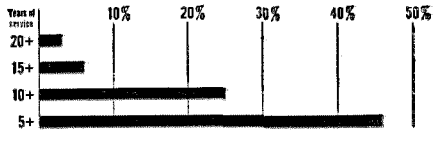


1916—The first Boeing plant, Seattle

1954—Boeing's Seattle plant as it appears today. New Engineering Building is shown in foreground.

Is career stability important to you?

Then the chart below will be of interest. It shows that 46% of Boeing's engineers have been with this company for five or more years; 25% have been here 10 or more years, and 6% for 15 years.



One reason for this stability is that Boeing has grown steadily for 38 years, providing plenty of room for advancement. Another reason is the highly interesting type of work at Boeing, such as designing and building America's first jet transport and the revolutionary B-47 and B-52 jet bombers, as well as work on pilotless aircraft, supersonic flight and research in nuclear-powered aircraft.

Still another reason is this: Boeing always has put dominant emphasis on engineering development. Pioneering in this field has meant that Boeing constantly has increased its engineering staff in relation to total employees. Fifteen years ago, one out of 16 employees was in engineering. Five years ago the proportion of engineers had been raised to one in ten and today it has climbed to one in seven.

Boeing has rewarding openings for engineers of EVERY category—electrical, civil, mechanical, aeronautical and related fields, as well as for applied physicists and mathematicians with advanced degrees.

Careers at Boeing afford a wide variety of experience in research, design and production, as well as work with new materials and techniques, and contacts with a cross section of industry through Boeing's vast subcontracting program.

Boeing promotes from within and holds regular merit reviews to assure individual recognition. Engineers are encouraged to take graduate studies while working and are reimbursed for all tuition expense.

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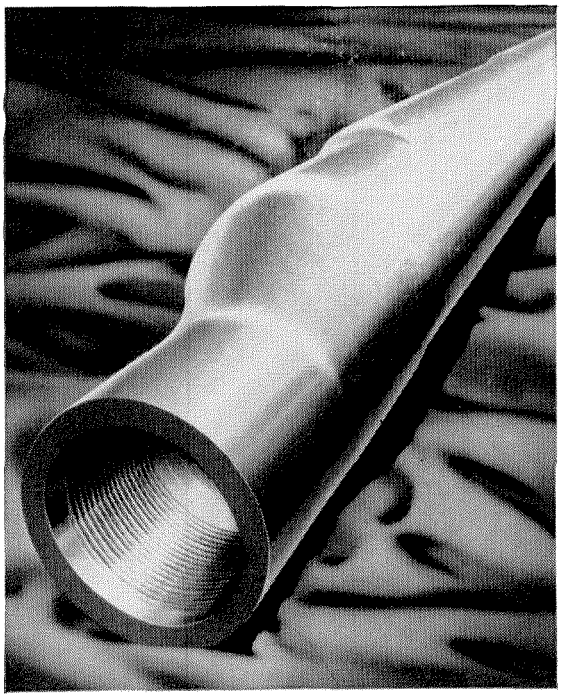
ernment contract investigating treatment of malaria. In 1948 he won the American Chemical Society's $1000 award in Pure Chemistry. During the past year he has been serving as Faculty Research Lecturer at UCLA, the highest faculty honor on that campus.

Caltech alumni previously elected to the National Academy of Sciences, aside from those on the Caltech staff, include: Robert B. Brode, PhD '24, Sterling B. Hendricks, PhD '26, Edwin M. McMillan, MS '29, Joseph E. Mayer, '32, Wolfgang K. H. Panofsky, PhD '42, Kenneth S. Pitzer, '35, William B. Shockley, '32, E. Bright Wilson Jr., PhD '33, and William G. Young, PhD '29.

Other alumni elected to membership in the Academy, and now on the staff of the Institute, total 12. They are: Carl D. Anderson, BS '27, PhD '24, Richard M. Badger, BS '21, PhD '24, Hugo V. Benihoff, PhD '35, James F. Bonner, PhD '34, J. W. M. DuMond, BS '16, PhD '29, Charles Lauritsen, PhD '29, Linus Pauling, PhD '25, H. P. Robertson, PhD '25, Oliver R. Wulf, PhD '26, Don M. Yost, PhD '26; and from Mt. Wilson and Palomar Observatories, Horace W. Babcock, BS '34, and Ira S. Bowen, PhD '26.

Another page for **YOUR STEEL NOTEBOOK**

Steel that saves two days' time two miles down



The oil in an oil well is forced to the surface by the injection of gas under pressure. The valves used to regulate that gas take terrific abuse. When they wear out and need replacement, oilmen have to haul up perhaps two miles of pipe—unless they use the valve housing shown here. Its valves can be changed from ground level by lowering special tools down the tubing on a wire. These housings must withstand 6,000 pounds per square inch. Ordinary steels failed under inspection test. Others cracked during heat treat.

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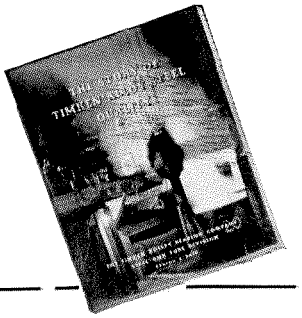

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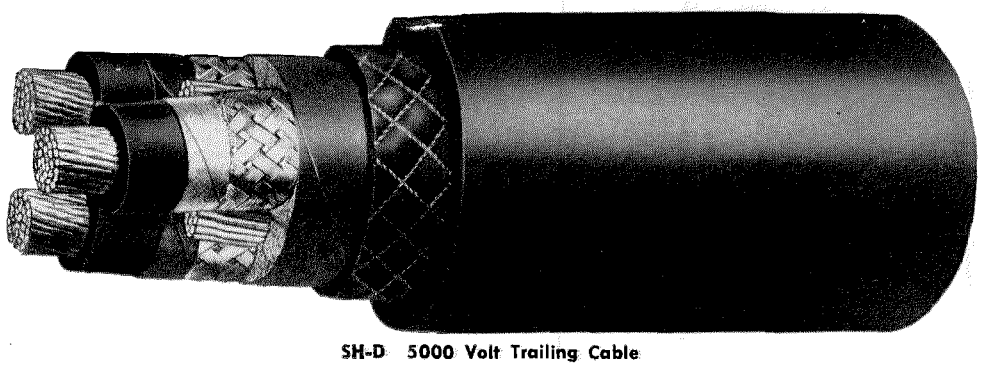

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PERSONALS

1920

George O. Suman, who has spent many years with the Tide Water Associated Oil Company, was appointed general superintendent of their coastal district last July, with headquarters in Ventura, California. "I find the people and the climate most agreeable," George writes, "And since coming to Ventura have a new wife, Sally. Also became a member of the Satroy Country Club and am busy chasing the elusive golf ball at times."

1925

Neale D. Smith has been living in Santa Rosa, California, for the last year and a half, and is employed as county administrator of Sonoma County. Neale remarks that his three grandchildren make him aware of just how quickly time passes by.

1926

Robert Burt, PhD, and his wife Eleanor, have been traveling for the past year—first through Australia and New Zealand, and now in Europe. " . . . We followed spring south 3,000 miles in November from the Great Barrier Reef of Northern Australia to the southern tip of Tasmania," Bob writes. "For three months we explored New Zealand, 5,000 miles in our Holden car. First, the North Island with its famed Bay of Islands . . . jungles of tree ferns and giant Kauri treees, said to be older and larger than our Sequoias; Auckland . . . and the unique thermal region of Rotura.

"Flying back to Australia we boarded the SS Orsova for Europe on March 14th. After a day of sunshine in Naples, we disembarked at Marseilles for six weeks on the Riviera."

1928

Edward E. Tuttle has been elected a director of the Hycon Manufacturing Company of Pasadena. Ed, who is a partner in the Los Angeles law firm of Tuttle, Tuttle and Taylor, is the legal counsel for Hycon. He is also executive vice president of the Essick Manufacturing Company, which makes construction equipment and vapor air conditioners.

1933

Robert R. Mead was recently appointed district manager for the Ethyl Corporation, with headquarters in Dayton, Ohio.

1939

Ronald Connelly, who is living in San Francisco, writes: "I have been in the Bay Area for so long now (15 years) that I feel as though I were a native. The last 10 years have been occupied with work at the San Francisco Naval Shipyard as supervisor in electronics design. A baby girl born March 11th has pushed other activities such as house-building and square dancing to a very low priority for my wife, Barbara, and me."

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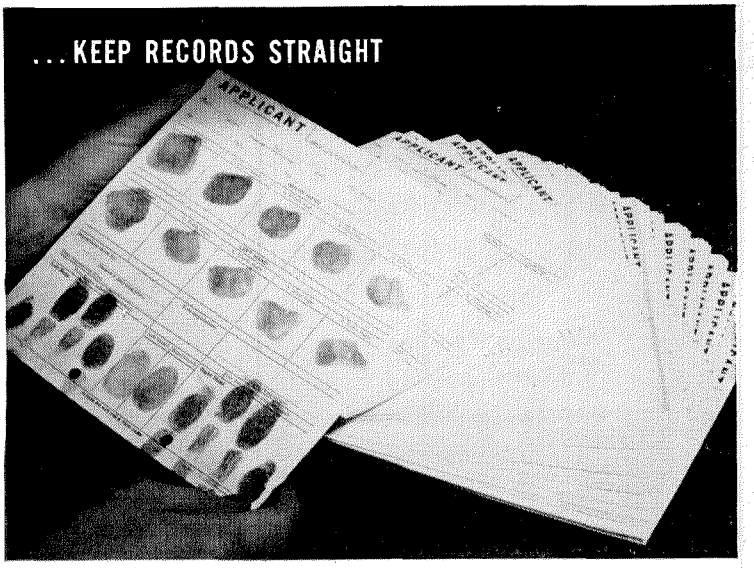

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PERSONALS . . . CONTINUED

1940

John C. Kupfer writes from Claremont, Calif., that he is planning to leave the U. S. Geological Survey this summer to teach geology at Louisiana State. John and his wife now have two children—their new boy having arrived last February.

1941

Dr. Harold K. Fink, MS, a psychoanalyst in private practice, has a new book, *Long Journey* (Julian Press)—the true story of a troubled young man's psychoanalysis. Last year Dr. Fink published another book, *Mind and Performance*, a comparative study of learning of mammals, birds and reptiles. He has been in private practice since 1945, and presently conducts classes for executives in industry at the Brooks Psychological Institute.

1942

Pichel W. Pichel has joined Solar Aircraft as an experimental engineer. Before joining Solar, he had been with the Aerojet-General Corporation in Azusa for more than six years, and had served as project engineer for the past three years. The Pichels have a daughter, Robin, 10, and live in Rancho Santa Fe, California.

Peter L. Nichols, Jr., PhD, is now a section chief at Caltech's Jet Propulsion Lab. Peter is in charge of a newly created section devoted to "Solid Propellant Chemistry." He has been at JPL since 1950.

1943

William H. Halpenny and *John A. Zivic*, '44, were recently appointed project engineers for the Hunter Engineering Company of Riverside, California. For Bill this means a return to his home town, as he went to school in Riverside. Before joining Hunter he was project engineer for the Fluor Corporation of Pasadena, and had to do quite a bit of traveling. Last year he spent several months each in Alaska, South America, and Canada.

John has been with the Naval Ordnance Test Station at Inyokern, California, ever since his release from the Navy, where he held the rank of lieutenant commander.

1944

Ruben F. Mettler, MS '47, PhD '49, was married early in May to Donna Jean Smith of National City, California, and they are now living in Brentwood. Ruben joined the Ramo-Wooldridge Corporation of Los Angeles last March as director of Ad-

vanced Systems Planning and director of the Systems Engineering Staff.

1946

Richard Lagerstrom is working for his PhD in electrical engineering at Stanford, and if all goes as planned he will be receiving the degree this year. Dick and his wife Bobbie have a two-year-old son, Jeffrey, and are expecting another family addition in November.

1947

Roderick K. Clayton, PhD, will be spending the summer at the Marine Biological Laboratory at Woods Hole, Massachusetts, studying on a Lalor Fellowship.

1949

William N. Harris just received his commission as an Ensign in the U. S. Navy at the Newport, R.I., Officer's Candidate School. Bill will now be serving three years in the Civil Engineers Corps, starting with two months of school at Port Hueneme, California.

Kenneth W. Gardiner received his MS from MIT last year, and is now working for the Stanford Research Institute of Menlo Park, California. Ken was married in July, 1953, and now he and his wife have a nine-months-old daughter.

Hardy C. Martel and his wife Jean became parents for the first time when Jeffrey Charles was born May 9. Hardy is an instructor in Electrical Engineering here at Caltech.

1950

Edward M. MacKevett, MS, writes: "Since leaving Caltech I've been employed as a geologist with the Mineral Deposits Branch of the U. S. Geological Survey. The past few years I've worked mainly in Inyo County, California, principally in the Darwin Quadrangle. This summer I'm scheduled to map in the southern Sierra Nevada. My wife and I are living in San Jose and have a daughter, Patricia Ann, 2 years plus."

Edsel A. Worrell is now working for the Westinghouse Electronics Division at Baltimore, Maryland. He was married last April to Louise Neuhaus in Baltimore.

1951

Richard Brewer was employed as a propellant chemist at Aerojet right after graduation, and he stayed with them until 1953, when he decided to work on his doctorate at the University of California in Berkeley. Right now all Dick's plans have been interrupted by a two-year hitch in the Army.

William Roberts, MS, and his wife Lorraine, report the birth of "Our First Little Rockhound"—son Randolph, who arrived in February.

1952

Donald Stewart, MS '53, is on military leave from Standard Oil of California in San Francisco, where he was employed in the engineering department. Don's going to be in the Army until July, 1956, but what with a 40-hour week, off-quarters living, and allowances, he says the Army is *almost* bearable. He's serving with the Headquarters Material Command in Baltimore.

1953

Duane Marshall is living in Menlo Park, California, and writes: "Same job at Hewlett Packard. Going to Stanford part time . . . get MS in June. No school plans for next year. April 13, '55, we had a boy, named Lance. Other two children, Scott, 3, and Dana, 2, are doing fine.

"Bought a house in Los Trancos Woods . . . a genuine community of civilized, moonshine mountaineers. Have long since sold my assorted motorcycles, but am still sticking to old cars for awhile. During the summer I bicycle the 9.1 miles to work.

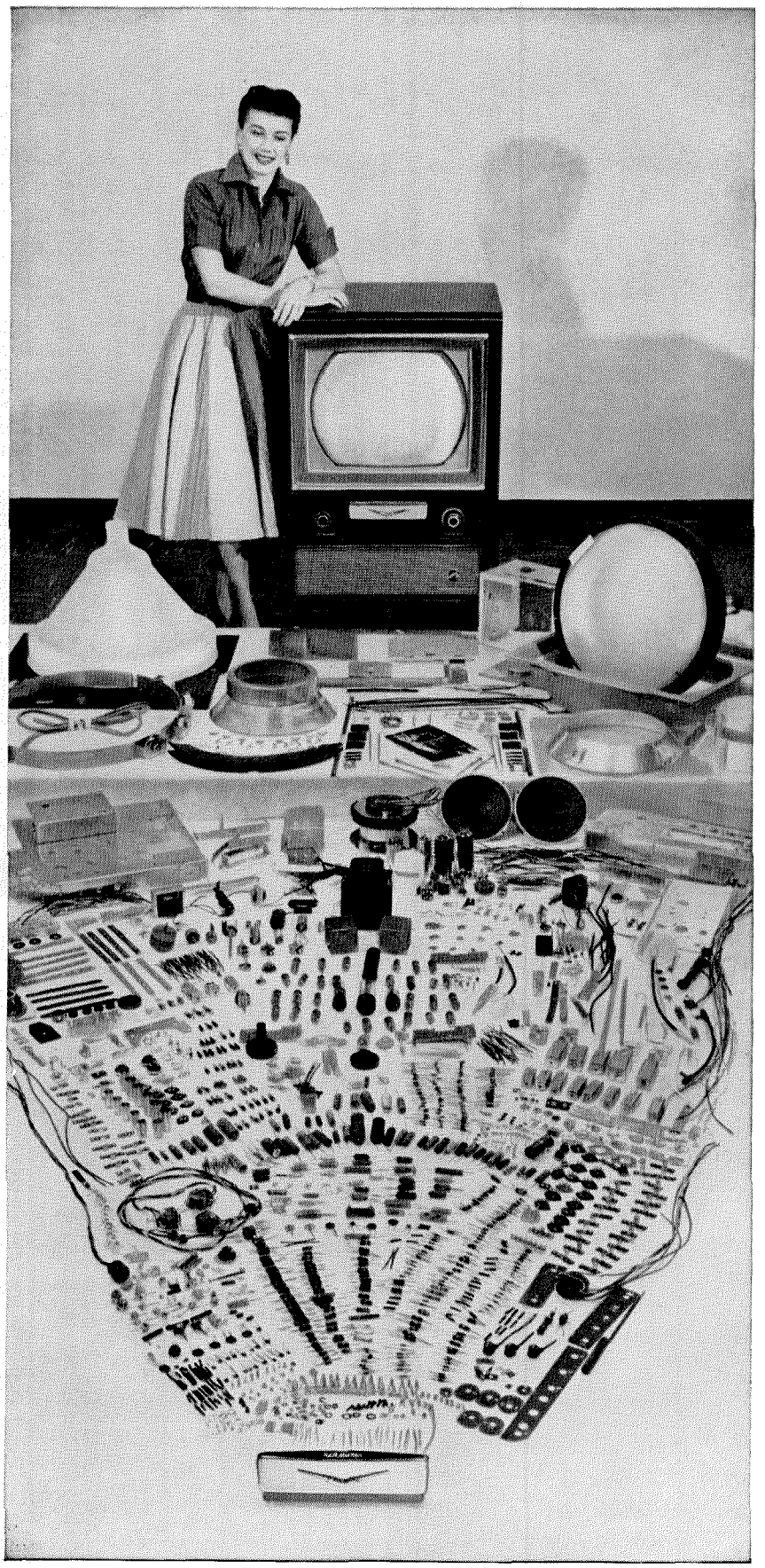
"Recently I was thrown off the bike on a bad road and bridge—broke my arm and still have it in a cast. Just got my foot out of a cast—had some missing ligaments replaced in my ankle."

John Wilson came back to visit the Caltech geology department a few months ago, and reported that he had just completed his requirements for an MS in geology at Kansas University. He now plans to work as an independent consulting geologist in the vicinity of Fremont County, Wyoming.

1954

Francis W. Joyce is returning to Los Angeles this month to begin working for Dames & Moore, right after he receives his MS from the Harvard Grad School. Francis and his wife have two boys, the youngest born a week after he graduated from Tech. "I have been seeing many Tech men at Harvard," Francis writes. "About 10 people of the class of '54 are here, plus others from earlier classes."

Gordon Zentner sends in the following: "Working for Shell Oil Company, presently in Bakersfield, California. Have been in Nevada, Utah, Arizona in the past two months. Was in Ventura, California, last winter with *J. T. Billings*, *Hans Mol*, *Bruce Watkins*, *Bob Olson*, (all class of '54), and *Leon Michaelson*, *Pat Fazio* and *Wahi Ghauri*, (all class of '53). To be married to Elizabeth Walker of Glendale on June 26th."



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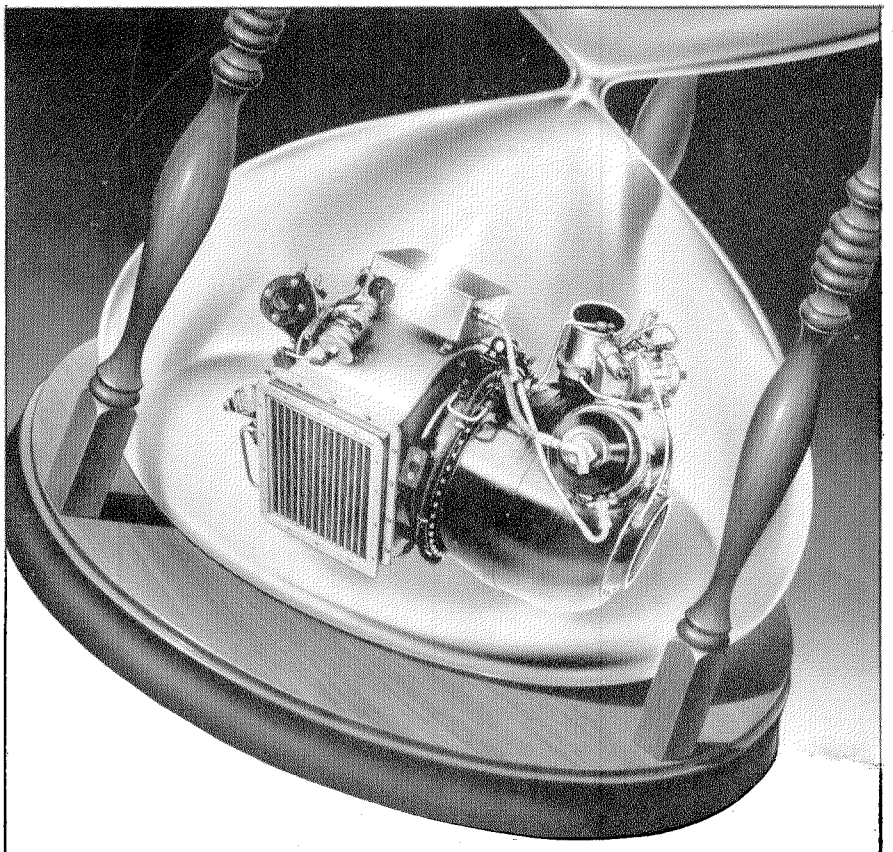

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