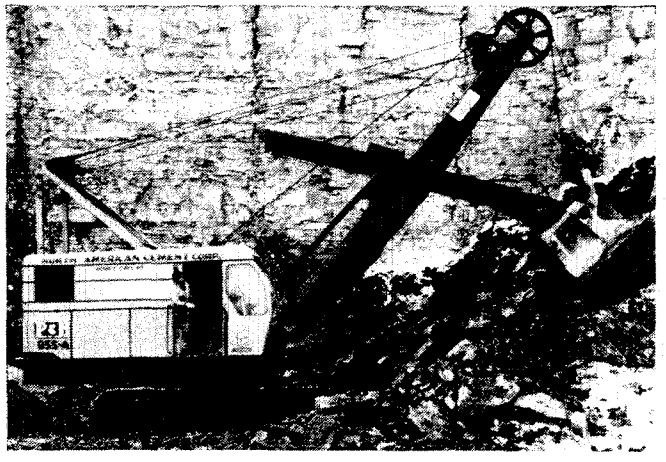
ENGINEERING | AND | SCIENCE

JUNE / 1951

Commencement . . . page 14

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Another page for **YOUR BEARING NOTEBOOK**



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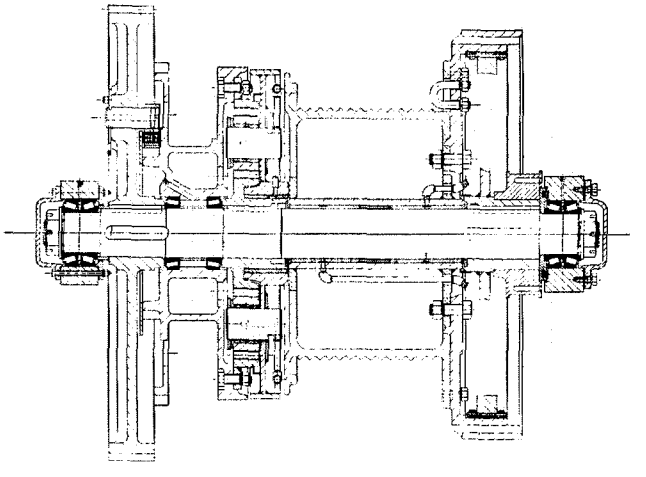

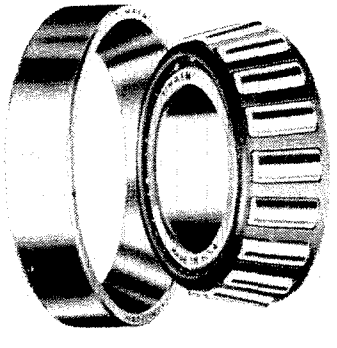

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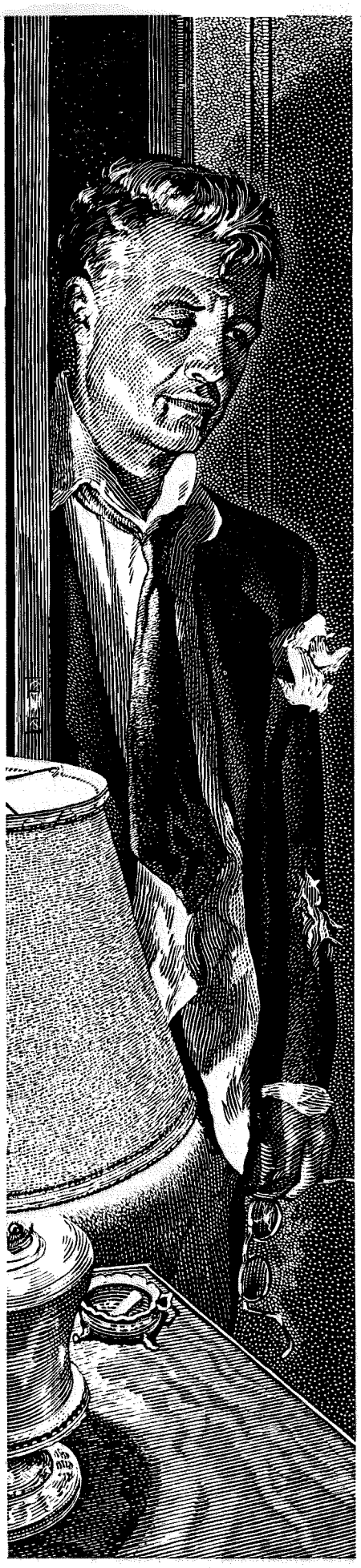

"I spoke up at town meeting

"This picture shows how I *didn't* look when I got home. Actually, *nobody* laid a finger on me.

"But I *did* speak up at Town Meeting that night . . . something I didn't like about the way town funds were being spent. I'm not much of a guy for making speeches, understand . . . I just work in a steel mill. And both we and Republic have a big stake in this town.

"But nobody beat me up! Now, you might say, what's so unusual about me *not* getting beat up for speaking out against the local government?

"That's just my point...it *isn't* unusual! Not in this country. Here we *all* have free speech. It's part of our Constitution, even if we hardly ever think about it twice. But just think of the folks in other countries . . . billions of 'em, maybe . . . who'd give their right eye to be American citizens and talk out at town meetings. Or, if they want, from a soapbox. And *not* get slugged.

"Ever stop to think that while all these people are trying to get *into* America, nobody here is trying to get *out?* That's because we like it here. No, not just because we've got autos and phones and bathtubs and all that. The real reason is . . . *we've got Freedom!* Seven days a week! We're free to follow our own religions . . . free to choose our own jobs in any industry we like . . . or go into business for ourselves, if we prefer. We can vote as we please . . . or *not* vote if we want. Though I personally think anyone who doesn't is a 14-carat dope.

"And here, like I said, you can talk up at Town Meeting. No black eye. No bloody nose. Though, if you don't know what you're talking about, you'll be in for a lot of kidding later.

"Now *this* is no Town Meeting, of course . . . it's an ad. But, in this ad, I *am* speaking up . . . for Freedom. Corny? Maybe . . . but I happen to believe in it. And 10 to 1 you do, too!"

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BOOKS

THE NATURE OF THE UNIVERSE
by Fred Hoyle
Harper & Brothers,
New York, $2.50

Reviewed by Robert S. Richardson
Mount Wilson and Palomar Observatories

ABOUT 1945 a mysterious group of individuals known to the world only as THEY decided that women's clothes should undergo a radical revision called the New Look. Women were informed that they could either adopt the New Look and be in style or resist and be old fuddy-duddies.

After reading *The Nature of the Universe* I experienced much the same reaction that many women felt when the New Look was thrust upon them. The book, which developed from a series of broadcasts delivered about two years ago, deals with the New Cosmology (the capitals are the author's). In this case, THEY consists of Fred Hoyle of Saint John's College, Cambridge, England, and his associates. Without explicitly saying so it is implied that unless you adopt the New Cosmology you are definitely a back number.

Apparently THEY have discussed the nature of the Universe at great length, weighed the various alternatives in the balance, and decided that it *must* function in a certain manner. Why? Well, because there just simply isn't any other way that it *can* function.

The style in which the book is written constitutes both its strength and its weakness. Hoyle writes with such fervor that it would be a dull reader indeed who was not lifted up and carried along with him. In effect, he says, here is a subject that is tremendously important to me, and he holds your attention because you feel that he could not write with such enthusiasm unless the subject were important to you, too. In seven short chapters he tells you about the origin and destiny of the solar system, stars, galaxies, and the Universe. In such a brief space these subjects can barely be touched upon, yet you arrive at the end a trifle breathless and dizzy but still feeling that you have been somewhere and retained a good deal regarding the significance of the places you have visited.

On Speculation

The irritating thing about the book is the arbitrary way in which material of a highly speculative nature is presented. An uninformed reader would certainly gain the impression that astronomers are generally agreed upon the majority of the statements made.

For example, on page 26 of the first edition Hoyle says, "When you look at the heavens, how many of the stars you see have planets encircling them and on how many of these planets might living creatures look out on a very similar scene? To give a numerical estimate I would say that rather more than a million stars in the Milky Way possess planets on which you might live without undue discomfort."

Now aside from the sun, we do not *know* that there is a single star in the Universe with a planet encircling it on which we might live in comfort. Often we find it hard to live in comfort on the planet of the only star that we do know anything about.

Some of Hoyle's remarks, besides being arbitrary in tone, are curiously worded. Thus, in describing a brand new theory of the origin of the lunar craters by Gold, which "is almost certainly correct," he speaks of the "lower parts of the moon." This is the first time that most of us were aware that our satellite had any such appendages. (Incidentally, have Proxima and Alpha Centauri been displaced from their position as the nearest stars to the sun at 4.3 light years? On page 53 it is stated that light takes about three years to travel to us from the nearest stars.)

The most interesting concept in the New Cosmology is the continuous creation of matter, an idea which it is said represents the ultimate goal of the book. This assumption is needed to account for the fact that the Universe consists almost entirely of hydrogen. For unless hydrogen is being created continuously to replace that converted into helium it would all have disappeared long ago. Hence the Universe is under the necessity of creating hydrogen in somewhat the same way that the government is compelled to keep issuing new greenbacks to replace those that are worn out.

This spontaneous creation of matter out of nothing sounds incredible at first, but, as Hoyle remarks, is it any less palatable than other ideas of the creation of matter such as the big bang hypothesis, for instance?

The Word

The last chapter contains Hoyle's strictly personal views on the general philosophic issues that come out of his survey of the Universe. Here he never hesitates to meet difficult questions head-on. He neither hedges nor does he discuss them in such generalized terms that they cease to have any practical meaning. Instead he gives with simplicity and candor his ideas on man's place in the Universe, the cosmology of the Bible, and survival after death.

The Nature of the Universe was originally published in the United States in *Harpers Magazine*, where already it has attracted wide attention. The book can be recommended as by far the most interesting popular commentary on cosmology that has appeared recently, if it is read with reservations. Hoyle believes that the conception of the Universe described in this book is correct in its main essentials: that our conception of the Universe 500 years hence

CONTINUED ON PAGE 6

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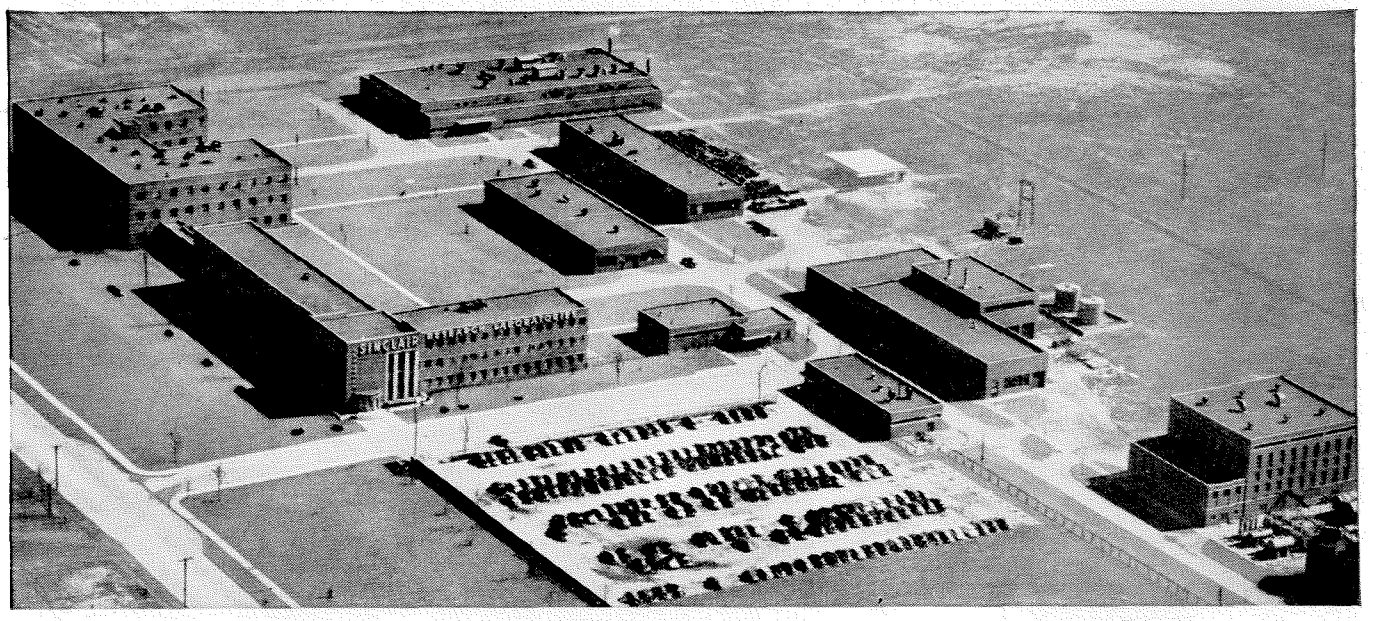

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The SINCLAIR PLAN will open up the Company's great laboratories to every American who has an idea for a better petroleum product

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Instructions on how and where to submit ideas under the Sinclair Plan are contained in a complete Inventor's Booklet that is available on request. Write to the office of the Executive Vice-President, Sinclair Research Laboratories, Inc., 630 Fifth Avenue, New York 20, N. Y. for your copy of this booklet.

IMPORTANT: *Please do not send in any ideas until you have sent for and received the booklet of instructions.*

SINCLAIR—A Great Name in Oil

ENGINEERING | AND | SCIENCE

IN THIS ISSUE

This month's cover shows some of the men of the class of '51, as they received their final instructions on Commencement Day, just before joining the academic procession. You'll find a report on this year's Commencement—the 57th, incidentally—on page 14 of this issue.

Thomas K. Finletter, Secretary of the Air Force, was this year's Commencement speaker. His speech, which we have taken the liberty of titling, "The Prospect Before Us" (Secretary Finletter didn't give it any title at all) appears on page 7 of this issue. We think it's one of the best Commencement addresses we've ever heard, and (though this is a quality not generally required of a Commencement address) one of the most realistic.

Speaking of Commencement—have you ever wondered how the cap and gown came to be the correct dress for scholars on parade? Do you know what the difference is between a bachelor's, master's and doctor's outfit? Do you have any idea what the colors mean on a hood?

You'll find the answers to such miscellaneous questions in the article, "Who's Who in Academic Gown," on page 12. The author, Ali Bulent Cambel, is now Assistant Professor of Mechanical Engineering at the State University of Iowa. He received his M.S. degree from Caltech in 1946.

PICTURE CREDITS

Cover	Robert Spencer
pps. 7, 9, 12, 14	Robert Spencer
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p. 22	Barry Bieler

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will still bear an appreciable resemblance to that of the Universe of today.

The New Look survived about two years. Will the New Cosmology have a longer lifetime?

COSMIC RAYS
by Louis Leprince-Ringuet
Prentice-Hall, New York, $6.65

Reviewed by Carl D. Anderson
Professor of Physics

PROFESSOR LE PRINCE-RINGUET'S fascinating little book *Cosmic Rays* is intended for readers who are not specialists in cosmic ray research. It assumes little more knowledge on the part of the reader than do most of the so-called popular books on science. Within its 270 pages, however, it does present a clear and interestingly written introduction to the whole subject of cosmic rays. Its outline is in general historical, and while the subjects treated include such highly theoretical and abstract matters as special relativity and meson field theory, it is for the most part a qualitative description of notable pieces of experimental work selected by the author from the very extensive history of research in cosmic rays. The properties of the elementary particles of matter—protons, neutrons, mesons, electrons, etc.—are discussed in some detail.

For a completely authoritative book on a scientific subject it is written in a lively and personal style. The book will reward the reader with some very definite impressions. He will realize, for example, the magnitude of present-day research in cosmic rays, and what an extensive, important and complex subject it is. He will appreciate how many important advances in our basic understanding of atomic and nuclear physics have resulted from cosmic-ray research. In some measure this book will reveal to the reader that research in physics is dramatic and fascinating, and that at times it can be as exciting and adventuresome a pastime as any exploration in a far-away jungle.

One of the book's most appealing features is the large number of illustrations, including many dozens of track photographs of the particles of cosmic rays made in cloud-chambers and in photographic emulsions, and many laboratory scenes in mountain locations or in balloons and airplanes.

The author is himself a distinguished French scientist, professor at l'Ecole Polytechnic, and a member of the select French Academy of Science. At the present time he leads the largest and most active group in France engaged in cosmic-ray research. He has made many important contributions to our knowledge of cosmic rays and nuclear physics.

CONTINUED ON PAGE 30

THE PROSPECT BEFORE US

by THOMAS K. FINLETTER
Secretary of the Air Force

History repeats itself—and right now history is in one of those cycles which has always before led to great wars. It is our job —and our responsibility—to defeat this analogy of history.

IT IS NOT EASY to talk to a graduating class today. The world of action into which you are now going is not a joyous one. Your country is at war—not full out war, but still grievous war. And overhanging you, and all of us, is the seemingly irreconcilable struggle between Communism and freedom, with its menace of even greater conflict.

Many of you will be called upon to put aside your personal life and your professional career to serve your country. Even those of you who will not serve in the armed forces will be required, by your sense of obligation, to devote much to the problem of your country in its time of crisis.

Events have been behaving badly for the past 80 years; by which I mean that history is in one of those cycles which Arnold Toynbee has called a time of troubles, a time in which the rivalries of states reach a boiling condition which, so far in history, has led only to great wars.

It is our job to defeat this analogy of history. It is the opportunity of the United States as the leader of the free world to see to it that this time history does not follow this old and dismal pattern. We can succeed in doing this. It is your opportunity to play your part in the great adventure.

Pure and applied science has had a good deal to do with getting us into our present troubles. It is science which has developed the weapons which are about to destroy our civilization unless we can learn to control them.

The cardinal political fact today is that war is no longer a bearable institution. We often forget that this was not always so. Indeed, it is only in the last few years of history that it has been so.

The story of how science made war unbearable is simple. It is that the weapons which man uses have increased geometrically in their power while the political institutions by which man governs himself have stood almost still.

The spreading apart of these two lines—the line of man's capacity to injure himself with the weapons he makes and the line of man's progress in the political institutions by which he governs himself—this divergence is the tragedy of today. The depth and seriousness of the crisis can be measured by the divergence of the two lines. And the seriousness is such as to raise the question whether civilization will survive unless we pull these diverging lines together.

Only a little more than a century and a half ago, before the French Revolution began, war—though horrible—did not raise the issue of survival. A war decided whether there would be a gain or a loss in territorial or

THE PROSPECT BEFORE US *was presented as the Commencement address at the 57th annual Commencement exercises of the California Institute, June 8, 1951*

political prestige for the warring family dynasties which then ruled the western world, but it did not raise the question whether one or the other side was to survive.

War then was an extension of the foreign policy of the ruling houses of Europe. One of the rules of the game, of which there were many, was that you didn't entirely destroy the fellow whom you beat.

This was, by modern standards, a happy state of affairs. The political institution—rule by the family monarchy—was able to control the weapons of war as they then were.

Science and War

In the little more than a hundred and fifty years, war has been transformed into the horrible thing it is today.

We cannot chalk up to the credit, or debit, of science the first great advance that was made. We can charge, or credit science with the final steps which have made war what it now is, but not with the first step.

Before the French Revolution, armies were largely professional and small in numbers. The French Revolution injected the idea of the whole nation rising up in arms to defend itself against the aggressor.

This was a noble idea—the whole people rising to protect their patrimony. It was the sister principle to another great idea—the idea of universal suffrage. But it is a depressing fact that both these great principles were distorted when they fell into the hands of evil men. Universal suffrage in the hands of the dictators became a trick to destroy liberty. The nation in arms, in the hands of aggressors, became a terrible weapon with which to attack one's neighbor.

And, unfortunately, with the growth of this terrible weapon came the growth in applied science for destruction—gradual at first during the 19th century, increasing under the stimulus of the two world wars, and finally culminating into the utterly devastating power which science has now added to the nation in arms.

By the time World War I began, science's new machine guns and artillery had equipped the mass armies with terrible new weapons. By the time World War II was over, science had done the job most thoroughly. Man now had tanks, radar and other electronic devices, recoilless weapons, artillery of a type never before conceived, guided missiles, and those two terrible weapons which were to make the dose complete—the airplane and the weapons of nuclear power. The combination of the mass army and the products of science has now definitely made war incompatible with the survival of society.

All of this has put the United States in a serious dilemma. Wars always speed up the process of change. The two world wars not only made a great acceleration in the development of weapons, but also made great political, economic, and social changes.

One of these changes was to catapult the United States into the position of leadership in the free world and to put on our shoulders much of the responsibility of the decision whether the free world is to be destroyed or is to go on to a greater and fuller future than any society has ever had.

Since you are about to take your place in the midst of the problems of America today, this dilemma and this responsibility of your country are most definitely your concern.

As technicians you will have to play a heavy role in preparing the defenses of the United States and the rest of the free world.

The armed services will turn to you for help in the building of these defenses. On you will fall much of the burden of seeing to it that the quality of our defenses is always superior to that of any possible enemy.

It is you who will have to see to it that our tanks, airplanes, and ships are better than anyone else's, that our radar is the best and that inventiveness and daring are brought to bear so that the new weapons of this rapidly moving era are in our hands and not in the hands of those who might be our enemies.

I suggest that you approach this task with a sense of humility. There is too much willingness today to underestimate the capabilities—and especially the engineering capabilities—of the Iron Curtain world. There is a smugness in the West which has led many to believe that it was we alone who had the engineering capacity to produce the best weapons of modern war.

I don't know how many times we have to learn the lesson that this is not always so—that we can maintain our superiority in this field only by always questioning our own progress. "He who thinks he knows, has ceased to learn."

A Necessary Sense of Humility

There is no doubt about the high ability of our men of science and those who have to make workable instruments out of the basic theories. We can be superior to all possible enemies in our technical output—provided that we are not over-confident and do not think that there is something God-given in us which allows us to get results without putting into our work everything we have. We must go about our work with a sense of humility and full recognition of the stiffness of the competition.

It is not just in the area of your chosen profession that your task lies. For the work of building the defenses of the free world is not just a matter of material things. There must be a determination on the part of this country to stick to the job for as long as it has to be done, and a like determination on the part of our allies in the free world, if we are to succeed.

Specifically, we have got to get ourselves ready for a long period of a steadily sustained posture of defense.

This burden is going to fall largely on our own country, for although we did not seek it and do not want it, we have had the leadership of freedom put upon us.

Let us look at some of the tasks which lie ahead. In the first place, we have to maintain our armament pro-

gram at a steady level. We cannot allow our armaments to vary with the vagaries of the international scene. We hope that some day the governments of the world will put teeth into a plan for enforcing the peace, and we are working now to achieve this end. But until it is accomplished we must not vary the intensity of our military effort in accordance with the shifts in the news in the morning newspaper.

There is danger that if the international scene improves, if Korea is settled, if there is an apparent ending to or interlude in Communist aggressions, we shall feel that we can afford to relax in our military strength. Especially will this be true as the full impact of this military spending becomes clear, as it is not now clear, to the American people.

It is relatively easy to make sacrifices when the situation is as it is today, with this dreadful fighting going on in Korea, with the Communists claiming control of Tibet's foreign relations and defense, and with the uncertainties in Iran and in other parts of the world. But it will not be easy if—possibly as part of a calculated scheme—the Communists decide to make things look better for a while. Then is the time when our steadiness will be called upon.

Toward a Unified Foreign Policy

Then, too, we must not be torn by divisions at home in matters of foreign policy. This is not to say that debate is not a good thing. On the contrary, no sustained posture in international relations is possible in this country unless the people have fully debated the issues and have made up their minds what should be done after hearing all sides of the problem.

But once the debate is over and the consensus arrived at, then is the time to bury all the sharp things that may have been said in the course of the debate and to come out for a unified policy for America.

This is what was done in the debate as to our participation in NATO and in the defense of Western Europe. The same thing is being evolved and will, I believe, result in the same kind of agreed policy as to our military and political purposes in the East.

Specifically, I believe that our Korean policy should and has become firmer as a result of the debate which is now going on.

I happen to believe that the intervention by the United States and the other members of the United Nations to stop the North Korean aggression was a necessary and wise thing to do. Some may disagree. But the point is that those who approve this policy and those who disapprove it will all have had their say, and out of it will come, and has I think about come now, a united policy backed by the entire country.

I believe that the intervention in Korea took the United Nations at a turning point in its career and gave it a vitality which promises great things for the future. I believe that if we had sat by in frustrated fashion while the North Korean troops destroyed South Korea, right under the noses of the greatest concentration of American military power outside the United States, the United Nations would have catapulted rapidly downhill. I believe that our intervention not only prevented this catastrophe but held out hopes—to be sure, not conclusive hopes—that the United Nations would become an instrument for the collaboration of the free world in stopping aggression everywhere.

It may seem to you that the prospect of maintaining indefinitely a defense force, at huge expense to the taxpayer and great inconvenience to the citizen, in the hope that some day the Communists may realize that they will not be able to destroy us, is a dismal prospect.

Dismal or not, we will have to do this. For if there is anything on which we are all agreed, it is that we are going to do whatever is necessary to have the kind of military establishment we need to deter the Communists from attacking and to be able to take care of ourselves if they do attack.

There is, though, something that will help us in doing this job. The United States, in the position of world leadership into which it has been put, has another arrow to its bow—one which has elements of high hope.

It is nothing less than the determination of this country to close the gap of which I have spoken—to bring into bearable balance the weapons man has and the political arrangements by which he controls them.

Few great nations in history have sought to avoid war more earnestly than this country of ours.

This country has always tried to keep out of wars. And when we were drawn into them, we did our best in the peace settlements to set up new relationships between nations with the hope of getting rid of the institution of war itself.

Secretary Finletter holds a brief press conference on campus just before delivering his Commencement address

This we did after World War I. It was an American president who largely inspired the League of Nations. Although we did not join in the effort to make the league a success, the fact remains that we had much to do in setting it up.

The same was true of World War II. It was with American leadership that the United Nations was established: *and it is with American leadership that the first* great effort to give vitality to the United Nations is being carried on in Korea.

Our ideals go beyond this.

The conferees at the San Francisco conference which set up the United Nations did not know that the atomic bomb had been perfected.

Soon this knowledge came to a startled world and the United States took the leadership once more in doing something about meeting this new and terrible danger. The President of the United States called a meeting of *himself and the foreign ministers* of the United Kingdom and Canada in Washington in the fall of 1945. Out of this meeting came the atomic declaration of November 1945, in which a great purpose was stated. It was to set up a fool-proof system of security which would enable the nations to eliminate from their armaments the new weapons of mass destruction—not only the atomic bomb but all the other developments of applied science which had made war the intolerable institution that it is.

Again, it was under the leadership of the American Secretary of State, Cordell Hull, that the Moscow declaration of December 1945 was made. The Moscow declaration was word for word the atomic declaration of the preceding November, except that this time Russia joined in and agreed to go forward with the program.

Again it was under American leadership that the general assembly in January of 1946 adopted these great principles and announced it as the purpose of all the United Nations to eliminate from their arsenals the mass weapons of destruction under a fool-proof system of security.

Again it was American leadership which produced another of the great state papers on this subject—the report of the Secretary of State's committee of April, 1946, in which detailed proposals for the elimination of atomic weapons from national armaments were made—including an elaborate system of inspection and control. This was the first step in detailed planning for the great purpose of eliminating war by banning, under a fool-proof system, the weapons which make war.

We all know what happened. The Communists blocked every effort to carry out the great principles of the atomic declaration, the Moscow declaration and the general assembly resolution.

There was no alternative for the United States. We had to rearm.

The United States and the rest of the free world thus has on its books a pair of apparently inconsistent policies. Our fundamental purpose is a world of peace under enforced disarmament. But side by side with this fundamental purpose goes our policy of being strong and of playing our part in building up the strength of the free world so that we shall be safe while we are working for peace and so that by our military power we shall make it clear to our possible enemies that it would be a mistake to attack us.

There is in fact no inconsistency between these two *policies. Our policy of rearmament is a half way house* —an intermediate point in the seeking of our final objective—a world of peace under enforced disarmament.

Peace Can Be Won

It can be and is argued that it is mere words and not a facing up of facts to talk of peace with the world the way it is today. It is argued that the Communists have shown finally that they will have none of any peaceful solution; that war is therefore inevitable; and therefore that our talk of peace is mere words.

This is definitely not so. It is true that the situation looks sombre. But it is still an American aspiration to use its leadership and strength not for self-aggrandizement, not for the perpetuation of war, but to show that the use of military power is not the way to settle things.

And if you question the realism of all this, I submit that anything is realistic if you believe in it enough. We in this country do believe that war is not inevitable. We believe that peace can be had. The people believe it and the government believes it. As recently as last October the President, speaking before the United Nations, restated this objective of enforced and fool-proof disarmament. He did not speak in generalities. He made specific and detailed proposals as to the kind of plan which the United States would be willing to accept. These proposals are on the record as the great aspiration of this country .

In short, you, as you enter on the scene of action, will have before you the prospect not only of a determined America, ready to do what may be necessary to defend itself, but also of an America working for the great ideal of a decent world at peace.

I am not saying that the prospect which lies before you is easy and agreeable. The future is difficult and dark. The threat of war is overhanging us all. The future of our search for peace is uncertain.

But there is no question about one point—the great opportunity which lies before you as the future leaders of America.

Justice Holmes said that to live was to function. You will have your opportunity to function. There is no doubt about your chance to serve, and about the challenge of the task which lies ahead of you.

You are coming into your own at a time when the stakes are the highest in our history, when success will give us the greatest prize our country has ever worked for, but when failure may mean the end of our society and all that our forefathers have achieved. There is before you the highest opportunity for service any generation of Americans has ever had.

ILLUSTRATIONS FROM MARCUS MARCI'S "DE PROPORTIONE MOTUS"

by E. C. WATSON

IN THE PREFACE to his *Science of Mechanics*. Ernst Mach wrote:

> "In less immediate connection with the text stand the facsimile reproductions of old originals in my possession. The quaint and naive traits of the great inquirers, which find in them their expression, have always exerted upon me a refreshing influence in my studies, and I have desired that my readers should share this pleasure with me."

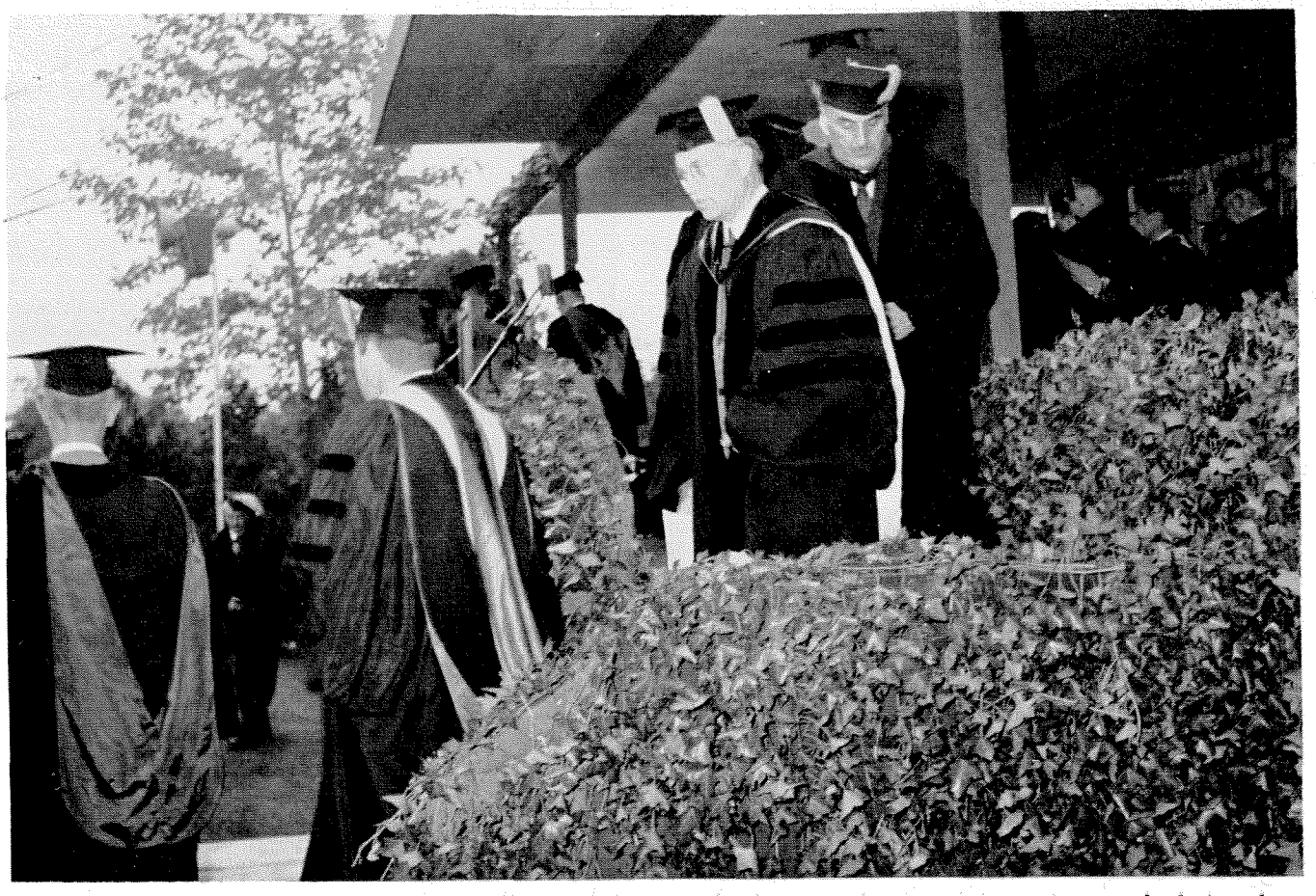
Some of the most interesting facsimile reproductions in the *Science of Mechanics* are from Marcus Marci's *De Proportione Motus* (Prague, 1639).

Joannes Marcus Marci was a professor at Prague and a contemporary of Galileo, from whom he probably obtained many of his ideas regarding the laws of motion. He was one of the most learned men of his time, as the two books of his still extant bear eloquent witness. His *Thaumantias.Liber de coelesti deque colorum apparentium natura, ortu et causis* (Prague, 1648) treats of the color phenomena associated with prisms and states "that the colors *originate in* refraction and that the *degree of refraction* determines the color." He recommends observing the spectrum in a darkened room and makes the important observation that the color, once obtained, will always remain the same, however much refracted. As pointed out by F. Rosenberger in *Die Geschichte der Physik* (1884), he might have anticipated Newton if he had known the exact law of refraction.

Marcus Marci's knowledge of the laws of motion, as displayed in his *De Proportione Motus*, was equally advanced for his time. While he did not succeed in reaching as clear ideas regarding the motion of falling bodies and hence of force and acceleration as did Galileo, he was the first to make substantial progress with the difficult problem of impact, a problem that Galileo touched on without success and that Descartes completely muffed. Thus he clearly states both that an elastic body making direct impact with a second body of the same size at rest will itself remain at rest after the impact, while communicating its entire motion to the second body, and that two equal elastic bodies moving in opposite directions with the same speeds will after impact simply reverse their motions, that is, exchange velocities. He also had a very considerable knowledge concerning pendulum motion, centrifugal force, and the composition of motions, and he restated Galileo's theorem that the time of descent down all chords which start from the top of a vertical circle is the same.

All this is cleverly summarized in the frontispiece to the *De Proportione Motus*. This charming engraving (reproduced above) shows weights being dropped from a high tower, shots fired from a cannon impinging upon other shot, an early form of a billiard table and a man batting a ball against a wall, as well as a man swinging from two ropes (pendulum motion) and sparks flying off tangentially from a grinding wheel (centrifugal force).

One of a series of articles devoted to reproductions of prints, drawings and paintings of interest in the history of science—drawn from the famous collection of E. C. Watson, Professor of Physics and Dean of the Faculty of the California Institute.



Education, background and standing are all revealed in academic apparel—if you know how to look for them.

WHO'S WHO IN ACADEMIC GOWN

by ALI BÜLENT CAMBEL

Some notes on the origin and purpose of the Commencement cap and gown—or how to tell what's going by in an academic procession

THERE ARE FEW CEREMONIES more impressive than academic functions, with faculty members in full dress, wearing proper caps, gowns and hoods. And just as every faculty member enjoys an individuality within a group, so does his academic garb, which he wears on these special occasions. It should not be surprising, therefore, that academic apparel can be a most revealing characteristic as to an individual's education, background and standing.

In Europe, academic apparel goes back to medieval times. In the very early days, people in Europe—from king down to beggar—wore long gowns with hood and cap. The differentiation of social standings was made by observing the trimmings of the gown and the elegance of its bearer.

During this period, scholars did not have a special

type of dress, but in the 14th century various universities adopted codes prescribing the styles to be worn by their educators.

Around the 16th century, it became fashionable to wear trousers, breeches and plumed hats, but scholars did not become involved in this vogue. It is difficult to know whether this was due to traditionalism or to a decree which stated that "it is honorable and in accordance with reason that clerks to whom God has given an advantage over the lay folk in their adornments within, would likewise differ from the lay folk outwardly in dress."

Thus a tradition began which is precious to scholar, administrator, new graduate and, above all, proud parents.

The Intercollegiate Code

In the United States caps and gowns have been used since colonial times, with the Ivy League institutions being among the first to adopt such customs. As every institution had different criteria for the academic dress to be worn, there were many inconsistencies. To bring order out of chaos the Intercollegiate Commission, in 1894, drafted a most simple and adaptable code for the wearing of academic apparel. This Intercollegiate Code was presented to American universities in 1895 and today is accepted by almost all of our institutions of higher learning.

The bachelor gown is made of black worsted material and has long, pointed sleeves. The master gown, also black, may be of wool or silk and has long sleeves with an arc and a slit for the arm. The doctor gown is made of black cotton, rayon-wool or silk and has full, round and open sleeves. There are three bars of velvet on each sleeve and the gown itself is faced with velvet in the front.

The mortar board and tassel are worn by all three degree holders or candidates. Bearers of doctorates and institutional presidents may wear a golden tassel in contrast to the black tassel, or a tassel with the color indicating the field of learning.

The hood, too, is worn by all degree candidates. The bachelor hood is three feet long; the master, three and one-half feet long; and the doctor, four feet long. The width of the hood binding changes with the degree, being two inches for the bachelor, three inches for the master and five inches for the doctor. The hood is made of the same material as the gown.

The color of the velvet hood binding is an important item and the following standard is set up by the Intercollegiate Code:

Agriculture—Maize
Arts and Letters—White
Commerce and Accountancy—Drab
Economics—Copper
Engineering—Orange
Fine Arts—Brown
Forestry—Russet
Humanities—Crimson
Law—Purple
Library Science—Lemon
Medicine—Green
Music—Pink
Oratory—Silver Gray
Pedagogy—Light Blue
Pharmacy—Olive
Philosophy—Blue
Physical Education—Sage Green
Public Health—Salmon Pink
Science—Golden Yellow
Theology—Scarlet
Veterinary Science—Gray

The velvet trim of the doctor gown may be either black or the color of the field of learning, while the color of the velvet edging of all hoods indicates the field of learning.

No matter what the degree, all hoods are lined with silk of the official academic color or colors of the institution conferring the degree. Chevrons are used if the institution has more than one color. For example, the University of California, whose colors are blue and gold, has a hood lining of golden silk on which is superimposed a blue chevron. Different color shades are used whenever the same colors are shared by several institutions.

The scholar who does not appreciate the simplicity of the Intercollegiate Code would do well to study some of the British traditions of cap, gown and hood, which are confusing to say the least. And the educator who finds colored velvet not up to his standing is advised to receive a degree from the University of Paris which prescribes a scarf with no less than ermine triming.

THE HIGH COST OF ACADEMIC COSTUME

FEW EDUCATORS can afford to own their own cap, gown and hood. Going rates for doctors' gowns, for example, range from $42.50 for a poplin robe to $80 for a rayon and wool creation. Doctors' hoods cost from $23 to $32. Caps are priced from $2.85 to $6.75—and the tassel, which is extra, comes in the $2.50 to $5 price range. All of which means that the well-dressed Ph.D. has to pay $123.75 if he wants to be dressed in the best, and $70.85 if he wants to be dressed at all.

Holders of the M.S. degree can join the academic procession for a mere $78.25 for the best materials, or for $40.85 for poplin. Bachelors' prices run from $67.25 down to $34.35.

The easy way out of this economic impasse, of course, is for just about everybody to rent his academic outfit. Doctors can do this for $3 a day, masters for $2.75, bachelors for a comfortable $2.50.

The Right Reverend Francis Eric Bloy delivers the Invocation at Caltech's 57th annual Commencement exercises.

THE MONTH AT CALTECH

Commencement

A TOTAL OF 357 students received degrees from the Institute at the annual Commencement exercises held on Friday afternoon, June 8.

Eighty-one men received the B.S. degree in Science—19 of them with honors; 79 men received the B.S. in Engineering—11 with honors.

Of the 30 men graduating with honor, seven coupled this distinction with "exceptionally effective participation in extracurricular activities", for which they were awarded Student Body Honor Keys. They are Dallas Peck, Ulrich Merten, Robert Kurland, William Whitney, Peter Mason, Richard Lihbey and Charles Steese, Jr.

Twenty-six men were given the M.S. in Science—3 in Chemistry, 3 in Chemical Engineering, 6 in the Geological Sciences, 1 in Meteorology, 7 in Physics. The M.S. in Engineering went to 87 men—30 in Aeronautics, 15 in Civil Engineering, 20 in Electrical Engineering and 22 in Mechanical Engineering.

Seventeen men were awarded Engineer's degrees, and 68 men received Ph.D. degrees.

Among the graduates were 17 members of the Armed Forces, assigned to Caltech for advanced study by the Army, Navy, Air Force and Marine Corps.

James R. Page, Chairman of the Board of Trustees, presided at the ceremonies. The Right Reverend Francis Eric Bloy, Episcopal Bishop of Los Angeles, delivered the Invocation and Benediction. Degrees were conferred by President DuBridge, who also delivered the charge to the graduating class and reported briefly on Institute activities during the school year.

Commencement speaker this year was Thomas K. Finletter, Secretary of the Air Force. His address appears in full on page 7 of this issue.

Mr. Finletter, who succeeded W. Stuart Symington as Air Force Secretary in April, 1950, is credited with promoting military teamwork and the joint task concept of combined Army, Navy and Air Force defense activity, emphasizing the development of long-range bombers as a deterrent to aggression. Under his leadership the Air Force is being built up from 48 groups to a total of 95 wings by 1952.

Born in Philadelphia in 1893, Mr. Finletter was graduated with top honors from the University of Pennsylvania and went on to the University's Law School. His

law training was interrupted by service in the first World War, and in 1920 he was graduated, again with highest honors. In 1931, when he had a successful law practice in New York, he returned to his old law school as a lecturer, and commuted between the two jobs for the next 10 years.

Mr. Finletter entered government service in 1941 as special assistant to the Secretary of State on international economic affairs. In 1945 he was consultant to the United States delegation to the United Nations Conference in San Francisco. In 1947 he was named chairman of the President's special Air Policy Commission. In 1948 he went to England as chief of the Economic Cooperation Administration mission to the United Kingdom.

Mr. Finletter was accompanied to Pasadena this month by his wife, the former Margaret (Gretchen) Damrosch, daughter of the late composer and conductor, Walter Damrosch.

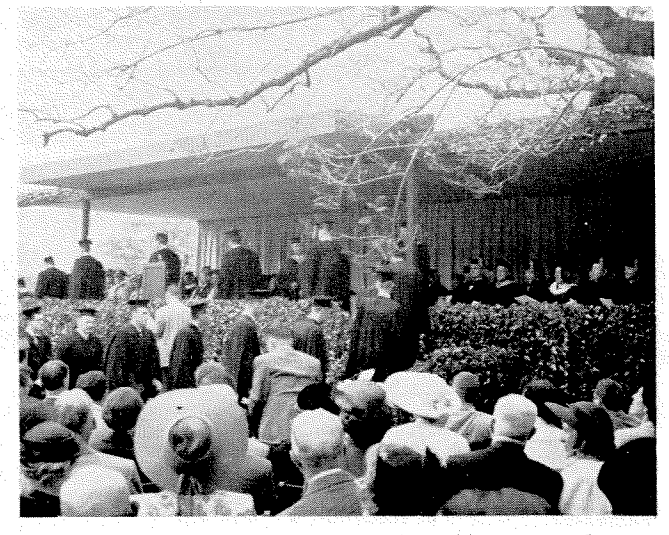
Fulbright Scholars

TWO CALTECH STUDENTS have been awarded Fulbright Scholarships for foreign study in 1951-52.

Sanford Sweet, a senior, of Stockton, California, will study physics and philosophy at the University of Edinburgh, Scotland. At Caltech on a scholarship, Sweet has been vice-president of the Caltech Musicale, a member of Tau Beta Pi, the Y.M.C.A., and a varsity basketball letterman. He recently won both the McKinney Prize Contest in English and the Conger Peace Prize Contest.

Norman M. Wolcott, graduate physics student from St. Paul, Minnesota, will continue his study of physics at Oxford University, England. He was graduated from Harvard summa cum laude in 1949, and received his M.S. in physics there in 1950. He is a member of Phi Beta Kappa.

Fulbright scholars are selected not only on the basis of scholarship, but on suitability as representatives of American life and on their ability to adapt to conditions abroad. The scholarships are awarded under an act of Congress sponsored by J. William Fulbright, senator from Arkansas. Funds used in the program, in which 20 countries are now participating, are foreign currencies realized through surplus property sales abroad.



The class of '51 steps to the platform to receive degrees

Waiting to join the academic procession—R. A. Millikan, Bishop Bloy, Leonard C. Lyon and James R. Page

Richard Springer

THE DEGREE OF Master of Science was awarded posthumously to Richard Earl Springer, 25, of Los Angeles, who lost his life in an automobile accident on May 26.

Dick Springer received his B.S. from the Institute in 1945 and was majoring in electrical engineering. As an undergraduate he was prominent in athletics. He was a member of the water polo team, had been senior manager of the baseball team and was a leading member of the Ski Club. He headed the touring and hut committee of the Far West Ski Association and was a ski patrolman.

Dick had done a large amount of snow survey work, including a winter spent in Mineral King for the purpose of studying snow and avalanche conditions there, and he had planned to study avalanche-craft in Switzerland next winter.

A movement is now under way to raise funds for a Dick Springer Memorial Hut to be built in Mineral King.

Hinrichs Award

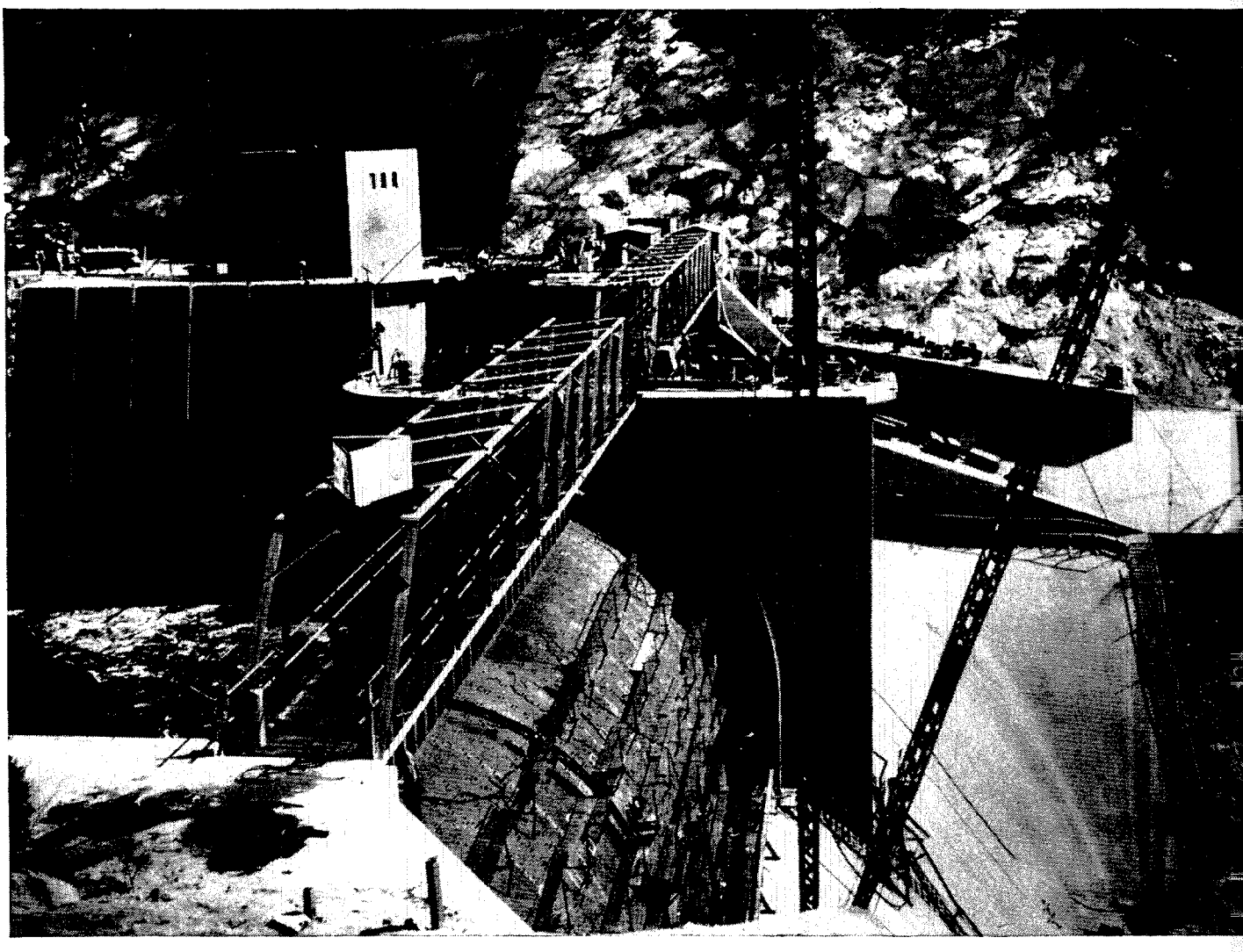
OLIVER H. GARDNER, of Melrose, Mass., was named 1951 winner of the Frederic W. Hinrichs, Jr., Memorial Award at the Commencement ceremonies.

The award is made annually to the senior who, in the judgment of the undergraduate Deans, has made the greatest contribution to the welfare of the student body throughout his undergraduate years and who has shown outstanding qualities of character, leadership and responsibility.

It was established by the Caltech Board of Trustees in memory of Professor Hinrichs, faculty member and Dean of Upperclassmen from 1921 until his death in 1944.

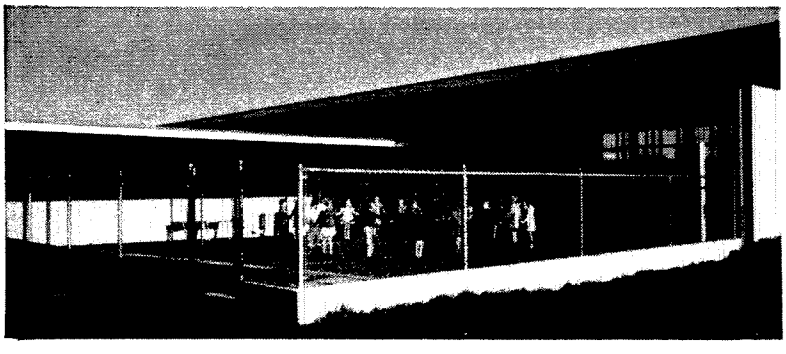
CONTINUED ON PAGE 18

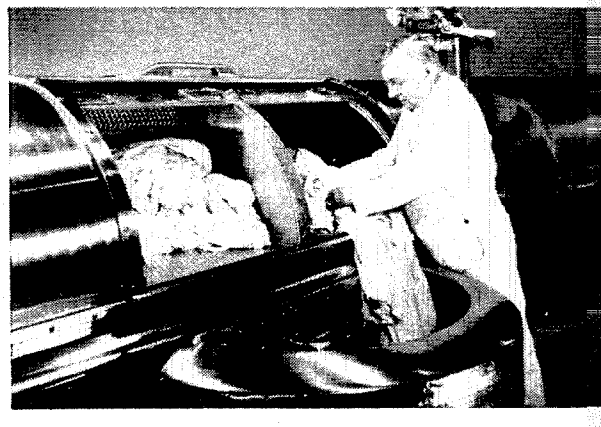
Only STEEL can do so many jobs



ACTION IN CALIFORNIA. On the north fork of the Feather River in California, Pacific Gas and Electric Company has placed two new dams . . . Cresta Dam and Rock Creek Dam. The huge drum gates for these dams, and the bridges directly above them, required 4,380,000 pounds of steel. They were fabricated and erected by United States Steel.

NEW SCHOOL HAS 2-WAY PROTECTION. No matter how absorbed these children become, they can't rush into the path of passing traffic, because they are protected by sturdy, long-wearing Cyclone Fence. And the fence not only keeps the children inside, it keeps undesirables out.





WASH DAY IS NO HEADACHE in hospitals, hotels, restaurants, clubs, or laundries where equipment is made of U·S·S Stainless Steel. For stainless steel means easy cleaning, corrosion resistance, good looks and long life. Lucky that United States Steel is big enough to turn out steel for washing machines as well as warships, for toasters as well as tanks.

so well...

UGH ON TANKS. The steel rocket fired this new 3.5 inch "superbazooka" s already proved itself an effective ti-tank weapon. It weighs nine unds, is able to penetrate up to 11 hes of armor. Although mobilization ll require increasing amounts of steel, e constantly-expanding steel-produc- facilities of U. S. Steel should enable to make plenty of steel for essential acetime uses, too.

NEW LIGHT ASSAULT TRANSPORT. Six rocket units help to lift the 40,000-pound weight of this new U. S. Air Force light assault transport in a recent test flight. With the addition of rocket units, the three-engine plane can now transport heavy loads in and out of small clearings. Only steel can do so many jobs so well.

FACTS YOU SHOULD KNOW ABOUT STEEL

American steel mills can out-produce the rest of the world combined by 13 million tons of steel a year. The plants of United States Steel alone are pouring more steel than all the Communist nations put together.

Listen to . . . The Theatre Guild on the Air, presented every Sunday evening by United States Steel. National Broadcasting Company, coast-to-coast network. Consult your newspaper for time and station.

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. . . and this label is your guide to quality steel

UNITED STATES STEEL

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Olly Gardner came to Caltech after three years with the 29th Infantry Division. He spent 22 months in the European Theater as Staff Sergeant and combat squad leader. At Caltech he has been awarded three Honor Keys by ASCIT, for exceptionally effective participation in extracurricular activities. He has been secretary, representative and vice-president of ASCIT, headed the Board of Control which administers the Caltech honor system, and was a member of the ski team. He was also prominent in speech and debate, was a member of the Beavers, and served as a campus guide.

Cancer Research

THREE CALTECH RESEARCHERS, working under an American Cancer Society grant, have uncovered evidence which may link viruses to the spread of cancer in plants.

Dr. Guy Camus, Rockefeller Foundation Research Fellow in Biology, Dr. James Bonner, Professor of Biology, and Dr. Frits Went, Professor of Plant Physiology, working with sunflower plants, noted that when tissue was grafted from a tumorous to a normal plant, tumors grew at the site of the graft and spread vigorously to other areas. This raised the question of what agent carried the disease to the once healthy plant, then through it.

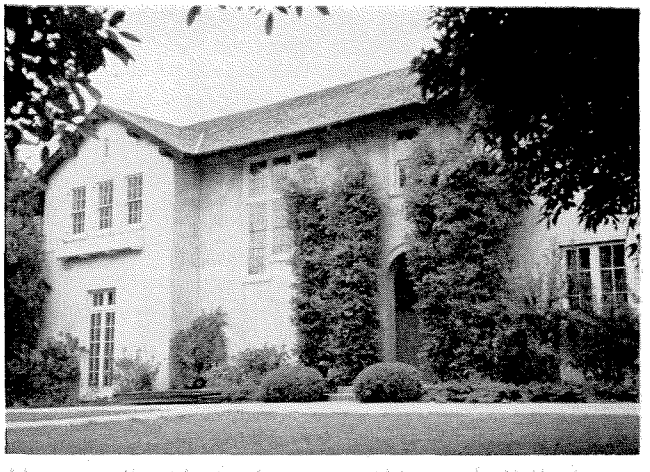
Further study indicated that the transmission phenomena followed the general laws of transmission of viruses, the smallest organisms known to science. Hence, the researchers set out on a biochemical virus hunt, tediously breaking plant tissues down into their component parts.

Ultimately they reached a stage at which they could study the plant proteins alone. These life essentials form a major portion of all living things, including the ultramicroscopic viruses.

Viruses differ, however, from normal cell material in the nature of their proteins. By the critical method of electrophoresis—passing an electric current through a concentrated mixture of protein—the scientists found a unique protein constituent in tumor tissue but not in normal tissue. Its chemical and physical characteristics —high molecular weight and high mobility in an electrical field—resembled those of a virus, though more work must be done before the constituent can be identified positively as such.

But whether it is a virus or not, the researchers say, it may act as a switch which sets an assembly line in motion, with a tumor as the end product. The agent does not necessarily cause tumors, but, in some way as yet undetermined, it appears to change the normal cell pattern. Normal cells cannot produce an essential growth hormone, indoleacetic acid. They depend on the plant buds for a regulated supply. But tumor cells acquire the ability to synthesize, or make their own indoleacetic acid and therefore grow in an uncontrolled manner.

Oliver H. Gardner (right), 1951 Hinrichs Award winner, and Paul Helfrey, getting set for Commencement.



The new President's house at 415 South Hill Avenue

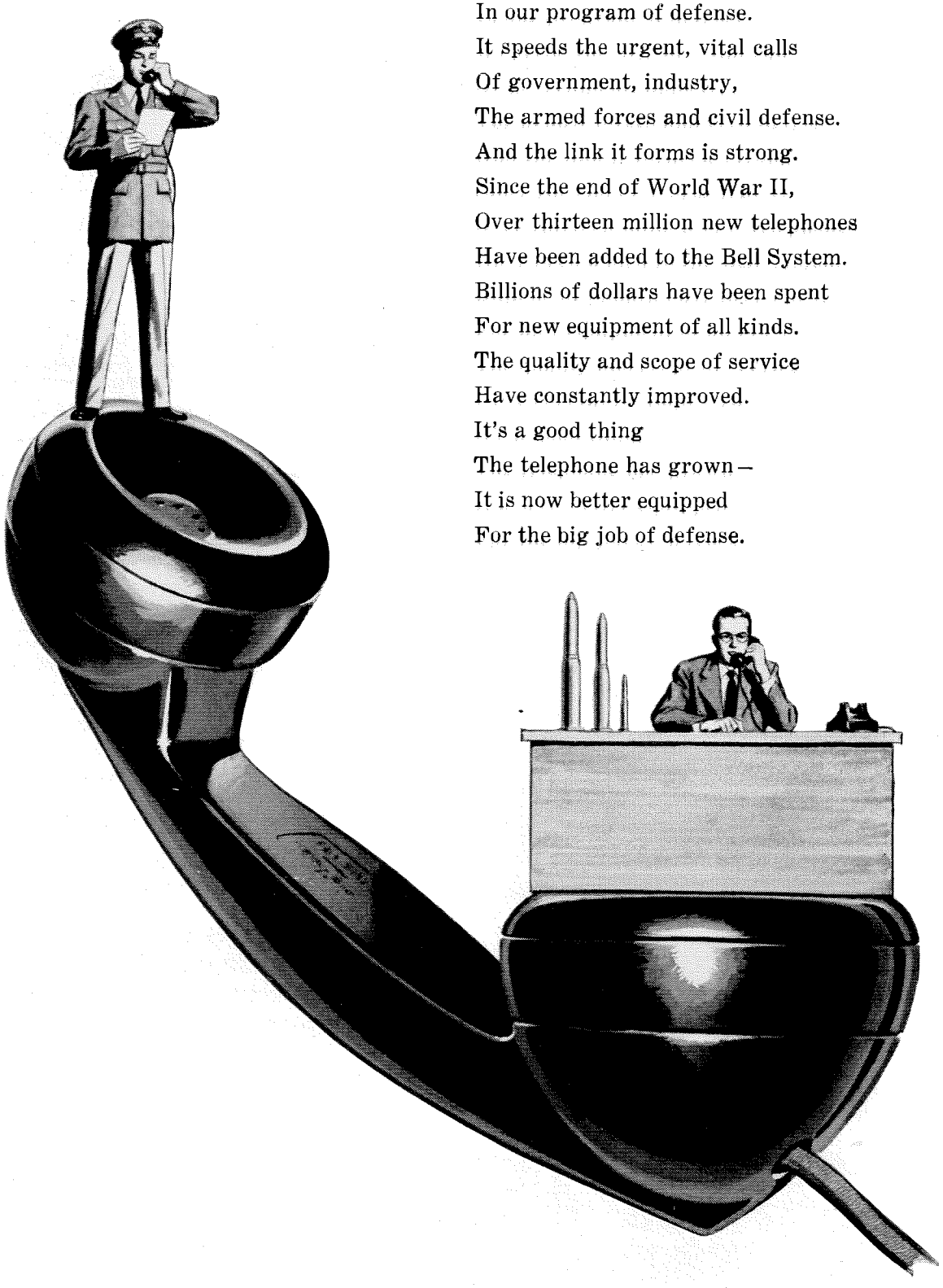
President's House

LATE THIS MONTH Dr. L. A. DuBridge and his family will move into a new President's house at 415 South Hill Avenue, Pasadena, less than a block from the campus. The DuBridges' present home on Fairfield Circle was purchased by the Institute as temporary President's quarters in 1946—when Dr. DuBridge came to Caltech—until a house close to the campus became avilable.

The new President's house is situated on about an acre of ground, has a living room, library, dining room, kitchen and bedroom on the first floor, and four bedrooms and a study on the second.

The link is strong

The telephone forms an important link
In our program of defense.
It speeds the urgent, vital calls
Of government, industry,
The armed forces and civil defense.
And the link it forms is strong.
Since the end of World War II,
Over thirteen million new telephones
Have been added to the Bell System.
Billions of dollars have been spent
For new equipment of all kinds.
The quality and scope of service
Have constantly improved.
It's a good thing
The telephone has grown—
It is now better equipped
For the big job of defense.



BELL TELEPHONE SYSTEM

THE BEAVER

Some Notes on Student Life

Ditch Day

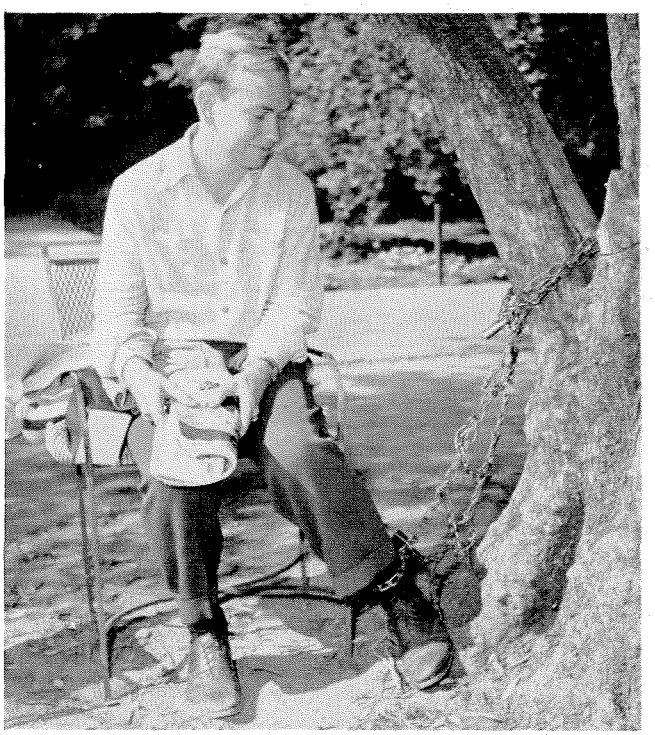
SENIOR DITCH DAY proved to be far more enjoyable to the seniors this year than it did to those last year. The class of '51 contrived some ingenious schemes in order to insure their rooms from being trundled to various parts of the campus, but new locks, timing devices and steel bolts were equally futile. The underclassmen gained entrance to the most closely sealed rooms.

In one room the usurpers installed a horde of rabbits, while in another they removed the means of entrance that the occupant had left himself and thus necessitated a rather dramatic window removal. The seniors were more pleased with these tactics than with the really destructive tricks of last year.

It is not surprising to learn that all non-ditching seniors did not escape the ubiquitous eye of the underclassmen. One senior, in fact, stalked innocently into Fleming lounge at lunch time, seeking the nourishing noon meal. He was immediately seized and chained to the nearest olive tree, so that the multitudes might see the manner in which such flagrant violation of the tradition of d-day was treated.

Summing Up

With finals over and Commencement only a few days off, the seniors found themselves with nothing to do. They sat in the sun and talked about future jobs and past classwork. An occasional jibe was thrown at an underclassman as he passed by, loaded with books and notes, in recognition of the fact that underclassmen had not begun their exams yet. For the seniors the end had come. They could now look forward to a different life and could even become sentimental about their recent past worries. But the ratio of sentimentality to criticism was low and they were more inclined to discuss the failings of themselves or of the courses that they had taken for the past four years.



This hapless senior forgot to ditch on ditch day

Competitive Spirit

To some, the intense competition at Tech has proved to be not only exhausting but unprofitable. These men point out that we compete in the classroom, in the laboratory, on the athletic field, we even compete for honor keys.

They complain that the trophies which have been set up for all sports have not created a friendly atmosphere. As there are a vast number of different types of students, it would be most remarkable if all men wanted to enter house sports. Some are not even capable, but the argument is that they should support these things and if they do not do so they are without house spirit. The trophies have become a symbol of house spirit.

Some students would rather listen to music than go to the athletic field, but they don't require that the other members of the house join them and cheer each new cadenza. Since there is no trophy for music-listening, car-building or fishing, these things cannot come under the heading of house spirit.

The Modified Curve

The classrooms provide more competition—and the system of grading is wholly responsible for this. While grading on the "modified curve" is probably the only method that can be properly used, it has resulted in some inequitable gradings. One senior described it as an unstable system; that is, those in the upper half tend to work harder and gain better grades, while those in the lower half lose enthusiasm and sink even lower.

But the seniors have seen some noteworthy improvements in their four years' attendance at Caltech. Any students who have been to other schools appreciate many of the liberal policies here. It surprises many of the students to know that a great number of colleges do not allow undergraduates to have cars. Other schools will not permit an undergraduate to marry and remain in school. The student at Tech discovers that there is a singular lack of red-tape in comparison with other schools. He feels that he will not become caught up in the impersonal cogs of a great machine, but, instead, that the faculty has a sincere interest in his ability. There exists a confidence that the student body has more than the usual control over the policies of the school.

—Bob Madden '51

Bad News for Bugs

BUGS are in for the surprise of their lives. *They're going to zoom into allethrin, the new insecticide ingredient. It looks like especially bad news for many of the insects that pester you most.*

Take flies, mosquitoes and gnats . . . allethrin's paralyzing touch searches them out . . . delivers the blow that knocks them down fast . . . leaving its slower acting companion ingredients in the spray or powder to complete the kill.

Until now this type of insecticide came from flowers picked hy the natives in Asia and Africa. But *allethrin is an all-American product,* synthesized under scientific controls and has the definite advantages over importations of uniformity in strength and quality.

It is only natural that the people of Union Carbide pioneered in the production of allethrin on a commercial scale. For they were already making most of the needed chemical ingredients.

As a result, the people of Union Carbide are already providing allethrin in ever-increasing quantities to manufacturers of household and dairy sprays. And researchers all over the country are now engaged in testing its value for the control of agricultural pests and for other purposes. Other Union Carbide chemicals are important ingredients in many other insecticides and fungicides. One or more of them may have a place in your future plans.

FREE: *Learn more about the interesting things you use every day. Write for the illustrated booklet "Products and Processes" which tells how science and industry use Union Carbide's Alloys, Chemicals, Carbons, Gases, and Plastics in creating things for you. Write for free booklet C.*

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ALUMNI NEWS

Annual Banquet

THE ANNUAL ALUMNI BANQUET was held this year on June 6 at the Los Angeles Athletic Club. The honored guest on this occasion was Miss Diantha May Haynes, only surviving member of the class of '96—which means she was not only in the first graduating class, but was the first woman to be graduated from the Institute. Caltech has had only three women greduates in its 60-year existence; Miss Haynes is the only one now living.

The class of 1896 at Throop Institute, as the school was then called, had a total of two pupils. Miss Haynes majored in biology and became a high school science teacher after receiving her degree. She taught for 38 years—27 of these at Redondo High School, where she was chairman of the science department at the time of her retirement in 1938.

Alumni Association President George K. Whitworth's report on the year's activities revealed that membership in the Association this year had reached a peak of 2315, and that the Alumni Fund now stood at a healthy $84,000.

President L. A. DuBridge, in his year-end report on the affairs of the Institute, announced that Caltech's total assets now amounted to $45,000,000. Student enrollment is (purposely) declining after the peak war years; applications for undergraduate scholarship aid are constantly increasing, so that scholarship funds are urgently needed—though graduate scholarships are on the rise now. Tuition, which is going up as much as 5 or 10 per cent in some schools, will remain the same ($600) at Caltech next year, but student house rates will have to be increased.

The main speaker of the evening was Gordon P. Larson, Director of the Los Angeles Air Pollution Control District, whose topic was, "Smog—The Talk of the Town."

Reunion classes this year included 1911, 1916, 1921, 1926, 1931, 1936, 1941 and 1946. Reports from some of these are presented herewith:

1911

Our class was the first to graduate at the present campus and consisted of three men. Two of us are now alive and were present for our 40th Reunion at the annual Alumni dinner. That makes 66 2/3 per cent of the class or 100 per cent of the ones alive, which must certainly be a record turnout.

All three of us went with General Electric, but I am the only one still with them. Royal Ward, the other

CONTINUED ON PAGE 24

Robert P. Sharp, new president of the Alumni Association; George K. Whitworth, outgoing president; and Caltech's President L. A. DuBridge chat with Diantha Haynes, honored guest at the annual Alumni Banquet. Miss Haynes was a member of the Institute's first graduating class, and the first woman graduate of Tech.

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living member of the class, is with the San Bernardino Flood Control, and has done a lot of consulting engineering, as well as carrying on a citrus ranch. He has two sons and, I believe, six grandchildren. I have one daughter and a grand-daughter.

We have seen Tech grow to become one of the best known technical schools and are pleased to have had a small part in its history. I hope we can continue to assist in its progress.

—Harold C. Hill

1921

At the 30th reunion of the class of 1921 there were 14 present out of 25 southern California residents—Barnett, Catlin, Craig, Honsaker, Smith, Lee, Lyon, Makosky, Mintie, Morrison, Mullin, Potts, Quirmbach, Simpson and Stenzel. Regrets were received from Alfred Stamm of Madison, Wisconsin and Dick Hambrook of San Francisco.

—C. F. Quirmbach

1926

There were 26 men from the class of '26 at the 25th reunion. This is about half the number living in southern California, and approximately a quarter of the living members of the class. In 1926, 105 were graduated; 101 are now living.

Messages came in from Joe Matson of Hawaii, Bob Bowman from San Francisco and Jack Fahs and Al Ball from Wilmington, Delaware.

Most startling news received was from Don Macfarlane, Class Secretary, who had just got married and was honeymooning in South America. At the other extreme, Bob Moodie, who was married in June, 1926, was at the meeting.

—Allen Laws

1931

The class of '31 was represented at the Alumni dinner by Bob Lehman, E. Peer, Emory Buffum, Ray Labory, George Langsner, Tom Tarbet, Ed Green and Ted Jurling. We enjoyed reading the notes some of our non-attending classmates sent in (they're in the Personals section of this issue of the magazine), and observed that of all the men who did show up there wasn't one bald head. In the dim light there were hardly even any gray hairs either.

We're already making plans for our 25th in '56. This is going to be a special event for all of us.

—Ed Green

1946

A motley gathering of nine '46ers showed up to recall wartime Tech and make a few high-powered deals. W. G. Misner of Filtrol Corporation and R. A. Golding from Shell Chemical Corporation ably represented the chemical industries. A research problem for Douglas at El Segundo is taking up most of J. W. Stuart's time these days, while R. C. Siegel told us about his work at Margo Operating Company at Oceanside. From Long Beach came L. C. Haupt, ace soap maker of Proctor & Gamble. Down the table from him sat John Anderson, who is helping design the new Lever Bros. plant for the Bechtel Corporation. J. C. Evans from Audio Products, H. R. Woods of Studebaker, and J. E. Fleming from Clary Multiplier completed the group.

—J. E. Fleming

James W. McRae

JAMES W. MCRAE, M.S. '34, Ph.D. '37, has been named a vice-president of the Bell Telephone Laboratories. Director of Transmission Development since 1949, Dr. McRae will be in charge of systems development which, besides transmission development, embraces switching development and systems engineering.

Dr. McRea has been with the Bell Labs since 1937. His first work there was concerned with research on trans-oceanic radio transmitters. His next assignment was in the field of microwave research, which led naturally to work on military projects.

In 1942 he was commissioned a major in the U. S. Army Signal Corps and was assigned to the Office of the Chief Signal Officer in Washington, D. C. He remained in Washington for more than two years, engaged in coordinating development programs for airborne radar equipment and for radar countermeasures devices. He later received the Legion of Merit for his work on these programs.

In 1944 Dr. McRae was transferred to the headquarters of the Signal Corps Engineering Laboratories at Bradley Beach, N. J., as Chief of the Engineering Staff. He later became Deputy Director of the Engineering Division and attained the rank of colonel before returning to civilian life at the end of 1945.

Back at Bell Labs in 1946 he was appointed Director of Radio Projects and Television Research, and, with the addition of responsibility for electron dynamics research in 1947, he became Director of Electronic and Television Research. In 1949 he was appointed Assistant Director of Apparatus Development, soon became Director, and, later in the same year, Director of Transmission Development.

Dr. McRae is a fellow of the Institute of Radio Engineers, a member of the American Institute of Electrical Engineers and of Sigma Xi.

Harold C. Hill

HAROLD C. HILL, '11, has been appointed Assistant to the Manager of the General Electric Company's Industrial Division, Apparatus Department. Mr. Hill, who has been leader and manager of the User's Section, Industrial Division, for the past eight years, will take

over duties which include the further development of the industrial heating business in the Los Angeles area.

Mr. Hill joined GE in 1911, immediately after receiving his Mechanical Engineering degree from the Institute — then the Throop College of Technology. He worked in the Lynn and Boston, Mass. offices until 1923, and then joined the Los Angeles office as sales engineer. His time with GE has been interrupted only by a two-year hitch in the Artillery during World War I.

Hill is being replaced as Manager of the User's Section by another Tech man, R. E. Bear '22, who has been a sales engineer in the Los Angeles office since 1925.

Gordon Bussard

GORDON LUCAS BUSSARD '37 died of a brain tumor on April 29 in the Delaware Hospital, in Wilmington, where he had been a patient since January 24.

Born in Montana, Gordon spent his boyhood in Spokane, Washington. At Tech in 1936-37 he was president of Dabney House, treasurer of the student body, and chairman of the Interhouse Committee. He was a member of the Varsity Club, Beavers, and was on the staffs of both the Big T and the California Tech.

After his graduation from Tech with a B.S. in mechanical engineering, Gordon went to work for the DuPont Company, first at the Richmond, Va., plant, then at the nylon plants in Seaford and Martinsville, Va. Five years ago he went to the Wilmington plant, as a member of the personnel division of the DuPont Service Department.

He is survived by his wife, the former Carolyn Ackart; a son, Gordon Jr., and daughter, Roberta.

Kenneth Pitzer

KENNETH S. PITZER '35, who was named "Alumnus of the Year" by the University of California last month, has now been appointed Dean of Cal's College of Chemistry. He has been on leave from the university—where he was a professor of chemistry—since January, 1949, and is now serving as Director of Research for the Atomic Energy Commission in Washington. His new appointment at Cal is effective July 1.

Sacramento Chapter

BY RESOLUTION of the Board of Directors of the Alumni Association at its meeting of April 17, 1951, a Sacramento chapter was created at the request of a group of members of the Association. The officers and their addresses are as follows:

PRESIDENT — Fred Groat '24
California Division of Water Resources
Public Works Building
Sacramento

SECRETARY-TREASURER — Richard Silberstein '41
Arthur A. Sauer, Consulting
Structural Engineer
2203 13th Street
Sacramento 18

PERSONALS

1923

Donald H. Loughridge, Ph.D. '27, changed his position this spring from Senior Scientific Advisor to the Secretary of the Army (which he'd held for the past three years) to Assistant Director of the Reactor Division of the Atomic Energy Commission. Don's just bought a new home in the woods in Virginia and would enjoy having any Tech alumni who may be passing through Washington get in touch with him. "One of the virtues of being in the District," he claims, "is that sooner or later all your friends seem to come through."

1924

Carl F. Eyring passed away last January in Provo, Utah, where he was Professor of Physics and Dean of the College of Arts & Sciences at Brigham Young University.

Vladimir A. Kalichevsky, Consulting Chemical Engineer with the Magnolia Petroleum Co. in Beaumont, Texas, has completed two years of starting and organizing the Process Control Laboratory. The laboratory presented him with a scroll on his return to the main office.

1925

Frank Clayton writes from Fort Worth, Texas, where he's still Chief Plant Engineer at the Convair B-36 plant. Things are booming again there, with employment up to its wartime levels. Frank notes that his oldest son, 17, will start at the University of Texas next fall.

1926

Edgar P. Valby is still with Richfield Oil. He was transferred in January, 1950 to Bakersfield. The Valbys have three boys: Larry, 9; George, 6; and Richard 3½.

Roscoe Gockley is still with Southern California Edison as an Engineer in Electrical Design—which means substation and powerhouse design, new and rebuild. Roscoe had a bout with a bad heart this spring, which put him in the hospital for a while, but he's on the mend again now.

R. B. Bowman had to miss the 25th reunion of the class of '26 this year because he was celebrating completion of his 25th year with Standard of California by taking a five-week vacation in Canada. He's now an Associate Director of the California Research Corp. in San Francisco. He has a 12-acre walnut ranch in Concord, where alumni and their wives, living in the San Francisco area, gather every year, on the Saturday before Labor Day, for a swimming party.

1927

Bill Minkler writes from Pittsburgh, Pa., that he's recently become Manager of Engineering Staff Member in the Atomic Power Division of Westinghouse. Bill says he's still got two children and several gray hairs, but no cane or crutches yet.

1929

Richard M. Sutton, Ph.D., rounding out 20 years as Professor of Physics at Haverford College in Haverford, Pa., writes that he'll become a member of the staff of the General Electric Fellowship Program at the Case Institute of Technology in Cleveland this summer. Dick explains that this will be a six-week course for 50 selected Fellows—high school science teachers from the mid-western states who are brought to Cleveland by GE for a good refresher course. Dick was a member of the staff of this program in 1949; last summer

Duane Roller, Ph.D. '29, of Wabash College took his place.

Guy L. Chilberg, M.S., was appointed General Plant Supervisor in the Washington-Idaho area of Pacific Tel & Tel, effective June 1. His office is in the Seattle headquarters.

1930

Ralph K. Day, Ph.D., of the glass technology division of the research department of Libbey-Owens-Ford Glass Company, Toledo, Ohio, was recently elected a fellow of the American Ceramic Society at its 53rd annual meeting in Chicago. Prior to joining LOF in 1944 Ralph was engaged in glass research at the Corning Glass Works in Corning, N. Y., the Spencer Lens Co. in Buffalo, and set up a special optical project for the National Cash Register Company in Dayton, Ohio, during World War II. At Libbey-Owens-Ford Ralph has supervision of the field group in glass technology research. The Days live in Maumee, Ohio.

1931

Byron B. Johnson, Lt. Comdr., C.E.C., USNR has a new address, which gives some indication of where he now is:

P.W.O. Atsugi N.A.S.
F.P.O. 3835
San Francisco, Calif.

Glenn Chamberlain has been running a business in Palo Alto as consulting engineer (civil, electrical and mechanical) for the past three years.

Charles K. Lewis is working in the Power Division of the Bechtel Corp. in San Francisco. He's just moved into a new home in San Mateo, has four children—two male, two female; the oldest, male, graduated from grade school this spring; the youngest, female, is now in second grade.

1935

Herb Ribner writes from Parma Heights, Ohio, that a little red-head named Carol Anne arrived on May 11, a mere 31 minutes after his wife Lelia reached the hospital. Carol is their first child.

Herb was transferred from the N.A.C.A. Langley Field Laboratory to the Cleveland lab two years ago.

Louis T. Rader, M.S., Ph.D. '38, has been appointed assistant manager of engineering of the General Electric Company's Control Divisions at Schenectady, N.Y. He joined G.E. as a student engineer in 1937, and was assigned to the Control Engineering Division as a design engineer in 1939. In 1945 he accepted a position as head of the Electrical Engineering Department at the Illinois Institute of Technology, then rejoined G.E. in 1947.

1936

R. G. Heitz received a 15-year pin at a recent service award dinner held by the Dow Chemical Company's Western Division in Pittsburg, Calif.

1937

Martin J. Poggi has been transferred from Fort Worth, Texas—where he started a branch office for the Airsupply Company and worked for two years as Installation Engineer—to Los Angeles, where he'll be working on installation engineering problems as necessary in the various Airsupply offices in Ft. Worth, Seattle and Wichita. The Poggi family—which now includes Virginia, 4, and Carol, 2—is living in Glendale.

1938

John C. Lilly, M.D., has been Assistant Professor of Biophysics in the Graduate School of the University of Pennsylvania since 1949. He's also in the Department of Medical Physics of the Medical School there. John spends about 90% of his time on brain physiology, and has found some "shapes" in the two-dimensional surface view of the brain's electrical activity. The other 10% of his time goes into a collateral interest in psycholanalytical research; no returns are in on this yet.

John, Jr., who was born when his father was a Junior at Caltech, is now 14 years old; Charles R. is 8.

Major General Donald L. Putt, M.S., will be the principal speaker at the Fifth National Men of Science and Industry

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11141 S. Longwood Dr., Chicago 43
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53 Lenox Rd., Berkeley 7
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SECRETARY-TREASURER R. R. Bowles '41
7960 Terrace Drive, El Cerrito
Calif. Research Corp., 576 Standard Ave., Richmond

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

New York Chapter:

PRESIDENT Richard K. Pond '39
95 Forest Road, Fanwood, N. J
Westinghouse Electric Co., 150 Pacific Ave., Jersey City, N. J.

VICE-PRESIDENT Mason A. Logan '27
17 Pittsford Way, Summit, N. J.
Bell Telephone Labs, 463 West St., New York City

SECRETARY-TREASURER Erwin Baumgarten '40
302 E. Front St., Apt. B-16, Plainfield, N. J.
Calco Division, American Cyanamid Co., Bound Brook, N. J.

Washington, D. C., Chapter:

PRESIDENT James Boyd '27
Bureau of Mines
Department of the Interior
Washington 25, D. C.

SECRETARY-TREASURER P. G. Nutting '36
5112 Connecticut Ave., N.W.
Washington 8, D. C.

Dinner to be held on June 15 at the Ambassador Hotel in Los Angeles. The dinner climaxes the 23rd annual convention of the American Council of Commercial Laboratories.

General Putt was assigned to Caltech while a member of the Air Force and received his M.S. here in Aeronautical Engineering. He is now Assistant Deputy Chief of Staff, Development Headquarters, U. S. Air Force, Washington, D. C. During his tour of duty he supervised the initiation, development and procurement of all Army Air Force experimental bombardment type aircraft — during which time such bombers as the B-36, B-35, B-29, B-26 and B-25 were developed. He is a member of the Research and Development Board and the National Advisory Committee for Aeronautics.

1939

J. Eugene Stones writes that a new boy joined the Stones family last January—which puts the score at two girls and three boys. Gene is still a geophysical supervisor for the Superior Oil Co., based in Oklahoma City. He recently made a 10-week trip to the Persian Gulf.

1940

G. R. Brown and his wife, the former Floy McWilliams of Brownwood, have been living in Midland, Texas, since December, 1949, where he's District Petroleum Engineer for the Texas Company. The Browns have built a new house and, the last we heard, were fighting the bugs and wind in an attempt to raise a lawn and garden.

1941

J. F. Rominger brings us up to date with the information that he finished his grad work at Northwestern in 1948, and has spent the last three years as a research geologist for the Carter Oil Company (a subsidiary of Standard Oil of New Jersey) in and out of Tulsa, Oklahoma. Last summer he was in the field in Colorado, Utah, Idaho, Wyoming, and Montana. Last fall the Romingers built a house in Tulsa, but were in it only a couple of months when they were shipped off to live in a company house in Venezuela. They're due back home in August.

Frank G. Casserly is now a Major in the U.S. Marine Corps, stationed with the Marine Corps Equipment Board in Quantico, as an electronics test officer. Assisting him is 1st Lt. *Richard K. Kuck* '46.

Paul Lieber, M.S., has just been appointed Associate Professor of Aeronautical Engineering at the Rensselaer Polytechnic Institute located in Troy, New York.

1942

Forest M. Clingan, Lt., U.S.N., writes that, in mid-December, he was transferred from Washington, D. C., to Honolulu, where—after a wonderful drive across the country—the Clingans are now settled down again.

David L. Hill writes from Nashville that he was married last December 31 to Mary Shadow, a Tennessee legislator. He spent last summer at the Institute for Teoretisk Fysik in Copenhagen, by invitation of Prof. Niels Bohr, to carry forward work on fission theory.

Edwin R. Fay, M.S., is working as architectural draftsman for a firm specializing in commercial and school buildings in Fort Worth, Texas. The Fays have a son, Bryan Peters, born on April 20.

1943

Ralph Willits of Monrovia was called back into the Navy early this year. He's now a Lieutenant and Operations Officer aboard the USS Douglas Munro (DE 422).

John R. Buchanan writes that he was recently recalled under the Army reserve program and has been assigned to the District Engineer in Anchorage, in connection with the construction program in Alaska. Naturally, he notes, the main forms of recreation up there are skiing, fishing, hunting and travelling around the territory. John and his wife also extend an invitation to all their Tech friends to visit them if they ever get close to that part of the world.

1944

Bruno H. Pilorz is to be married this summer to Martha Ingram of Pasadena.

Richard Knudsen and Teddy Vita of San Diego will be married on June 24th. Dick finished requirements for his M.S. in Production Management at UCLA in February this year and is now working in production control at C. F. Braun in Alhambra.

William E. Lockwood, Jr. became the father of a daughter, Juliet Lee, on April 16th. Bill is still working for the Continental Can Co. and has just been transferred to the new plant at Terminal Island.

George G. Shor, Jr., M.S. '48, has taken a leave of absence from his position as Party Chief with Seismic Explorations, Inc., to return to Caltech to continue work towards a Ph.D., starting this month.

W. A. Bussard is completing his third year in production work at the DuPont nylon plant in Chattanooga, Tennessee. Willis was promoted to shift supervisor last October. His family now includes a son three years old and a daughter 15 months old. The only recent Techman Willis has seen is *Ted Bartlett*, who is in the technical section at the DuPont nylon plant in Seaford, Delaware.

1945

Charles R. Cutler writes from Washington, D.C., that Professor, Emeritus, John R. Macarthur paid the Cutler family a call last month. Prof. Macarthur was in Washington on a tour of the east, visiting friends and relatives before returning to California. He'd come east not by car, plane or train, but by *freighter* through the Panama Canal. This suggested to the Cutlers—and Prof. Macarthur's visit with them only confirmed the fact—that he's still one of the liveliest persons who ever graced the Tech campus.

When he stopped in, incidentally, Prof. Macarthur had *Al Guillou* of the class of '40 in tow. Al is in the Washington office of Douglas Aircraft.

In recent months the Cutlers have had the pleasure of being looked up by such other transients as *Ted Taylor* '45 and *Bob Kieckhefer* '45. In fact, by some coincidence, they called the Cutlers within five minutes of each other, though neither knew the other was in town. Ted, who was just in Washington for a few days, is now back at Los Alamos, New Mevico, with his wife and two children (the second of which, for the record, was born while Ted was in Washington). Bob Kieckhefer was in Washington on a two-week tour of active duty for Navy. He's now in Chicago with a manufacturing concern.

As for Cutler himself—he continues to enjoy the practice of law, and claims to have become something of an expert on landlord-tenant problems in L.A. last fall when his firm represented the L.A. landlords in the court battles in Washington to uphold the city council's action to end rent control. Charlie's firm (Kirkland, Fleming, Green, Martin & Ellis) engages in general practice, though a large majority of its clients are businesses which it represents before government agencies.

1946

Richard G. Kuck writes from Quantico, Va., where he's on the Marine Corps Equipment Board at the Marine Corps Schools. Dick says that Major E. G. Casserly '40 is on the Board with him, and both are doing research for the Marine Corps. Dick hopes to return to South Pasadena this fall with the release of the reserves. His wife, Clarice, and daughter, Crystal are with him in Quantico.

C. R. Ewen was married last summer to Patricia Ann Hoagland in Palo Alto. He's studying Chemical Engineering at Stanford and aiming for a Ph.D. next December.

1947

Harold De Groff, M.S. Prof. '49, has just gone to Purdue University in Lafayette, Indiana, as Associate Professor of Aeronautics. After leaving Tech in November 1949, he went to work for the NEPA Division (Nuclear Energy for the Propulsion of Aircraft) of the Fairchild Engine and Airplane Co. in Oak Ridge, Tennessee. He left this job this spring when the NEPA work went over to General Electric, Lockland, Ohio.

Andrew W. McCourt, M.S., since February of this year has been a Group Leader in the Analysis Group, Special Products Development Division of Westinghouse, in Pittsburgh, Pa. The McCourts have a son, John, born on October 7, 1950.

Fernand P. de Percin, M.S., is now Chief, Field Office, Research and Development Branch, Office of the Quartermaster General, Dept. of the Army, Cameron Station, Alexandria, Virginia. He has two sons, Fernand, Jr., 4, and Paul Rene, 2.

Spencer R. Baen M.S., Ph.D. '50, Captain with the Army Field Forces Board, Fort Knox, Ky., writes that he's been serving with this Army agency since graduation in 1950. The agency tests all types of vehicles and development equipment prior to acceptance by the Army. It's interesting work, Spence says, and his Caltech training has been invaluable.

Wallace D. Hayes, Ph.D., writes that he's now Associate Professor of Applied Mathematics at Brown University in Providence, R.I. During the academic year 1951-52, however, he'll be on a Fulbright appointment at the Technical Institute at Delft in the Netherlands. He was married in September, 1948, to Laura Merriman of Wayne, Pa.

1948

William J. Williamson, M.S. '49, recently left the Aerophysics Laboratory of North American Aviation, where he had worked on rocket motor development since leaving Tech, and has taken a job in the Aerodynamics Department of Sverdrup & Parcel, Inc., St. Louis consulting engineers who are designing the Arnold Engineering Development Center which is being built for the Air Force at Tullahoma, Tenn.

1949

George M. Petzar writes that he's still on the same job — with the American Smelting & Refining Co. in Salt Lake City —and still has the same family—wife and daughter—but does have a brand new house.

Rolf M. Sinclair is at the Rice Institute in Houston, Texas, working on cosmic rays. He's just finished the requirements for his M.S., and—the draft willing—plans to go on to the Ph.D. He's going to spend the summer at Rice on ONR-sponsored basic research. He's founder and president of the Rice Film Society, which shows hard-to-see films, all the way from "The Great Train Robbery" to "Blood of a Poet".

Other '49ers at Rice include *Ken Famularo* (Physics Fellow) and *Jim Young* (English Instructor).

1950

Nick S. Diaconis, M.S., is working as an Aeronautical Research Scientist in the Lewis Flight Propulsion Lab., N.A.C.A., Cleveland, Ohio.

The book seems to contain only very few errors, and those that were discovered were all trivial. For example, Plate 10.5 on page 153, titled "The first photograph obtained of a meson trajectory (1931)," is attributed to a German physicist, whereas many inmates of the Norman Bridge Laboratory will readily recognize this photograph as a distinctly local product of the year 1931.

THE RETURN OF CHRISTOPHER
by Margaret Echard
Doubleday and Company,
New York, $3.50
Reviewed by Harvey Eagleson, Professor of English

THE FIRST REASON why Miss Echard's latest novel should be reviewed for *Engineering and Science* is that the hero, Christopher Gayle, attends Caltech, and it is of interest to Caltech men to see their school presented in fiction. The second reason for reviewing the book here, however, is more serious and important than the first, for the problem presented in the novel is one which troubles every thinking man in contemporary life. What can I believe? In the light of modern education, particularly scientific education which has so rapidly changed our concept of the universe in which we live, in the chaos of modern life with its overwhelming problems of economics, war and conflicting ideologies, what can I believe? What should my standards of judgment be? What can I find which will sustain me against the the impact of the "slings and arrows of outrageous fortune"?

The solution offered by Miss Echard in this novel is a return to orthodox Christianity. At least that is the solution of her hero, Christopher. It is Christianity to which he "returns". Whether it is Miss Echard's personal solution is another matter. One of the best qualities of her novel is its complete objectivity. She presents her characters with sympathy and understanding, but she never manipulates them to her own ends. She says in effect, "I give you one solution to the problem of modern life. I do not claim it is the only solution, or mine. This story is one man's experience. You may take it or leave it."

The story of the novel is in itself not too important. Although the reader's interest is maintained throughout, it is not because of sensationalism or novelty in the plot. In fact the principal interest in the novel's story is that it is so typical of American life and experience. Every male reader will find bits of his own life and thinking recorded in Christopher's. One of the remarkable features of Miss Echard's novel is that she so vividly and accurately projects herself into a *man's* experience.

Christopher is reared in a small American town, Albemarle, which could be any American small town with its comfortable middle class life, its social prejudices, local scandals, gossip, and play. This setting Miss Echard presents as realistically and as well as it has been done in any American novel. We have had many fictional pictures of small town life in America, notably Sinclair Lewis's *Main Street*, but as in that novel most of these pictures have emphasized the disagreeable aspects to the sacrifice of the agreeable, of which there are many. Miss Echard chooses a middle ground and as a result the life she portrays is nearer to that which most of us have experienced.

Christopher's family environment is strictly and rigidly religious. As he grows older he revolts against this attitude. He drifts away from his home and friends, attends Caltech, marries, becomes a teacher, is involved in World War II. But always he is dissatisfied, feels something lacking in himself and his life. At the end of the war he returns to his home in Sierra Madre and grapples with his problem. Having found his solution in Christianity and the desire to enter the ministry, he is again affected with doubt.

"Everything for which I prayed, every step which it seemed God had led me to take, appeared to be an expression of my own egotism," he confesses to an old friend.

To which his wise advisor, Dr. Muncie, replies, "You've spent your life seeking an object for your complete devotion. Having found it, you are inflamed with the deadliest of all passions: the urge to give yourself without hope of reward. Suddenly the whole idea is presented to you in a different light. You are made to question your motives, not because you distrust them, but because, for the first time, you realize that you are going to *receive* more than you feel you deserve . . . My dear boy, you might as well get used to jolts of that nature. You'll never be able to do anything for God that you're not embarrassed for the compensation."

Christopher accepts ordination

and the book ends as he preaches his first sermon on *I Corinthians*, second chapter, second verse. "For I determined not to know anything among you, save Jesus Christ, and him crucified."

Miss Echard attempted a difficult task in this novel and succeeded. She avoided the pitfalls of sentimentality and bigotry which are latent in her subject. She has written a fine novel and created an excellent piece of Americana, presenting as it does a kind of life which may all too soon disappear from the American scene.

GEOGRAPHY IN THE TWENTIETH CENTURY
Edited by Griffith Taylor
Philosophical Library, New York $8.75

Reviewed by Richard Jahns
Professor of Geology

PREPARED AS a "study of the growth, fields, techniques, aims and trends of geography," this volume represents the joint efforts of twenty authors. It is at once a careful sampling and a skillfully edited summary of geographical thought during the past half century, and as such is a unique and valuable contribution. More than 600 pages of data and sober discussion could well be pretty deadly stuff, but the potential reader need not be frightened away from this book by its somewhat encyclopedic aspect, even though he will quickly recognize most of the chapters as both comprehensive and authoritative. Not only is the general approach philosophical rather than merely descriptive, but much of the writing itself is lucid and pleasantly tidy. Many provocative ideas and arguments, presented in a wide variety of forms, are bound to raise questions in the reader's mind, particularly if he is an engineer or scientist with normal interest in the techniques of converting data into sound answers. He may react favorably or he may react unfavorably to some of the arguments, but he assuredly will react!

The book comprises three sections, the first of which deals with the development of geography as a science, together with its philosophical basis and the several schools of thought that evolved at various times in different parts of the world. The introductory chapter, provided by Griffith Taylor, the editor, is extraordinarily broad in scope, and sets a strong pace for the rest of the book. Among its most attractive features is a succinct discussion of the old but not-yet-dead "theocratic" view of geography, in which the well-being of man is held to be the basic aim of an omniscient providence; the later and now-very-active "geocratic," or environmental view, which places emphasis upon physical factors as the chief control of human activities and development; and the "we-ocratic," or possibilist view, in which man is favored as master of his own geographic destinies and the natural landscape is subordinated to the "cultural landscape." These points of view are later treated in detail by George Tatham, who also contributes an historical chapter on geography in the nineteenth century. Other chapters summarize the development of geography in France, Germany, Czechoslovakia, and Poland. Interestingly enough, an attempt was made by the editor to obtain contributions from Russian and Jugo-Slav scientists, but no satisfactory contact could be made.

The second section of the book comprises four chapters that are concerned with geomorphology, meteorology, climate, and soils, and six chapters that present regional discussions in the light of these environmental factors. These 227 pages thus deal with the most fundamental elements of geography, and as such serve as the fulcrum of the book. The third section is concerned with aviation; fieldwork; political, social, and racial problems; and other more general topics of broad application. In many respects, such chapters as Geography and Empire, Racial Geography, Geography and Aviation, and Geopolitics and Geopacifics are the most stimulating in the book, but they will not yield a full return to the reader who skips over the material in Parts I and II. A good summary of all three parts is presented by the editor in the introductory chapter (pp. 19-27).

The Line-Up

The selection of contributing authors plainly was a careful one, and such well-known authorities as S. van Valkenburg, S. W. Wooldridge, Isaiah Bowman, L. Dudley Stamp, Charles B. Fawcett, and Ellsworth Huntington are represented by excellent chapters. It should be added that several of the other chapters, the work of younger men, seem fully as good, and include some of the most vigorous writing to be found in the book. Each contributor uses his own analytical approach and mode of presentation, which is at once an advantage and a disadvantage to the reader. Although the over-all balance of treatment is thereby improved, an essentially segmented coverage of so broad a field as geography inevitably leaves sutures and gaps in the final product; these, however, have been held to a minimum by the editor, who has integrated the numerous contributions with considerable success.

Scientists in other fields may be

somewhat less than favorably impressed by many of the attempts at quantitative treatment of data and concepts, and perhaps especially by the fundamentally subjective approach to some problems. The geographer's fondness for maps, diagrams, and charts is well shown in several chapters, but the intrinsic accuracy of these helpful illustrations rarely is indicated or even suggested. One wonders, for example, about curves that are based upon three control points, and about simple block diagrams that show the relations of several highly complex and imperfectly known variables. One might question, too, the derivations of several formulae on the basis of obviously incomplete data. The geologist will be shocked at some of the over-abbreviated, misleading, or even incorrect definitions of terms in the "concise glossary of geographical terms" that concludes the volume.

Scientific Analysis?

Another question that most readers will ask again and again relates to possible "sampling errors" in most of the geographic analyses. This problem undoubtedly is recognized by many geographers, and John Kerr Rose, in his discussion of geography in the Federal government, states (pp. 575-576): "Field methods, particularly elementary techniques of survey, which do not adequately consider the problems of representativeness of samples, are of no particular help—a good course in elementary statistical methods would be used many times more frequently." The somewhat "personalized" techniques employed by at least four of the authors raise some doubt in the reader's mind as to just where scientific analysis ends and authoritarianism begins. These men—and the editor himself appears to be one of them—repeatedly call attention to their own views in apparent attempts to increase the weight of their arguments.

Relation to Other Sciences

Despite these relatively minor shortcomings, this book is good reading. In particular, the man who deals with the more "exact" areas of science and engineering will gain a better understanding of geography, whose place in science is not easy to determine. In its dominantly physical, or "environmental" facets it is closely related to such well established fields as astronomy, botany, geology, and physics. In contrast, those facets that form the human side of geography are related to anthropolgy, economics, history (including politics), and sociology.

The geographer himself is at times somewhat bewildered by the internal complexity of his field, and certainly the attempts of a few geographers to analyze environmental data in rigorous fashion have been blocked again and again by the "human" aspects of the problems. "Human" geography, or the ontography of the late William Morris Davis, characteristically involves data that are elusive, inconstant, and all too often misleading. It is evident that such data are not susceptible to the rigorous treatment ordinarily demanded, for example, by the chemist or physicist, and they introduce maddening uncertainties into most geographic problems. And even in those problems that are perfectly free from ontographic complications, the geographer finds his "environmental" data none too promising. Here he joins the physical geologist, who must lean heavily — and perhaps shakily — upon the doctrine of uniformitarianism, who must be willing to make use of semiquantitative data (even though he is not necessarily content with these data), and who must extrapolate far beyond his area of observed relations.

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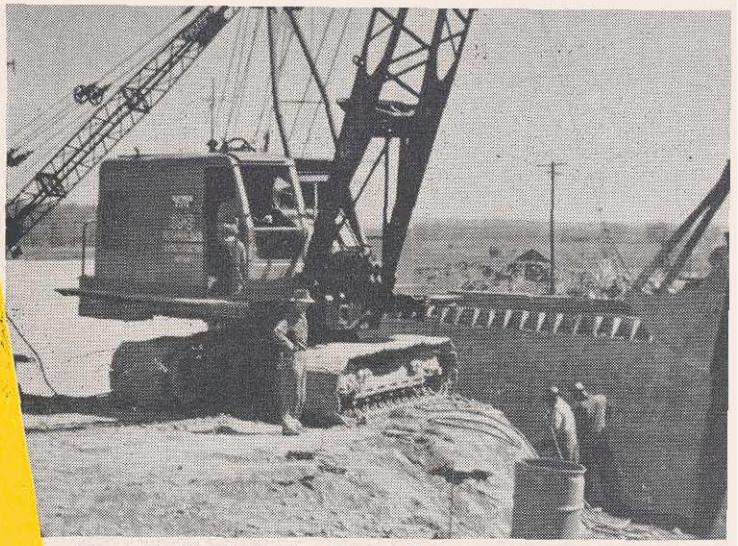

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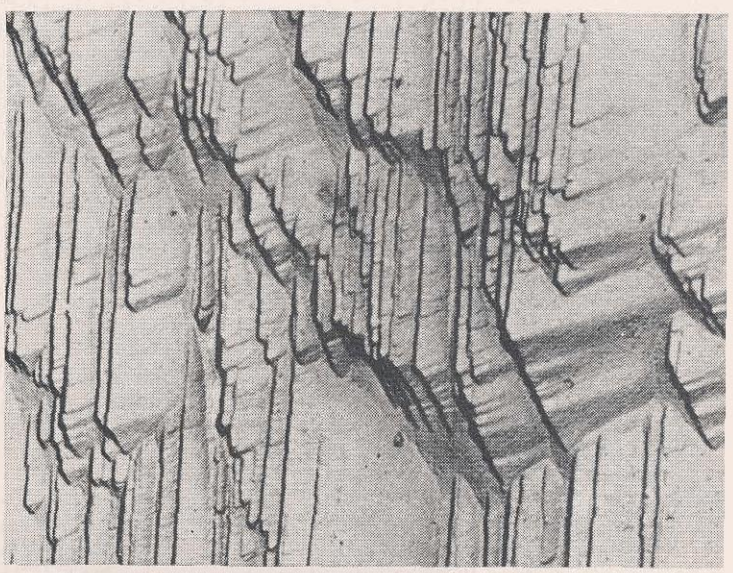

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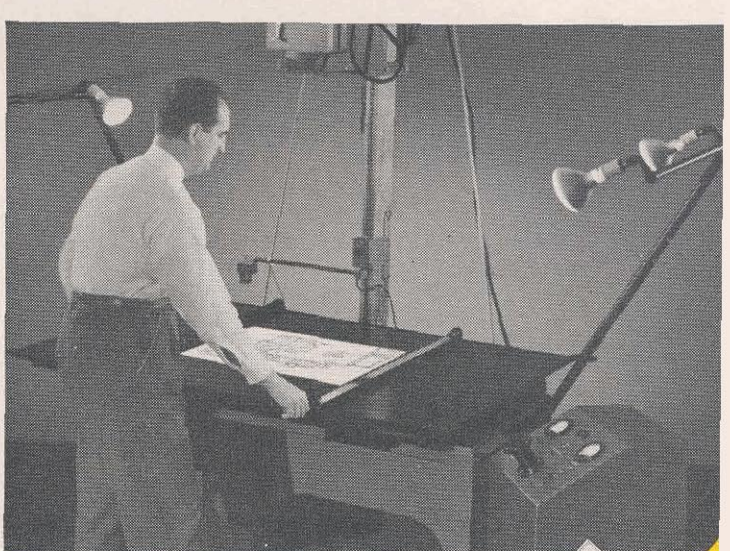

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