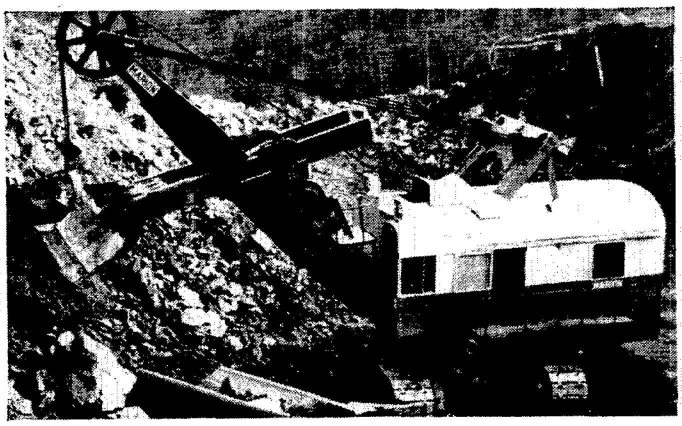
ENGINEERING | AND | SCIENCE

JUNE/1952

1952 Commencement . . . page 18

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Another page for **YOUR BEARING NOTEBOOK**



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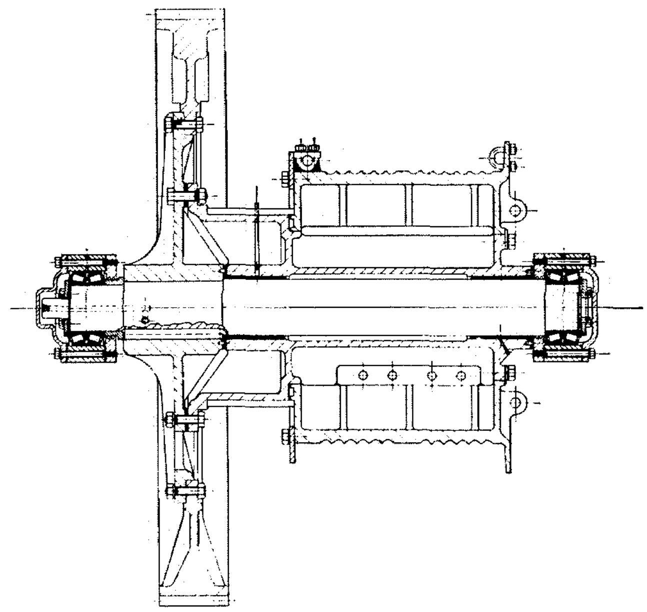

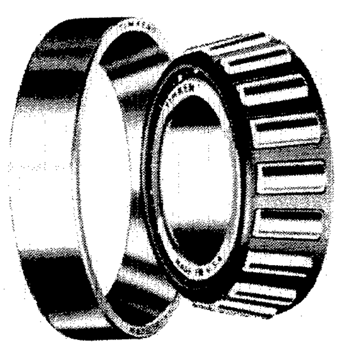

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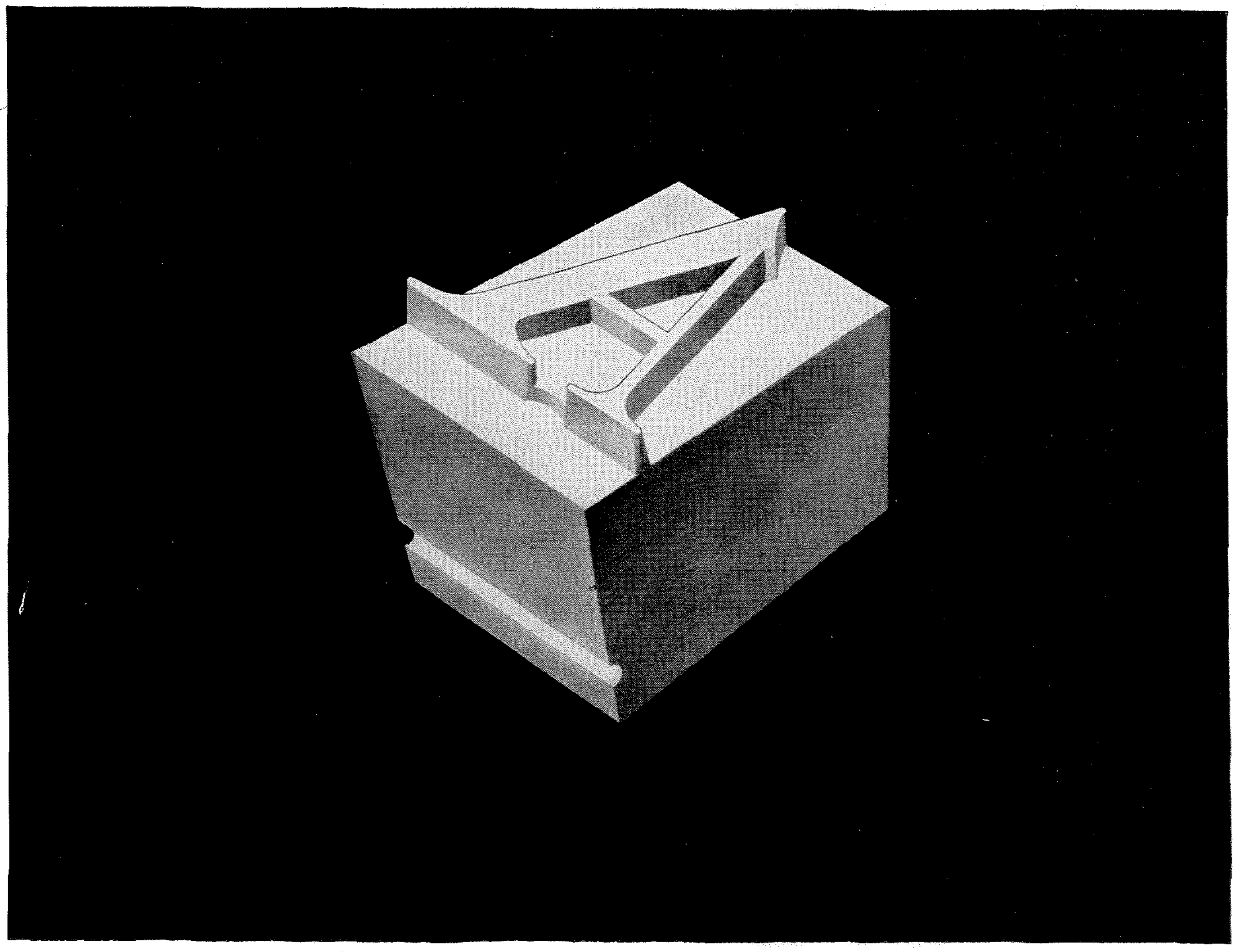

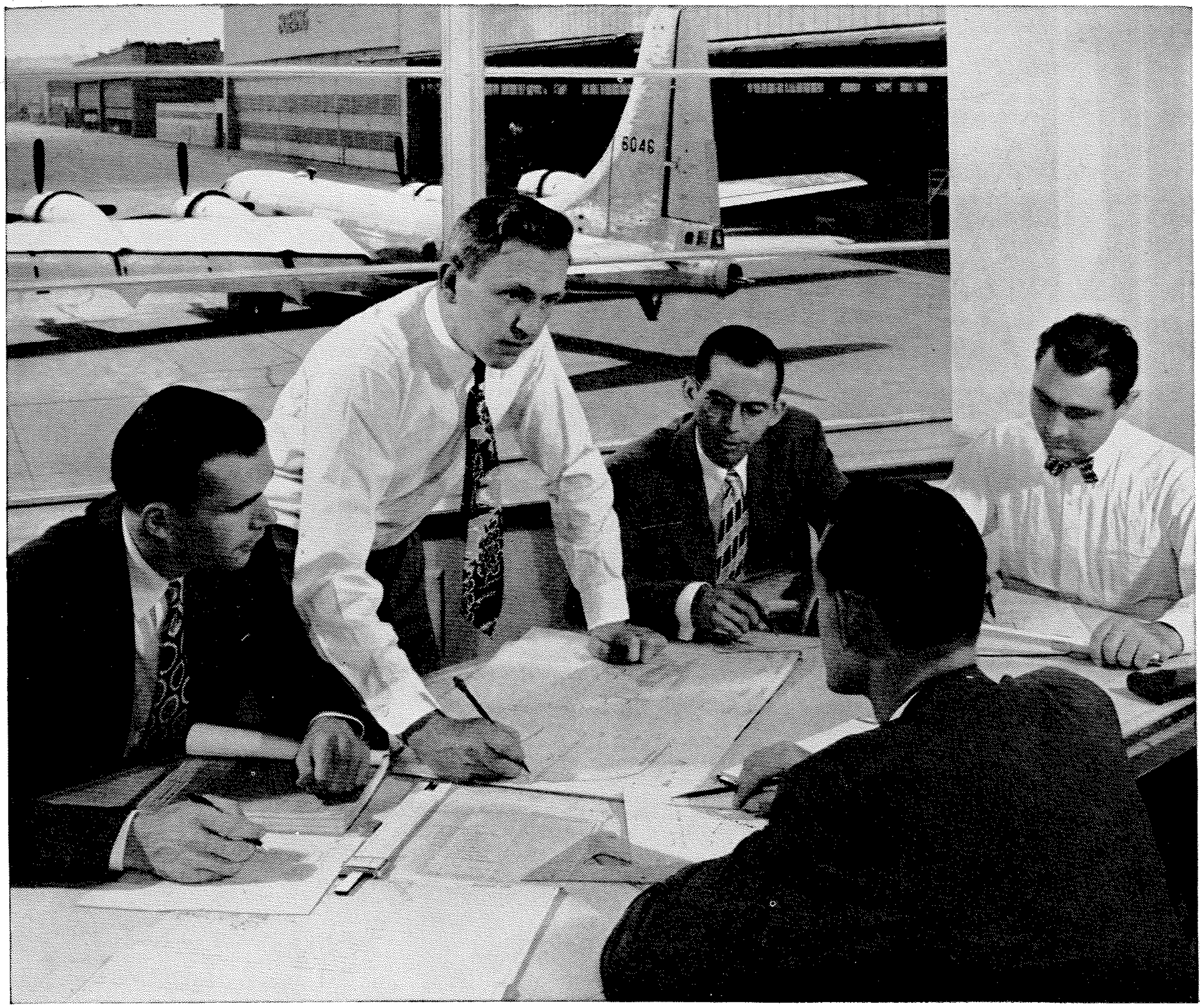

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JOHN C. SANDERS, Staff Engineer—Personnel
Boeing Airplane Company, Seattle 14, Washington

BOEING

LETTERS

Sirs:

In response to the inquiry (from the Institute's C. E. Division) as to what extent I have been able to use the technical knowledge I acquired at Caltech, I decided to shoot the works—as the following treatise will prove.

Before I can say much about what I'm doing, it might help matters if I gave a little background history of my company and the project it's now engaged in in Indonesia.

To begin with, the California Texas Oil Company, Ltd. is owned jointly by Standard of California and The Texas Company. It might be said that Caltex, as it is called, is the foreign "right arm" of these two companies—and it, in turn, owns several companies that operate refineries, develop oil fields, and market the products in all parts of the world except the U.S.A.

It has its central engineering and purchasing office in New York, and most of the engineers there—of which I am one—are often sent on assignments in various parts of the world.

One of the companies owned by Caltex New York is N.V. Caltex Pacific Petroleum Maatschappij. At present it has offices set up in Djakarta, Java, and is prepared to take over operation of the Minas Crude Shipping project in Central Sumatra, once the preliminary construction (putting in flow lines to the wells, storage tanks, pumps and generators, gathering lines to a central station, roads, power lines, loading facilities for tankers, etc.) is over.

Here is where I come in. The New York office has sent out an engineering staff to work separately, but in cooperation with the Dutch company, whose job it is to complete the construction end of the project. I am part of that staff. I was not sent out on any contract basis, but rather to do a job, whether it takes two months or two years—though rarely is an engineer away from the New York office for more than 18 months at a single stretch.

Most of the actual physical aspects of the job have been contracted to Bechtel (roads, pipelines, pumping stations, buildings, etc.) and the Chicago Bridge and Iron Company (tanks). The Engineering staff sent out by Caltex works mostly in coordinating and supervisory positions. Part of my job here is to keep close check on the shipment and delivery of critical items to the project. Up to now my job has been largely that of the job engineer, who does little design work but is on hand to advise the field and handle all of the thousand and one little problems that come up every day and require immediate solutions. The solutions are not always the best but they must always be adequate.

I'll have to admit that so far I've found very little need for the so-called "technical knowledge" I acquired at Tech.

CONTINUED ON PAGE 39

ENGINEERING AND SCIENCE

IN THIS ISSUE

This month's cover picture needs very little explanation—and what little it does need we aren't going to be able to give you. The father and daughter in the picture will have to go unidentified—for the present, at least. They went by at such a high rate of speed, and in such a happy trance, that our camera was lucky to have caught them at all. There are some more pictures, and all the details, on Commencement on page 18.

Milton Katz, Associate Director of the Ford Foundation, was the speaker of the evening at the annual banquet of the Caltech Alumni Association, held this year at the Los Angeles Athletic Club on June 4. Only 200 people got to hear his talk on "The Question of Peace" that night, and it's one of those talks that ought to be heard by ten times that many people anyway. You'll find it, exactly as delivered, on page 9 of this issue.

Matthew Sands, author of the article on page 14 of this issue, "Research With Large Accelerators," is a Senior Research Fellow in Physics at Caltech. He came here in 1950 from MIT, where he had been an assistant professor. At Caltech he has been teaching a course in electronics for graduate students, and working on the construction of the Institute's new synchrotron. He'll be taking a year's leave of absence starting in October, though. He has just been awarded a Fulbright grant, and will spend a year at the University of Rome on cosmic ray research.

PICTURE CREDITS

Cover	William V. Wright
p. 11	William V. Wright
pps. 11, 22, 24	Frank F. Crandall William V. Wright James W. McClanahan
p. 30	William V. Wright

JUNE 1952 VOLUME XV NUMBER 9

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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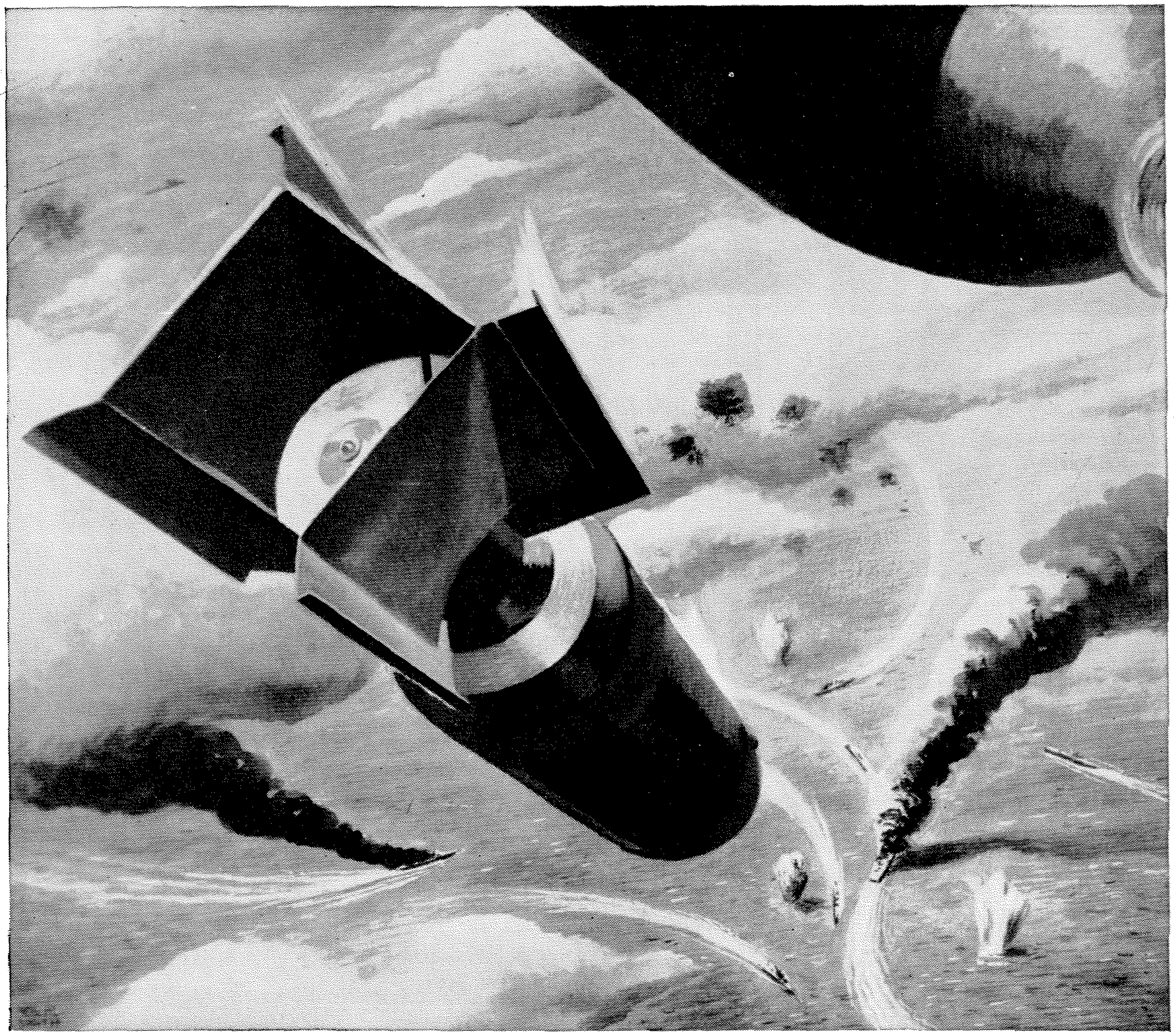
STAFF

Publisher..........Richard C. Armstrong '28
Editor and Business Manager..........Edward Hutchings, Jr.
Student News..........Al Haber '53
Staff Photographer..........Wm. V. Wright
Editorial Consultant..........Professor of English George R. MacMinn

Published monthly, October through June, at the California Institute of Technology, 1201 East California St., Pasadena 4, Calif., for the undergraduates, graduate students and alumni of the Institute. Annual subscription $3.50, single copies 50 cents. Entered as second class matter at the Post Office at Pasadena, California, on September 6, 1939, under the act of March 3, 1879.



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Engineering and developing these and similar complex electronic or electro-mechanical devices are the work of Arma Corporation. For 34 years Arma has collaborated with the Armed Forces—and more recently the Atomic Energy Commission—on such complex instruments. Adaptations of these systems will be readily applied to our industrial might in the future. Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y.; Subsidiary of American Bosch Corporation.

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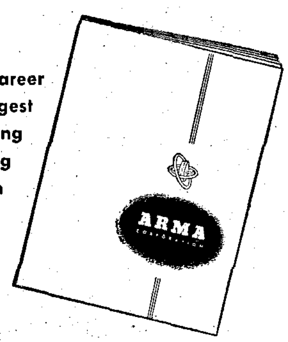


ARMA ADVANCED ELECTRONICS FOR CONTROL

Why—*when we have enjoyed so many doughnuts—* do we only see the hole?

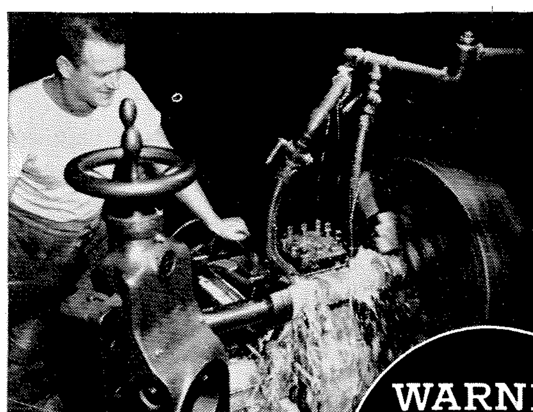
If all restrictions were removed so that people could go wherever they wished—wherever conditions were most to their liking—where would the travel be? From profit-and-loss America to socialist countries where the government agrees to take care of you from cradle to grave? To Russia where the rich have been destroyed and everyone is "equal"?

No, the rush would be to America. The world appreciates (often better than we do) that America still offers the opportunity to get ahead if you're willing to work for it; the only chance for a happier future.

No one claims the American profit-and-loss system is perfect, but it is so much better than anything else in the world that we had better make sure we keep it, and not whittle it away tax by tax, restriction after restriction.

No other system in the history of the world ever policed itself so well as the American system in the past fifty years, no other system ever improved itself and its country's standard of living so greatly.

The union officials, government bureaucrats and socialists who attack results of the profit-and-loss system should remember the dictate in the Bible about removing the beam in their own eyes before looking for the mote in capitals'. And they should look at the doughnut, not the hole.



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Takes a lot to lay a carpet in the jungle

The scene is "darkest Africa".

But Africa is lightening. Man's quest for minerals, for new areas for agriculture and trade, is slashing ultra-modern, glaring-white air strips in once impenetrable jungle.

Those pavers, portable air compressors, pumps and air tools—such as you might see working a city street—are Worthington Blue Brutes going to "lay a carpet" in that hole in the jungle.

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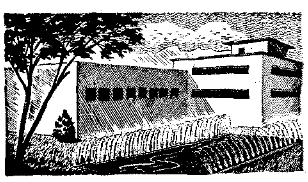

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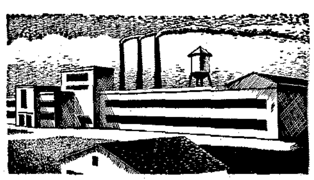

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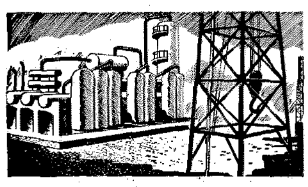


Petroleum Products—compressors engines • pumps • chilling equipment refrigeration • decoking systems

More Abundant Food—compressors fertilizer mixers • air conditioning refrigeration • pumps

THE QUESTION OF PEACE

By MILTON KATZ
Associate Director, Ford Foundation

A fundamental consideration of what it is we want in our foreign relations today—and what chance we have of getting it

A distinguished former Chief Justice of the United States had a habit of arranging his arguments in such a way as to make his conclusions seem inevitable. He had a favorite phrase with which he would dust off a claim. "To state the question," he would say, "is to answer it." A caustic critic on one occasion observed that this was true only because the good Chief Justice had assumed his answer by the very way in which he had stated the question.

It is also possible to state a question in such a way as to make it unanswerable. This can be a harmless parlor game: for instance, "Which came first, the chicken or the egg?" In practical affairs, it can be devastating. In a free society, men must be able to compose or adjust their differences on some workable basis. Their capacity to do so turns largely on how they see the questions which divide them. The issues can come up in such terms that discussion about them can have no useful outcome. For instance, what can we do with a question like this: "In the current crisis, which must give way, national security or the bill of rights?" Or how about this one—"Which is the quick, clean way out of the current mess—to pulverize the Soviet Union with atomic weapons; or to sit down with Stalin, lay the questions between us right on the line, and settle them firmly and finally?" These illustrations condense actual experience and give it a touch of caricature. But I believe you will recognize them. They reflect some of our vivid experience during the past few years.

Issues in such a form are unmanageable. They can only lead to fruitless controversy. I shall try later to show why this is so. To the extent that this happens among a free people, they lose political effectiveness. The issues must come up in terms which make them manageable.

This is in no sense a matter of glossing over questions, or looking at facts through rose-colored glasses. The facts must be seen as they are, and we must pray for the gift to see them that way. It is a matter of seeing issues and facts in their proper setting. This means seeing them in due relation to what we are and what we have been. It means seeing them in relation to the things we want and the things we live by.

It is in this sense that I should like to explore with you today some of the questions of foreign policy which concern us. As a point of departure, I shall try to examine what it is we want in our foreign relations. You may well feel that I have chosen to begin at a point which is certain to finish me. In these bewildering and clamorous days, one wonders whether the heart of our difficulties is perhaps that we don't know what we want, or that we want so many conflicting things that we have jammed ourselves into a frustrated standstill. Perhaps, however, there is a way to get at the question which won't mire us down.

Possibly the clue lies in bringing the question down from what we want as a people to what we want as individual men and women. We feel uneasy and insecure. We wonder whether we are not caught in the wash of a blind and uncontrolled rush of events. We'd like to recapture a sense of at least some participation in the control of our own personal destinies. This may be just another way of saying that we want a reasonable measure of security. With that security, we want to be free to live our lives as we see fit. We want to do our jobs and make a living and raise a family; we want to sing songs or play baseball or write poetry; in short, we want to be free to realize to the full our potentialities as human beings. Whatever the confusion of the times, these are the central and stable purposes of most Americans.

Peace with justice and freedom

We naturally want the foreign policy of our government to reflect these purposes. The consistent objective of American policy since V-J day has been peace with justice and freedom. It would be hard to imagine a more accurate expression in governmental terms of what we want as individuals.

So far, so good. But just what do we mean by peace with justice and freedom? Shall we take it to mean universal and permanent peace? As an ideal, this would be fitting. Yet, if we make this our political goal, most men will feel in their bones that it is beyond the grasp of this generation. They will therefore be unable to pursue it with conviction. We must define a goal which will command not only our highest aspirations but our sustained practical energies. I believe this can be done. Within the past century and a half, this world has known one or two periods of some thirty years which have been free of major international tension. Suppose we add ten years, and make our own goal peace for forty years. Since this is the year 1952, we might stretch it to forty-eight years—peace with freedom and justice for the remainder of this century. Forty eight years in which modern man could redress his moral balance, and recapture his humanity, and turn his incalculable resources of science and organization to constructive purposes.

What threatens this objective? Primarily, the policies and practices of the Soviet Union, and the reactions to which they give rise elsewhere in the world. This danger is compounded by confusion and impatience within the United States. There is also the immense ferment of Asia; economic dislocation in Europe; poverty, ignorance and restiveness in underdeveloped areas; and the lack, throughout the world, of a vision of the future toward which decent men can aspire and in which sensible and practical men can believe. I am aware that this begins to sound like a catalogue of all the ills and frailties to which flesh is heir. You may feel that I need only add "original sin" to make it complete. Indeed, in the long perspective of history and geology, except for relatively brief periods in relatively limited corners of the earth, mankind as a species has hardly been more than a few jumps ahead of starvation and mutual destruction. Today is no exception. Its special feature is perhaps our greater awareness of incipient misfortune due to the range of modern communications. Even without such communications, Job perceived that man that is born of woman is of few days and full of trouble.

Properly understood, this is true, and valid. It can be misunderstood, and taken as a counsel of despair. Rightly understood, it establishes perspective, and becomes a counsel of humility and patience. It reminds us that we must limit our objectives, and keep them in focus.

Let's try to sharpen the focus. At what point would we celebrate VCW Day—Victory in the Cold War Day? At what point would we say: This is it, this is what we have been seeking. Are we sure we would recognize it if we saw it?

We can try to bring our objectives into focus in other ways. Winston Churchill has advised us that we cannot reason with the Soviet Union, but that it may be possible to bargain with it. Bargain for what? Particular bargains might be limited and specific, but they would involve choices which should be guided by longer purposes. What purposes?

Many experienced voices remind us that we must rebuild our relative strength, in order that we may take the initiative and lead from strength. Lead toward what?

It would be easy to give these questions a sarcastic twist, in the spirit of a debater trying to score a point. This might be clever, but would get us nowhere. It seems to me we must approach them simply and directly in a real attempt to decide what we want.

There is, of course, an element of oversimplification in these questions. Taken literally, they might suggest an expectation of precise and final solutions. We know that things seldom really happen that way. But in their essential meaning, questions of this sort must be faced. We should have a reasonably concrete and flexible idea of what we want, if we are to have a reasonable chance of getting it. In the world as it is, this means a reasonably concrete and flexible idea of what we want of the Soviet Union.

What we want of the Soviet Union

With your forbearance, I will rush in where angels fear to tread, and try to suggest what this might be. We can test what we want by a grim process of thought.

Suppose that we should have a full-scale war with the Soviet Union. Suppose that, after the full cost in blood and chaos, the Kremlin should surrender unconditionally. Russia, let us say, would lie under our heel, waiting for us to do what we would. What would we do? There is no need to guess in a vacuum. Let's look at what we did when free to impose our will on a defeated Germany and a defeated Japan in 1945, and a defeated Germany in 1918. We pushed the Germans and the Japanese back within their own boundaries. We disarmed their forces. We brought about a change in their political regimes—in Germany, a change based upon the extirpation of the Nazi hierarchy; in Japan, a change with a factor of continuity in the person and status of the Emperor. We

Milton Katz has been Associate Director of the Ford Foundation since September, 1951. Before joining the Foundation, he was U. S. Special Representative in Europe, with the rank of Ambassador. As such, he was chief of the Marshall Plan in Europe — succeeding W. Averell Harriman in this post. Concurrently, Mr. Katz served as the U. S. member of the Defense Financial and Economic Committee under the North Atlantic Treaty. He was also the senior U. S. delegate to the United Nations Economic Commission for Europe.

Prior to taking up his duties in Europe, Mr. Katz was Byrne Professor of Administrative Law at Harvard University. He is a graduate of Harvard College and Harvard Law School. During the war he was a Lt. Commander in the Navy, assigned for duty to the O.S.S.

gradually opened both countries to the entry of people and ideas and information and trade from abroad. Incidentally, we also undertook to help feed and rehabilitate them. It is reasonable to assume that our treatment of a defeated Russia would not be very different.

We have permitted ourselves a cold and brutal exercise of the imagination. I feel it to be justified, for it helps us to see what really matters to us. The programs we have imposed on defeated enemies after bitter wars have recurrent themes. These throw light on what we want of nations which seriously threaten our security and freedom.

By this light, I believe we can broadly sketch what we want of the Soviet Union. There are differences, of course. We are talking about life, not geometrical patterns. For instance we would obviously be glad to forego the burden of helping to feed and rehabilitate Russia. There are also differences in degree, which at least in part grow out of our will to reach our objectives without a full-scale war. But the main elements can be seen.

We want the withdrawal of Soviet military forces within the proper borders of the Soviet Union.

We want the reduction of the Soviet and satellite forces to a size and composition which the common sense of honest and realistic men would accept as genuinely defensive. Countless hairs have been split in an effort to distinguish defensive weapons from offensive. Nothing could be farther from my purpose than to involve this inquiry in such an effort. When I speak of a genuinely defensive condition of the Red forces, I mean a condition which the common sense of honest and realistic and well-informed men will accept as in fact consistent with real freedom from tension and the real concentration of human effort throughout the world on constructive purposes.

We would also want reasonable assurance that these forces, once reduced and limited, would stay that way. This might require an arrangement for international inspection and verification. Over the long pull, such an assurance could perhaps be effected more simply and naturally through greatly increased access of people, ideas, information and trade from the outside world to the Russian people, and a corresponding flow of information about the Russian people to the outside world. This, it seems to me, would be necessary in any event to establish a general sense of security. Without it, the free peoples would tend to feel themselves subject to any abrupt and unforeseeable change in dictatorial whims, and so remain uneasy and restive.

The spread of Communism

We would also want to end the spread of Communism. The spread of Communism is a compound whose principal ingredients must be brought separately to light and examined. In part, it means Communist penetration— that is, the systematic use of the Communist party by the Kremlin as an instrument of organized espionage and subversion. This raises a problem of discovery, disclosure and mature and responsible countermeasures by appropriate authority and appropriate procedures. In a broader and vaguer sense, when we speak of the spread of Communism we often mean the spread of ideas and sympathies related more or less loosely to Communist doctrine. This raises a problem of competition in the free and open market of ideas. I need hardly add that these problems overlap, and this greatly increases their complications.

There are of course many other things we may want, if we take the word "want" in a completely literal sense. But we must consider what we want in terms of the things we live by, and in terms of possible and probable action in the world as it is. This raises the question of how we may reach our ends, and the relationship of means to ends.

I don't know how to achieve these ends. I do have some ideas about how they cannot be achieved. I also have some ideas about the conditions which must be satisfied if we are to have a realistic prospect of achieving them.

Is war the way out?

There is a ghost that sometimes walks at this sort of inquiry, and whispers in our ears, "Is there any way out but war?" As sane and honest men, we instinctively reject the whisper, but it sometimes leaves a dim echo of doubt. It seems to me that the remedy is to keep our eye on the ball—to keep in mind what we are after, and not let ourselves be distracted. Since our objective is peace with freedom and justice, war is obviously not a means of achieving it. Since our objective is peace with freedom and justice, we would accept war rather than surrender to aggression. Aggressors must understand that the free peoples will pay even the price of war rather than submit to tyranny. In making this clear, we must avoid the infantile folly of forgetting what we ourselves are after. We must not dance to the Kremlin's tune. If we should let the Kremlin's behavior throw us into an aimless frenzy, we would in fact be dancing to its tune. It's elementary tactics in all forms of competition to throw your opponent off his game by getting him riled. The Kremlin makes skillful and persistent use of such diversionary tactics. We must not be taken in by them.

We can also be thrown off our course by romantic escapism. This can take a surprising variety of forms, but they all have a common theme: the vain hope for a quick and easy solution. There have been some who have felt that the men of the Kremlin could be turned from their objectives by a show of trust and confidence in them, by friendly words and gestures of self-denial on our part, designed to reassure them. This delusion appears to have been pretty well laid to rest among us. But another delusion persists. Under its influence, some believe that the destiny of this republic could safely be rested on some special weapon; that the Kremlin and its creatures could be quickly and easily bludgeoned into meekness; that perhaps they could even be terrified into good behavior by rough loud talk. On the surface, these notions are very different. At bottom, they are similar, in the sense that they are both forms of daydreaming escapism. The handwringer who would appeal to the Kremlin's better nature, and the quick-and-easy bomb-dropper, are brothers under the skin. Neither will face the facts as they are. Neither has the stomach to stay the course.

In our thoughtful moments, most of us are painfully aware that there are no quick and easy solutions, but the fact tends to exasperate us. We incline to an impatient feeling that such a state of affairs is somehow abnormal. In fact, the situation is fundamentally normal, and it will help us to maintain balance and perspective if we hear this in mind. There never has been an easy road to freedom or justice or security or peace. We see this plainly enough in our lives as individuals. There are books on cheap bookshelves which purport to lay down the ten rules for a successful career or the twelve rules for a happy marriage, but we laugh them off. We know there are no easy formulae to enable us to circumvent the processes of life. Yet, by some freak tendency of the human mind, when we pass from the single individual or the married couple to the one hundred and fifty million souls who make up the American people, or the two and a half billion who people the earth, we have a perverse feeling that the problem should somehow be simpler and that there should be ready answers. We cannot afford to indulge these whims. The times are too serious. In our lives as citizens, as in our personal lives, we cannot expect prompt, exact and final solutions to the deepest of human problems, and it will only throw us off balance if we look for them. It is the right lines and quality of effort which we must seek, the sense of direction, the standards of performance, and the values to guide us.

Perhaps I may venture some suggestions about the lines of effort which are needed. These will relate to some of the conditions to a wise and strong course of action.

On two of these conditions I have already dwelt: the need to keep our eye on what we want; and the need to bear in mind that we have a long row to hoe. There are two others which seem to me to warrant special emphasis. We must understand the nature of the struggle in which we are engaged; and we must understand the true sources of our own strength.

The sources of Soviet imperialism

Some believe that Soviet imperialism grows out of an old-fashioned lust for dominion on the part of the Kremlin. Some believe it grows out of an ideological thrust to world revolution. Some think it reflects a craving for security by the Kremlin, combined with its conviction that it can have no security so long as any power exists which could challenge it. Whatever may be the elements of motive and in whatever mixture, the practical course of conduct which flows from it tends to be the same. In the seven years since VE Day, the Kremlin has seriously extended its sway. Some eight hundred million people now listen primarily to the voice of Moscow. This has been achieved without the direct engagement of any of the Soviet Union's own military forces. It does not follow that she has not used them. She has put them to steady and terrible use, as an instrument of fear. The shadow of the Red army has lain like an incubus on Europe and Asia. This has been more than a by-product of military preparation. It has been a deliberate policy, specifically designed to smother hope, to stifle initiative, to sharpen tensions, and to break the will. There is therefore a double need to rebuild the armed strength of the free world. We must deter military aggression and be able to cope with it if it should come; and we must counteract the Kremlin's strategy for imposing its will through terror.

Rearmament is indispensable. But it is only part of what we need, just as the Red Army is only one of the tools of the Soviet Union. The very nature of the use which the Kremlin has made of the Red Army shows the pattern of its aggression. On the record, the Red Army during the past seven years has been employed primarily as a political and psychological weapon. It has been used in a mutually supporting relationship with other devices. Through these, the Kremlin has maintained an astute and steady pressure against the free peoples on all fronts—political, economic, psychological and moral, as well as military. The strategy of terror has been supported by a strategy of division. The Kremlin has worked unceasingly to sow suspicion and discord, and to harvest cleavages within and among the free peoples.

What we need

We have been anxious to achieve a wise relationship among the air, naval and ground army components of our strength. But in the current struggle, the effective use of our resources has a deeper and wider meaning. We need a wise relationship among the political, military, economic, psychological and moral components of our power. It would be as pointless to build up our armed forces and forget the political or economic sector, as it would be to build up the ground army and forget the air force, or to build up the air force and forget the services of supply.

If we would marshal our strength effectively, we must also remember from whence it comes. We clearly see the need for our armed forces. We rightly appreciate the importance of our free economy, and of our industry and technology. Yet, in the deepest sense, the republic was already mighty in 1789 and in 1812, when its armed forces and economic resources were trifling compared to those of Napoleon and the Russia of Alexander I. Whence came its strength? From the principles on which it was founded, and the values out of which they grew. We affirm the spiritual value of freedom and justice as articles of faith. It is good for us to do so. Let us also remember their intensely practical value.

The most precious natural resource of any people is not its soil or iron or oil or uranium, but the quality of its men and women. The authoritarian society is biologically wasteful and inefficient. It quarantines the bulk of its human resources, and permits only a fraction of its men and women to make themselves fully felt. It is only a free society which can draw fully on this resource, for it is only a free society, in the measure that it realizes its principle of freedom, which gives full play to individual character and talent.

It is only through justice that the individual talents and energies of free men can be brought into harmonious unity. It is as true today as in Ben Franklin's time that we must hang together if we would not hang separately. In this far-flung struggle, the potential strength of America can only be fully realized through a deep and strong sense of community, within herself and with other free peoples. Each of us knows from his personal experience that nothing can disrupt an organization or team or family more surely than a sense of injustice, and that the key to unity among free men is fair play. The most enduring and powerful form of efficiency is the voluntary collaboration of free men, sustained by the sense of a common stake in which all participate on a just basis.

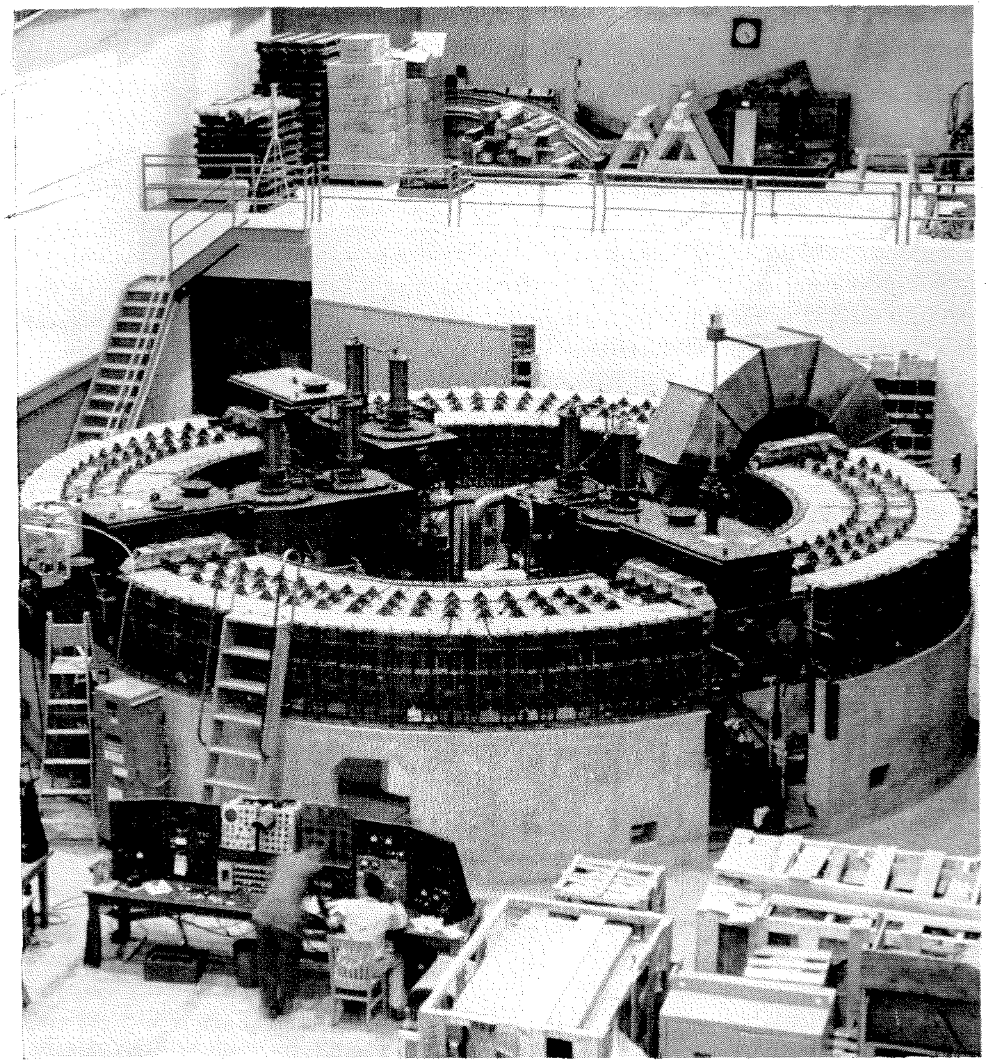
What we can't forget

These are matters which we dare not forget. In our anxious and impatient quest for security, it is possible at times to forget them, and to fall into the blind error of trampling on freedom of thought and the rights of men. We would do this at our peril. In the world as it is, we can maintain freedom and justice in America only if we keep the nation secure against her enemies. This is a fact which must be faced. It is no less true that our national security depends on the maintenance of freedom and justice, which are the ultimate sources of our strength. We would deny our history to assume that the American people lack the wisdom to harmonize these ends.

There is an ancient tale about the invasion of Ireland by the Danes in the Middle Ages. A group of Danish invaders camped alongside a swamp. They became ill, and died. We can surmise the illness was something akin to malaria or yellow-fever, but the Danes understood nothing of this. They felt themselves attacked from the air by an unseen enemy. They were valorous men, and drew their swords to fight back; and they died blindly cutting the air, and one another, with their swords. It was magnificent, but self-defeating and utterly futile.

In the bewilderment and stress of the times, this seems to me a story worth remembering. We must identify and understand the real sources of danger, and the true means to meet it. Perhaps we would also do well to remember that the human tongue, when recklessly used, is a dangerous instrument; and that it would be self-defeating and futile, and not magnificent, if we should wildly cut the air and one another with our tongues.

Let us strive to remember that the path to our objectives is also the path of fidelity to the deepest values of our tradition. Let us strive to remember that a free society is in essence a spiritual testament.



The synchrotron now under construction at Caltech is expected to produce between 500,000,000 and 1,000,000,000 volts

By MATTHEW SANDS

RESEARCH WITH LARGE ACCELERATORS

A NUMBER OF LABORATORIES have recently constructed, or are in the process of constructing, large machines for research in physics. The cost of these accelerators may run from several hundred thousand dollars to several million dollars; and their design and construction may consume several hundred thousand man-hours of work by skilled scientific personnel. I should like to try to give some idea here as to the motivations behind these expenditures of money and effort.

From the beginning of physics, physicists have taken upon themselves the problem of trying to understand and explain the motions of objects about them. Galileo and Newton, the first natural scientists who were interested in the subjects which we now call physics, tried to find regular rules of behavior for motions of objects. It was Newton who first hit upon the idea that one could more easily understand the motions of various objects if one divided the problem into two parts. He ascribed to every object rules of behavior which he conceived would govern its motion. These rules of behavior we now call the *laws of motion.* But the motion of an object is, in general, influenced by the presence of neighboring objects. These influences he described in terms of the *laws of force* between objects. Then, by combining the laws of force between objects with the laws of motion of the individual objects, it was possible to describe in a precise way the motion of an object under various possible circumstances.

This somewhat arbitrary division which Newton made between the laws of motion and the laws of forces between objects has turned out to be a convenient one, and has set a pattern which physicists have followed until today. For some time after Newton proposed his fundamental principles, it was possible to explain a large number of phenomena — from motions of the planets to the motions of every-day objects around us.

This fine state of affairs was only disturbed when electrical and magnetic phenomena were discovered, and it became evident that the law of gravitation, which Newton had proposed to explain the interactions between objects, did not obtain between objects which were electrified or magnetized.

For some years, physicists examined in detail the nature of the influences which magnetic and electrical objects held over each other, and these researches culminated in the work of Maxwell. In his summary of these new phenomena Maxwell found that it was only necessary to set down new rules of forces between electrified and magnetized objects, and that these new laws of forces, combined with the old laws of motion of Newton, were adequate to give a precise description of occurrences in this new field of observation.

By the beginning of this century, however, it became evident that there was some hidden inconsistency between Maxwell's laws of force and Newton's laws of motion, and that one or the other was a little in error. This conflict was finally resolved by Einstein when he proposed his theory of relativity.

The theory of relativity

The theory of relativity was based upon the idea that Maxwell's laws of forces for electrified objects are correct, but that Newton's laws of motion are only approximately correct for most observations. By introducing new laws of motion, somewhat different from Newton's original laws, it was possible to describe all the then known physical phenomena in terms of these new laws of motion, and the fundamental laws of force which had been prescribed by Newton and by Maxwell.

Further researches in physics, however, disclosed new phenomena which could not be explained in terms of the old laws of force and the laws of motion. These were atomic phenomena.

When it became possible to study in detail the motions of atoms, the manner in which the various parts of an atom hold together, and the way many atoms hold together to make large scale things such as chairs and tables, it was realized that it would be necessary to make certain modifications in the laws of motion or in the laws of force when dealing with infinitesimal objects. After some puzzling over this matter it finally evolved that one could understand the motions of atoms and the way that atoms held together in a solid object only by making another modification in the laws of motion.

It was Schroedinger with his theory of *quantum mechanics* who finally brought to a precise mathematical expression all of the known relationships between small objects such as atoms, electrons, etc. Thus, by introducing at this time a new law of motion, but maintaining the old laws of forces—gravitational, electrical, and magnetic—it was possible to explain all that was known about the motions of objects of all sizes.

This state of affairs, however, was still only provisional. Just as Newtonian mechanics was found to be only an approximation that needed modification as one made measurements under situations not ordinarily encountered in everyday life, so the new mechanics that Schroedinger had invented was not sufficient to explain all possible phenomena.

During the last 10 or 15 years the final mathematical theories of electrical effects were developed by Dirac, Pauli, and finally by Feynman and Schwinger; so now we have theories capable of giving a complete description of all the electrical, magnetic, and atomic effects so far observed.

There is, however, another realm in physics, in which observations have been made for some fifty years now, for which these laws of motion and laws of force do not seem to apply. This is the realm of nuclear mechanics, which is concerned with the study of the motions of the parts of the core of the atom, namely, the nucleus. Some progress has been made in trying to explain the motions of the parts of the nucleus, and the interactions of forces between various components of the nucleus of an atom. But at the present time occurrences in these fields are still not clearly understood.

We have no knowledge of the mathematical relationships which explain in any precise way what goes on inside this nucleus—or what the rules are which govern the behavior of the various parts. Of course this does not prevent our making practical use of nuclear energy, as in the atomic bomb or in work with radioactive materials. But we have here some tantalizingly mysterious behaviors, and physicists today are expending a great deal of effort in trying to formulate them precisely.

The study of the nucleus had its beginning with Rutherford when he first observed the effects of the radioactivity of certain natural minerals. Some time later other workers managed to make, in the laboratory, artificially radioactive materials. Still more recently, the scope of these researches has widened so that now the transmutations of elements, and the fission of the nuclei of atoms, are practical uses of nuclear energy.

The need for larger machines

Development of the methods of nuclear research has entailed the development of special techniques and tools, the latter often involving machines of some size and complexity for the production of nuclear projectiles of large energy. To illustrate the need for still more powerful machines, let me draw an analogy with the experimental methods employed in another field.

Suppose we had a large structural I-beam whose properties we wished to examine in detail. There are a number of ways that we could go about this. One way, though perhaps not the best, would be to pound on the I-beam with a tack hammer. By observing the sounds which came out and the minute vibrations which ensued, we could certainly draw some conclusions as to the nature of the particular I-beam.

Perhaps a more significant experiment would consist of placing large weights on the beam and observing the deflection of the beam under various weights. Still another way to get some information would be to subject the beam to the forces which can be delivered by a very large hydraulic press. If these forces were large enough, it would be possible to bend the beam to its breaking point. The measure of the force required to break the I-beam would certainly be one of its important characteristics and would provide us with a number which would be used in the design of structures employing such beams.

In working with atoms and the nuclei of atoms we can, by certain experiments, joggle these nuclei gently (an action corresponding to tapping the I-beam with a tack hammer) and, by observing the small motions of the nuclei under these gentle influences, learn something about the nature of the nuclei. Still another way is to exert somewhat more pressure on the nucleus and to observe the changes that take place in it under these stronger pressures. Finally, as in the destructive test of the I-beam, we can perform destructive tests on the nucleus, and find out what forces are necessary to break it into smaller parts. By measuring the forces required to do this, we can obtain valuable information as to the fundamental constitution of the nucleus.

Just as measurements on I-beams are made in terms of some scale of forces—say, the weight of the hammer that is used to hit the beam, or the force in pounds that the hydraulic press would exert upon the beam in breaking it—so do we need a scale or measure of the disturbance that we make on the nucleus.

Nuclear measurements

When we speak of the forces that we impress on a structure, it is convenient to talk in terms of pounds. In the study of the nucleus we find it convenient to speak in terms of the electrical potential necessary to apply the forces to the nucleus, and the unit of electrical potential that we use is the same one used in everyday life—the volt.

It is possible to do research on the nucleus with potentials of a few volts—in a manner analogous to attacking a structural member with a tack hammer—or, in a somewhat more vigorous manner, with forces of a million volts or so. However, it has become apparent that to perform destructive tests on a nucleus, and to find out what its inner workings really are, it is necessary to use forces corresponding to 100,000,000 volts and more. It is to achieve these forces that large nuclear research machines are now being made.

It is universally understood that an atom is a minute object. The nucleus of the atom is 100,000 times smaller still. The small size and obscureness of the nucleus prohibit us from applying to it, in a direct way, any strenuous electrical or mechanical force. We can, however, stress the nucleus by striking it with minute projectiles which are traveling at high speed. The electric forces which I spoke of before are, then, applied only in an indirect way, by imparting large striking power to a projectile.

To obtain these projectiles of large striking power one begins with an atom, or a fragment of an atom such as an electron, that is electrically charged. This charged fragment is subjected to the electrical force of a battery or of a high voltage generator. The electrical forces (governed by the well-known laws mentioned earlier) accelerate our charged fragment to a high speed. The striking power which such a projectile has depends on the magnitude of the electric potential used. Its value is, therefore, used as a measure of a projectile's striking power. In other words, when an electrically charged fragment is accelerated by an electric potential of 1,000,000 volts, it acquires a striking power measured by this 1,000,000 volts.

Projectiles of such striking power are obtained with large electrostatic machines such as those in Caltech's Kellogg Laboratory, where, by the use of refined techniques, it is possible to study the nucleus carefully and to come to rather important conclusions about the structure of any particular nucleus, even with the rather gentle effects of 1,000,000 volt projectiles.

The means of accelerating projectiles by subjecting them simply to the electrostatic potentials of a few million volts is not practical if one wishes projectiles to strike with power greater than about 10,000,000 volts. So, new principles and methods have been devised and are employed in the cyclotrons and synchrotrons and other large nuclear accelerating machines now being constructed for work in high energy physics.

In these machines the projectiles are accelerated in a way that is somewhat analogous to the way in which an automobile engine begins at a slow speed and is accelerated to high speed. In the automobile engine a single firing of a cylinder does not immediately cause the engine to rotate at high velocity; but the cumulative effect of a large number of firings of one cylinder after the other is sufficient to give the engine a high velocity. Similarly, in a cyclotron or a synchrotron, a rather small electrical voltage—say 1,000 volts—is applied for 1,000,000 times to the same projectile, and the combined effect then provides the projectile with 1,000,000,000 volts of striking power.

But one might ask, if it takes no more than 1,000 volts, why is it necessary to have large machines? Certainly it does not take a larger machine to make 1,000 volts than it does to make 1,000,000 volts.

The difficulty with the idea of repeatedly applying small 'kicks' to achieve a large striking power is that even those projectiles with a small striking power travel with tremendous velocities—in fact at speeds near the speed of light. After the first few kicks, the object will have traveled such a great distance that it is not conveniently available again for the next several thousand kicks that one would like to give it. This is why a large electro-magnet is employed. The function of the magnet is not to impart any of the striking force of the projectile, but merely to act as a guiding arrangement, causing the projectile, by virtue of its electric charge, to rotate in a circle. Then, each time that the projectile passes by on the periphery of this circle, one can kick it with a small electrical force; and the cumulative effect of millions of such kicks is then sufficient to impart a striking force of several billions of volts to the projectiles.

So it is this magnet, and its source of power, which contribute much to the size, complexity, and cost of these large machines. For example, the Caltech synchrotron, which is suitable for 1,000,000,000 volt projectiles, requires a specially designed steel magnet weighing 150 tons and special electrical power equipment capable of delivering 10,000,000 watts.

In addition to the magnet, the other important requirements of the accelerator are the "kicking mechanism"; a large vacuum chamber in which acceleration of the projectiles is accomplished; and other special equipment for operation, control, and protection of the machine and its operating personnel.

Accelerators under construction

The first of these machines were completed in 1947 and 1948. There are now about ten of them, capable of producing projectiles with striking power of from 300,000,000 to 500,000,000 volts. Three machines, still larger, are now nearing completion: the synchrotron at Caltech, which is expected to produce between 500,000,000 and 1,000,000,000 volts; a similar machine at the Brookhaven National Laboratory in New York which will operate between 1,000,000,000 and 3,000,000,000 volts; and a still larger synchrotron at the University of California at Berkeley which is expected to make available projectiles of up to 6,000,000,000 volts. The magnet for this latter machine will require about 10,000 tons of steel.

All these machines are in the United States. It is unfortunate that our European confreres have not been able to procure such machines for their researches. This is due, of course, to the fact that the cost of the machines —both in dollars and manpower—is prohibitive for many of the small countries of Europe. However, the future looks somewhat brighter. Under the leadership of UNESCO, the physicists of Europe are now banded together and are making plans for one large machine to be shared jointly by a number of the European countries. This machine will probably be something like the largest U. S. machine, now under construction in the radiation laboratory of the University of California.

When the large machines have been constructed and go into operation, the essential work has only just begun. Now, with projectiles of enormous striking power, we can proceed to examine the inner workings of the nucleus. Although the aim of the succeeding work may sound somewhat romantic, the methods used are in fact rather simple. We place a piece of ordinary material—aluminum for example—in the stream of projectiles, and place somewhat specialized and rather delicate instruments next to this piece of material and observe—through the instruments—the fragments, or the ricocheting projectiles which come out of the material.

By suitably specialized techniques and instruments it is then possible to single out those particular occurrences which can be traced back to nuclear encounters between the nuclear materials and the original projectile. Of course, what the nature of these fragments will be is still to a great extent unknown, since machines suitable for this work have just begun to function. But we do know that some pieces of the nucleus will come out; and it is already known that new types of material are created in the process of destroying any particular nucleus. These new types of materials, which have received some attention in the newspapers already, are called mesons and are known to be closely related to objects which have been observed in the cosmic ray for some years.

From the observations of these new materials will certainly come new laws and new understanding concerning the fundamental characteristics of the nucleus.

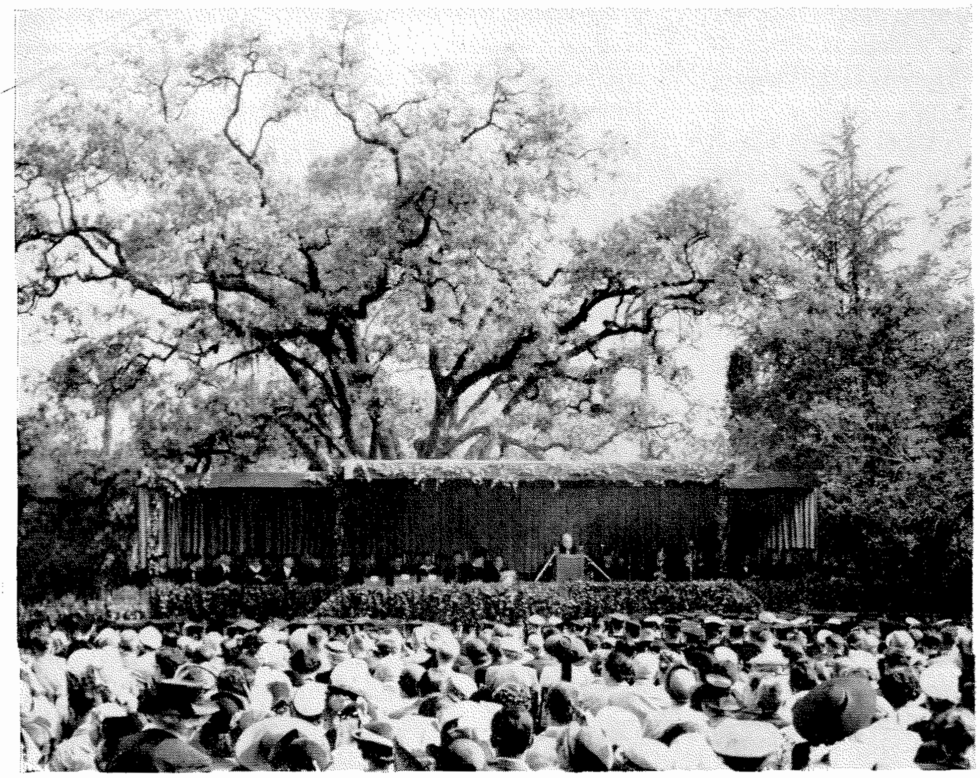
Will this new understanding of the nucleus have any meaning for the average citizen?

Pure research of any kind is a form of calculated risk which a society takes with certain of its resources, gambling that the deeper understanding that will be achieved by these fundamental researches will provide, at some future time, material reward for the particular society. It is never possible to predict in any accurate way what may be the final outcome of research in any particular field. But our civilization has benefited for several centuries now from the discoveries of people who were investigating the world around them only for the fundamental reason of trying to understand the processes which occurred. So it is with nuclear physics, with high energy physics.

What's ahead?

It is, of course, well known that nuclear physics of one sort has turned out to be of some practical, and even some military significance. We should not, from this, be led into thinking, however, that there is any guarantee that research in nuclear physics at high energies will reveal still newer and more startling sources of energy for operating the machines of the world. Indeed, all indications now are that the phenomena observed with these high energy machines are all inefficient ones. They simply absorb a lot of energy and do not give rise to new energy. And there seems to be very little likelihood that research in high energy physics with machines will lead to discoveries of ways of making new and more potent weapons such as the "cosmic bombs" so popular with science-fiction writers.

On the contrary, it is most likely that research in high energy physics will yield primarily a more complete and fundamental understanding of the nucleus, so that the processes which go on in the already discovered forms of nuclear energy can be more properly controlled and utilized. Once this has occurred, perhaps other uses for the very distinctive properties of the nucleus will be found and used to benefit mankind.



THE MONTH AT CALTECH

Commencement

A TOTAL OF 344 students received degrees from the Institute at the 58th annual Commencement on June 6. Bachelor of Science degrees went to 126 men. Fifty-four men received the B.S. in Science—9 of them with honors; and 72 men received the B.S. in Engineering—14 with honors.

Of the 23 men graduating with honor, 4 coupled this distinction with "exceptionally effective participation in extracurricular activities," for which they were awarded Student Body Honor Keys. They are John Boppart, Philip Orville, Albert Snider, and Jesse Weil. Honor Keys were awarded to 12 men in all.

Master of Science degrees went to 133 men. Sixty-nine men were given the M.S. in Science—1 in Astronomy, 2 in Chemistry, 6 in Chemical Engineering, 3 in the Geological Sciences, 1 in Geophysics, 1 in Mathematics, 44 in Meteorology, and 11 in Physics. The men receiving the M.S. in Meteorology completed requirements for that degree elsewhere, after they were given certificates in meteorology in special wartime courses at Caltech. Instruction in meteorology was discontinued several years ago at Caltech and this Commencement was set as the deadline for conversion of the certificates by those qualifying for the M.S.

The M.S. in Engineering went to 64 men—21 in Aeronautics, 8 in Civil Engineering, 13 in Electrical Engineering, and 22 in Mechanical Engineering.

Twenty men were awarded Engineer's degrees—15 of these graduates being officers in the armed forces who were assigned to Caltech for advanced work in physics or aeronautics.

Sixty-five men received the Ph.D. degree. Among these was Helmut Abt of Evanston, Illinois, who received the first Ph.D. in Astronomy to be awarded by Caltech since it began offering a complete course of instruction in this field in 1948, after the opening of the Palomar Observatory.

James R. Page, Chairman of the Board of Trustees, presided at the Commencement ceremonies. The Reverend Ganse Little, pastor of the Pasadena Presbyterian Church, delivered the Invocation and the Benediction. Degrees were conferred by President DuBridge, who also delivered the charge to the graduating class.

The Commencement speaker was Dr. John E. Pomfret, Director of the Henry E. Huntington Library and Art Gallery. Dr. Pomfret came to the Huntington Library last November from the College of William and Mary, where he had been president since 1942. Previously he had served as dean of the senior college and graduate school at Vanderbilt University and as a member of the history department at Princeton University.

Hinrichs and Morgan Awards

DAVID L. HANNA of San Diego and Richard Y. Karasawa of Los Angeles were named joint winners of the Frederic W. Hinrichs, Jr., Memorial Award at the Commencement ceremonies.

The award is made annually to the senior or seniors who, in the judgment of the undergraduate Deans, have made the greatest contribution to student body welfare and who have shown outstanding qualities of character, leadership and responsibility. It was established by the

CONTINUED ON PAGE 22

Only STEEL can do so many jobs

THE SINEWS OF DEFENSE are mostly steel, whether weapons, or steel mats, or the steel strapping that binds boxes of supplies. And for years, United States Steel has followed an uninterrupted program of expansion . . . so that it can produce ever-greater quantities of steel to help safeguard America's security.

NEW DELAWARE MEMORIAL BRIDGE, linking southern New Jersey and Delaware, will have an estimated traffic of 5 million vehicles a year. The bridge proper, with a total length of 10,765½ feet, contains the world's sixth largest suspension span, with a center span of 2150 feet. U.S. Steel products used include the structural steel, U·S·S AMERICAN High Tensile Wire for the huge cables, U·S·S TIGER BRAND Wire Rope and Universal Atlas Cement. The giant structure was fabricated and erected by United States Steel.

FACTS YOU SHOULD KNOW ABOUT STEEL

In the United States, there are 253 steel companies; 375 iron and steel plants. The payroll of the iron and steel industry in 1950 amounted to $2,390,000,000, and its approximate total investment to $6,750,000,000. The industry employs 635,000 people, exclusive of non-steel jobs, and has 650,000 stockholders.

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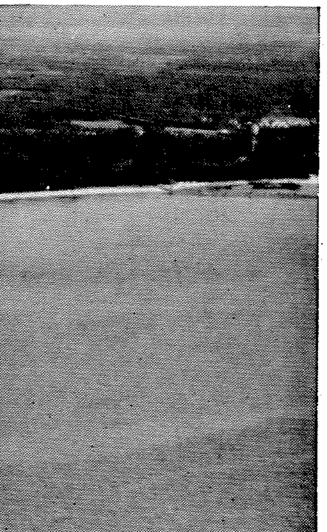

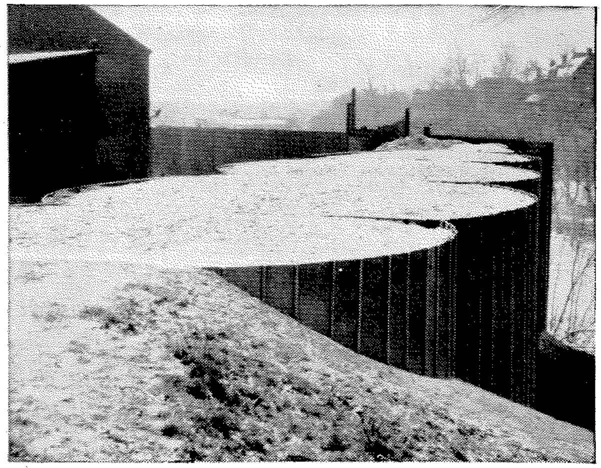

FLOODWALL OF STEEL. 76 earth-filled cells like this, built of interlocking U·S·S Steel Sheet Piling, protect a Kentucky rolling mill against flood waters in the Ohio River Basin. Because of its great strength, long life, and low installation cost, this product of U.S. Steel is invaluable in all types of projects involving control of earth and water.

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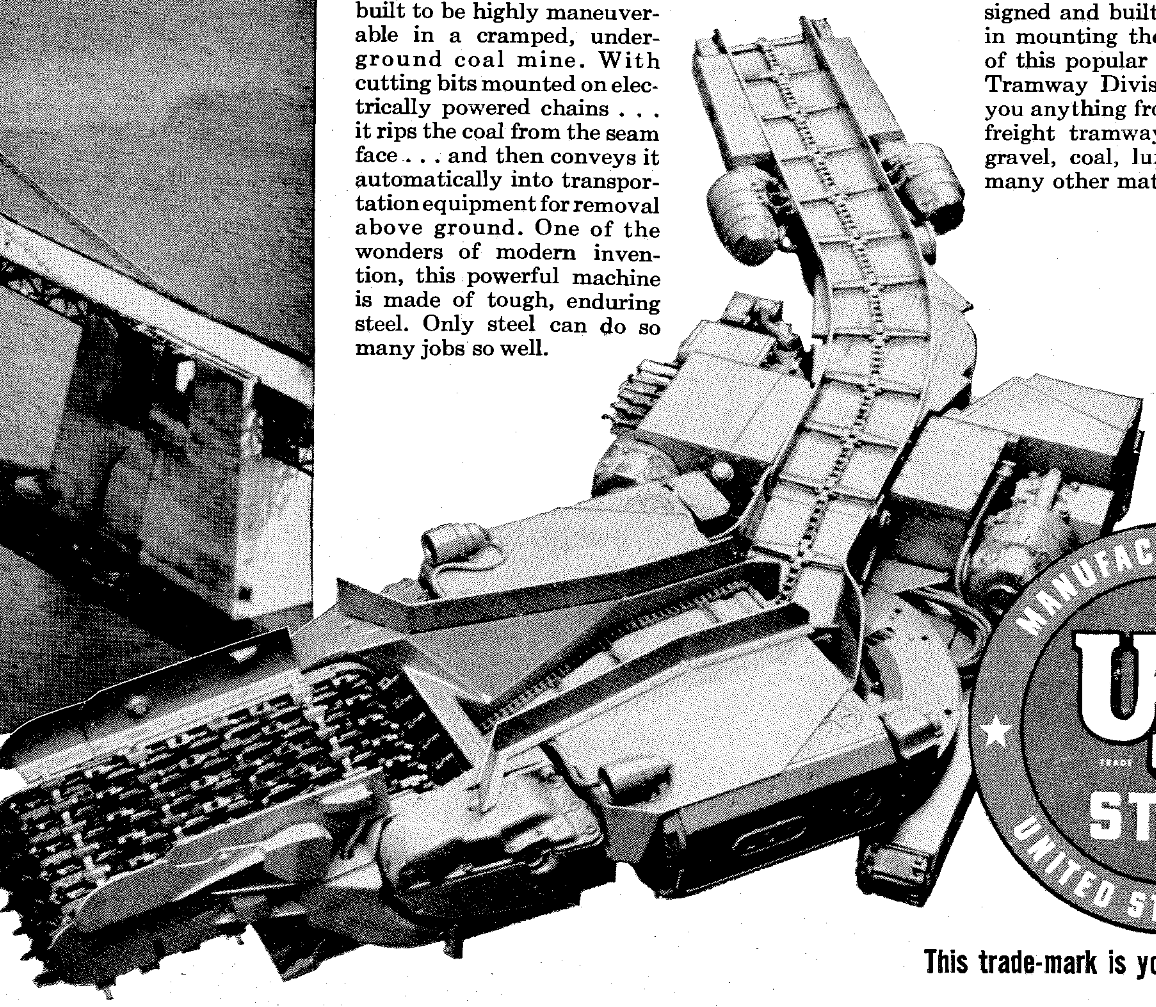
STORY-BOOK DRAGON? No, this is a continuous miner, built to be highly maneuverable in a cramped, underground coal mine. With cutting bits mounted on electrically powered chains . . . it rips the coal from the seam face . . . and then conveys it automatically into transportation equipment for removal above ground. One of the wonders of modern invention, this powerful machine is made of tough, enduring steel. Only steel can do so many jobs so well.



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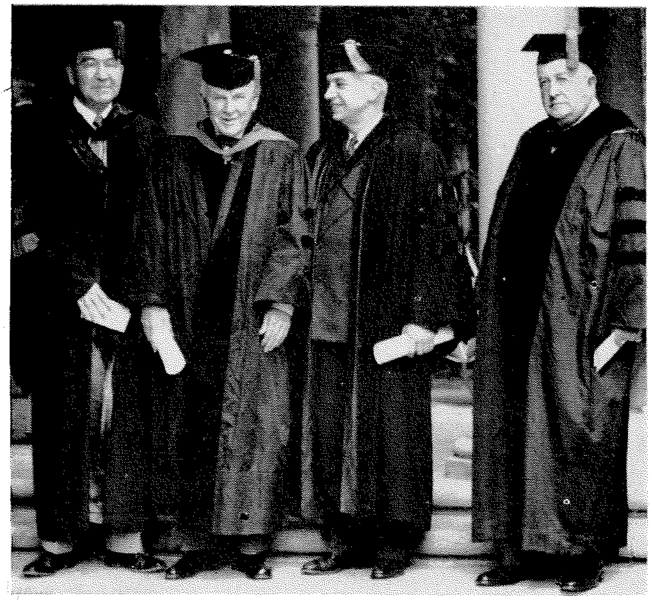
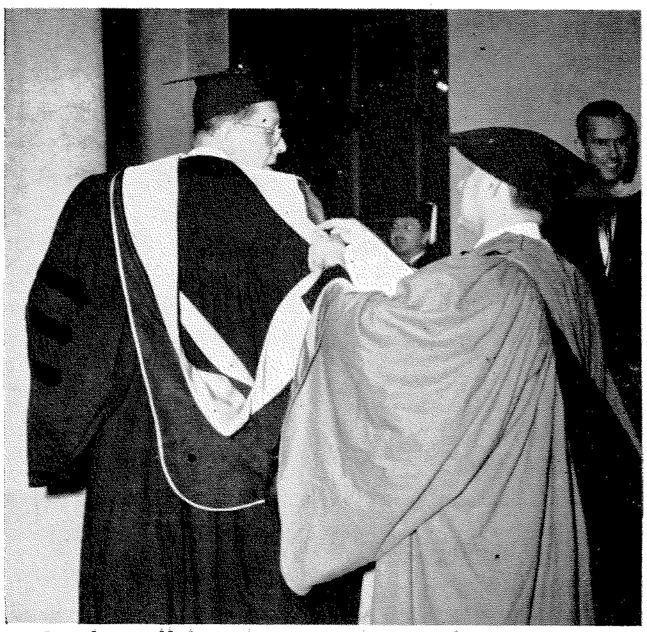


Dr. Pomfret, Dr. Millikan, Dr. DuBridge and James Page



It takes collaboration to get into academic costume

The academic procession starts down the aisle

THE MONTH . . . CONTINUED

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

This was the first time in the five-year history of the Hinrichs award that it went to two students. Hanna and Karasawa each received $50, a certificate and a desk pen.

Hanna served as 1951-52 president of the student body after a year as its athletic manager. He received two honor keys for participation in extracurricular activities and three varsity letters in football and golf. He also was a member of the Beavers, campus honor and service organization.

Karasawa was 1951-52 student body athletic manager and had served as vice-president of the junior class as well as secretary of the Varsity Club. He was a three year letterman in varsity football and baseball. In 1950 and 1952 he was captain of the baseball team; he was twice co-winner of the Alumni Baseball Trophy and was awarded an honor key.

Dan L. Lindsley, Jr. of Pasadena was announced as the winner of the $100 Thomas Hunt Morgan Award at this year's Commencement. This award, established in 1951 by friends of the late Dr. Morgan, who founded the Caltech Division of Biology, is made annually to an outstanding student in biology receiving the Ph.D.

Lindsley, who is 26, came to Caltech in 1949 as an Atomic Energy Commission Fellow, for graduate work in genetics, after receiving his M.A. from the University of Missouri.

P.H.T. Degrees

SOMETHING NEW was added to the 1952 Commencement—a diploma for the wives of students who were getting their degrees this year. The new diploma is not an official Institute document, though you'd never know that from looking at it. It's the same size as the Caltech diploma, comes in the same kind of case, and has very much the same kind of wording:

"California Institute of Technology Graduating Class, upon recommendation, has conferred on MARY SMITH the degree of P.H.T.—Put Husband Through—together with all the rights and privileges thereunto appertaining, in recognition of proficiency in accredited courses of Economic Management, Household Mechanics, Culinary Engineering, plus beneficial cooperation, and guiding inspiration. In witness whereof a seal and signatures are hereunto affixed at the City of Pasadena in the State of California this sixth day of June in the year nineteen hundred and fifty-two."

The document is signed by the Recommending Husband and by the First Lady of the Institute, Doris M. DuBridge.

Though similar degrees have appeared at various other institutions in the past, this is the first year the P.H.T. has been available at Caltech. The diploma is

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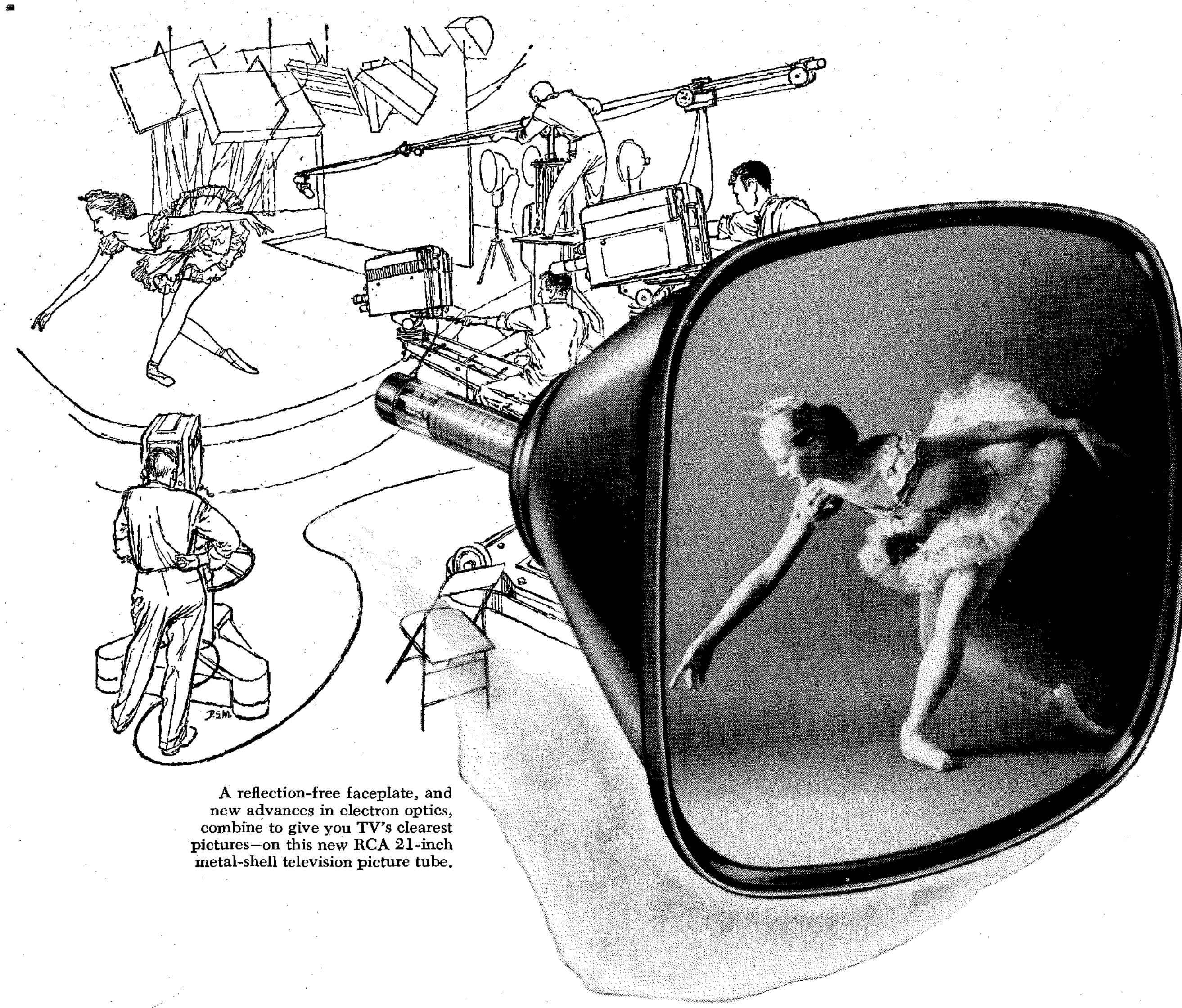


A reflection-free faceplate, and new advances in electron optics, combine to give you TV's clearest pictures—on this new RCA 21-inch metal-shell television picture tube.

New, metal-shell television tube makes pictures more realistic!

Benefits for the TV audience were immediate when RCA, in 1949, introduced its first metal-shell picture tube. Engineered for mass production, this new tube made larger television pictures available to more people. Subsequent RCA developments in the same field have resulted in better and better home receivers.

Now RCA scientists and engineers, working on principles pioneered at the David Sarnoff Research Center of RCA, have gone even further. Improved methods of focusing, based on the latest advances in the science of *electron optics*, assure more realistic images on your television picture tube.

In addition, the improved Filterglass faceplate is used as the "screen" in the new picture tube. Optically superior, this faceplate diffuses room reflections, transmits a uniformly bright image to the entire screen, and permits wider-angle viewing.

Enthusiastic reception by the industry has resulted in the use of this new tube by leading manufacturers. Be sure, when selecting a television set, to see those with the RCA metal-shell picture tube.

* * *

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

CONTINUE YOUR EDUCATION WITH PAY—AT RCA

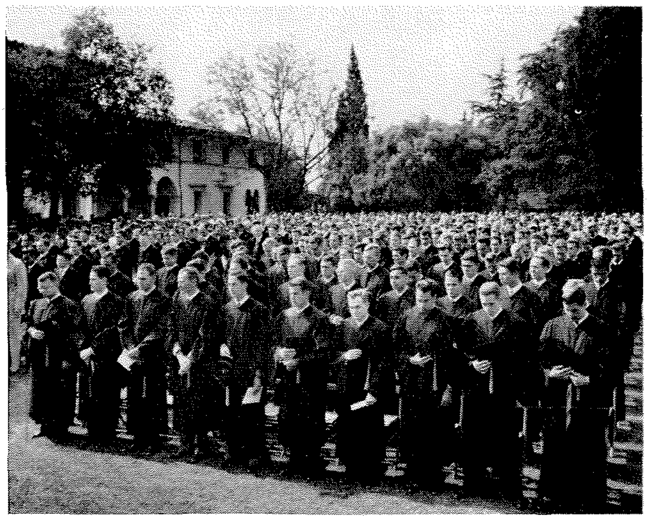
Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual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

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

Write today to College Relations Division, RCA Victor, Camden, New Jersey. **Also many opportunities for Mechanical and Chemical Engineers and Physicists.**

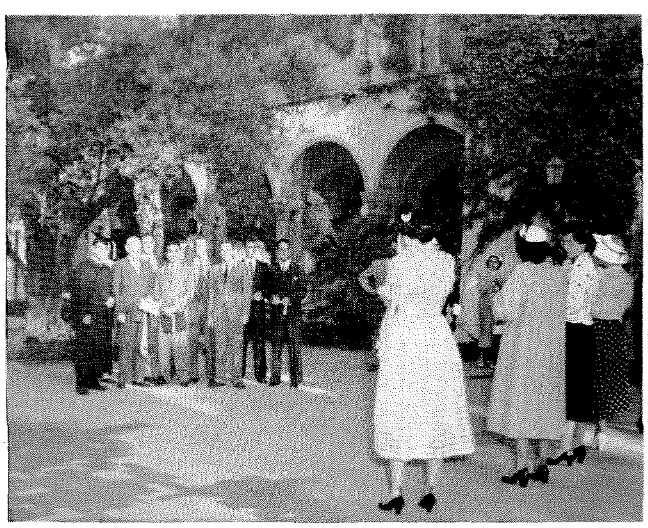
Radio Corporation of America

World leader in radio—first in television



Invocation

Celebration



Documentation

largely the work of Forrest William Davis and Edgar Wong, both of the Class of '52, who put in so much time perfecting the document this year that they are making sure it doesn't lose its value by falling into the hands of jokers. The diplomas will be sold exclusively by the Caltech Bookstore ($1 apiece) at Commencement time each year, and you can't buy one until your name is checked against an exclusive list of legitimately married men who are actually going to receive degrees from Caltech.

Science Advisory Chairman

PRESIDENT TRUMAN has named Caltech's President L. A. DuBridge as Chairman of the Science Advisory Committee of the Office of Defense Mobilization. The purpose of the Committee is to keep in touch with scientific work related to problems of national defense and to advise the executive branch of the government on such problems. It was established a year ago with Dr. Oliver Buckley of the Bell Telephone Laboratories as Chairman. Dr. Buckley has resigned the chairmanship, effective June 1, because of poor health, and Dr. DuBridge was nominated by his fellow members on the committee to succeed Buckley. The post will require Dr. DuBridge's presence at meetings in Washington about three or four times a year.

Animal Virus Research

IN A PAPER DELIVERED at the annual spring meeting of the National Academy of Sciences in Washington this April, Dr. Renato Dulbecco, Senior Research Fellow in Biology, described a new technique developed at the Institute which greatly simplifies research on animal viruses. These are the viruses which cause such diseases as influenza, poliomyelitis, shingles, and smallpox.

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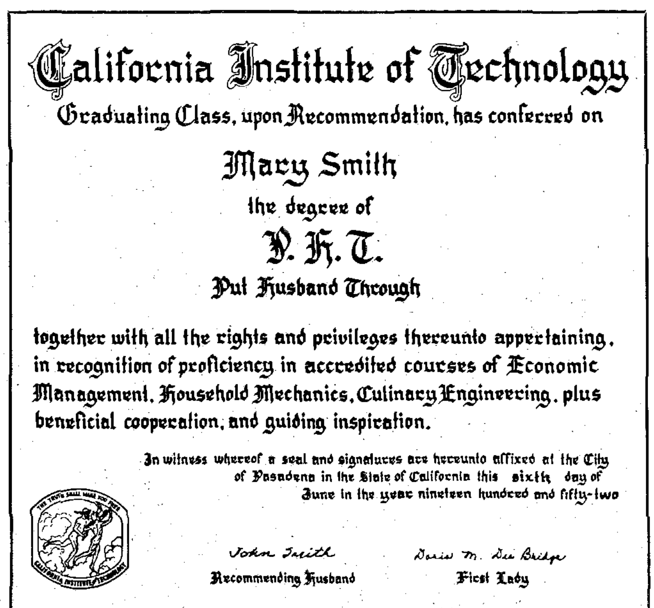


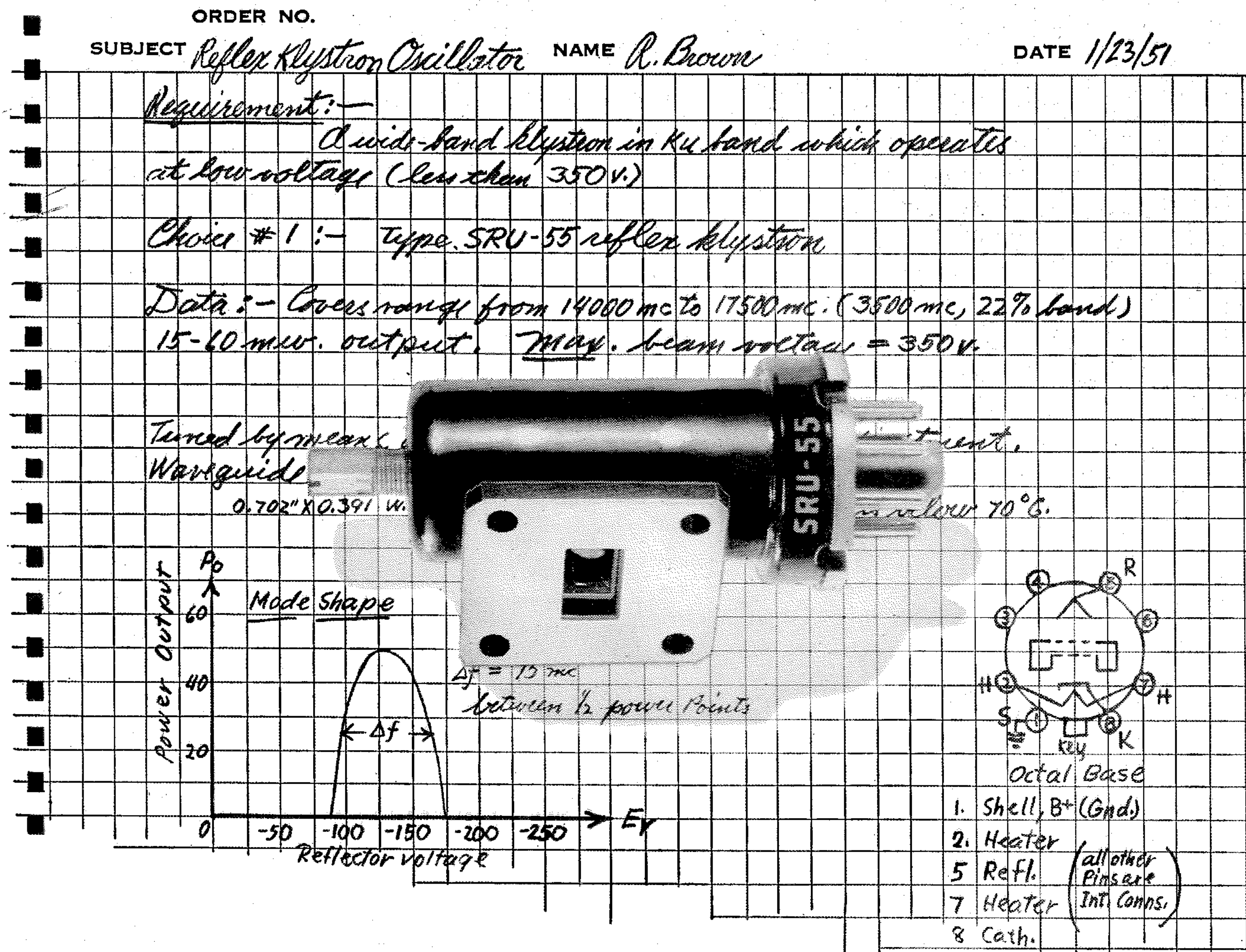
California Institute of Technology
Graduating Class, upon Recommendation, has conferred on
Mary Smith
the degree of
P. H. T.
Put Husband Through
together with all the rights and privileges thereunto appertaining, in recognition of proficiency in accredited courses of Economic Management, Household Mechanics, Culinary Engineering, plus beneficial cooperation, and guiding inspiration.

In witness whereof a seal and signatures are hereunto affixed at the City of Pasadena in the State of California this sixth day of June in the year nineteen hundred and fifty-two

Recommending Husband

First Lady

Diploma for wives



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LOW-VOLTAGE KLYSTRON 14,000 to 17,500 MC at 300 VOLTS

Type SRU-55 is a low-voltage, reflex klystron oscillator with radio frequency output of 15 to 60 milliwatts, operating over the frequency range of 14,000 to 17,500 mc. This Sperry tube can be used as a local oscillator for microwave receivers or as a bench oscillator in the measurements laboratory.

Keep Learning — But Start Earning . . . at Sperry

The klystron tube described here is but one of the many Sperry Klystrons which has resulted from Sperry's sponsorship of the development of the klystron in 1939. From Sperry laboratories have also come a complete line of Microline* instruments for precision measurement in the entire microwave field. In these labs career-seeking engineers keep learning but start earning—work with acknowledged leaders in their fields—do interesting, creative, important work—find the opportunity for advancement as high and broad as their own capacity for improvement.

Everything favorable to good work. Fine pay from the start. Every incentive for advanced study and personal advancement. Attractive Long Island location. Good housing and living conditions. Modern plant. Excellent working facilities. Liberal employee benefits. *Or in the field*— exceptional applied engineering opportunities in other parts of the U.S. and overseas.

Research, Product Development, Field Jobs Now Open

Aeronautical, Electrical, Electronic, Mechanical Engineers — Physicists — Technical Writers—Field Engineers for applied engineering here and abroad. *Join the leader.* From Sperry research and engineering have also come Gyropilot* flight controls, Zero Reader* flight director, radar, servo-mechanisms and computing mechanisms. Help us maintain Sperry's unique tradition of leadership through outstanding accomplishment. Write:

Employment Section 1 A 5

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*T.M. REG. U.S. PAT. OFF.

The Dulbecco technique, which resembles that developed three decades ago for the study of bacterial viruses, appears to provide an animal virus assay superior to any other now in use. It affords an enormous saving in time, labor and materials.

Dr. Dulbecco plans to use the technique as a means of studying the growth of a virus on animal tissue. Relatively little is known about the basic properties of animal viruses because of the technical difficulties involved in their study.

Research on these viruses has been done primarily with animals or chicken embryos as experimental subjects. The virus is lost from the moment it is introduced into the animal and the effects are observed on the animal as a whole—rather than on a specific type of cell—only when a radical change has taken place after the virus multiplies perhaps a million-fold. Tissue cultures have also been used, but here again infectivity is determined by some final effect which is produced on the whole culture.

In Dulbecco's technique, localized effects are produced for the western equine encephalomyelitis virus. The technique permits the use of a uniform type of host cell and provides an accurate method of determining virus activity. With it Dr. Dulbecco hopes also to be able to isolate the progeny of a single virus particle, which might pave the way toward development of special virus strains useful as vaccines. Ability to isolate progeny also would make it possible to study the factors influencing hereditary changes in virus characteristics.

Dr. Dulbecco's technique involves the formation of a continuous layer of chicken embryo fibroblast (connective tissue) cells on the bottom of a round, flat glass flask, according to a method devised by Dr. W. R. Earle of the National Institutes of Health at Bethesda, Maryland.

The layer grows in two days of incubation and the virus is applied on it. The virus particles attack the fibroblasts, multiply and continue destroying fibroblasts in the immediate vicinity until—after two or three days of incubation — small islands of destroyed tissue (plaques) are formed.

About one hundred plaques visible under a microscope, and sometimes to the naked eye, may form in a single flask. They provide information superior to that which would be obtained with an equal number of experimental animals or embryos, according to Dr. Dulbecco.

By statistical analysis Dr. Dulbecco has shown that each plaque represents an area of destruction initiated originally by only one virus particle. He has also introduced the virus in the same concentration directly into chicken embryos and found that the number of plaque-producing particles and infecting particles is virtually identical. This establishes that infection in the animal can be produced by one virus particle, he reported.

Passport

Because it was "not in the best interests of the United States," the State Department refused to issue a passport to Dr. Linus Pauling to visit Great Britain last month. Dr. Pauling, head of Caltech's Division of Chemistry and Chemical Engineering, had planned to take part in a conference of the Royal Society of London on the structure of proteins.

The passport was denied Dr. Pauling in February. He promptly appealed the State Department decision in a letter to President Truman. The President, however, referred the matter back to the State Department, and in April Dr. Pauling went to Washington to make a direct appeal. State Department officials informed him that their decision had been made because of suspicion that Dr. Pauling was a Communist and because his anti-Communist statements had not been "sufficiently strong." It was suggested to Dr. Pauling that he provide the Department with more evidence. Although he then submitted a statement, made under oath at a California State Senate Un-American Activities Committee hearing, that he was not now and never had been a member of the Communist Party, Dr. Pauling was told that the original decision not to issue him a passport would be upheld.

"It is my opinion," he said, "that my proposed travel, solely for the purpose of taking part in scientific discussions in Great Britain, would in fact be in the best interests of the United States. On the other hand, I believe that the refusal of a passport to me is not in the best interests of the United States, and that it involves the unjustified interference by the government with the freedom of action of a citizen of the United States.

"I am a foreign member of the Royal Society of London, and an honorary member of the Royal Institution of Great Britain. One year ago Prof. Robert B. Corey and I announced that we had discovered the structure of some proteins. The Royal Society of London arranged for a conference to be held on this subject. Because I was unable to attend at the time originally set, which conflicted with a meeting of the American Philosophical Society in Philadelphia, of which I am a vice-president, the date of the Royal Society conference was changed to May 1. I also accepted an invitation from the director of the Royal Institution of Great Britain to speak before the Royal Institution on May 16 on the subject of the structure of proteins.

"Aside from this, my wife and I had planned to visit universities in London, Oxford, Cambridge, and Leeds, in order to talk with scientists there about the structure of proteins and other scientific problems, and I had accepted an invitation to be guest of honor at a reception to be held in London by the Society for Visiting Scientists.

"During recent years my work on the theory of resonance in chemistry has been under attack in Russia. Russian chemists have been forbidden to make use of this theory in their scientific work. The action of the

CONTINUED ON PAGE 28

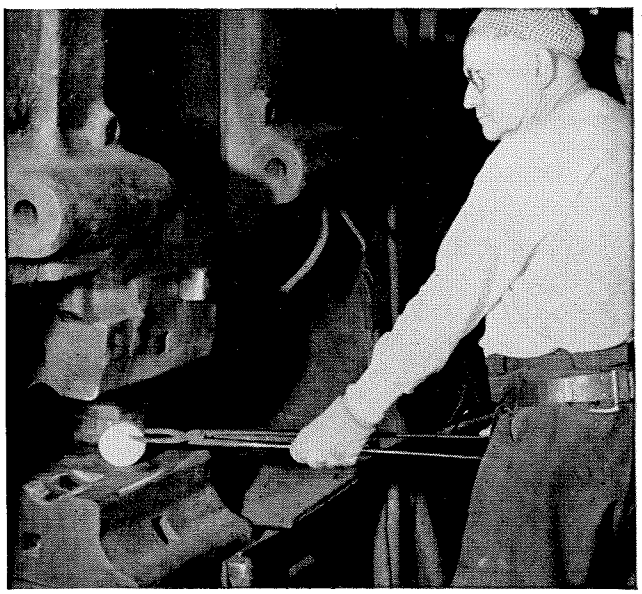
What's Happening at CRUCIBLE

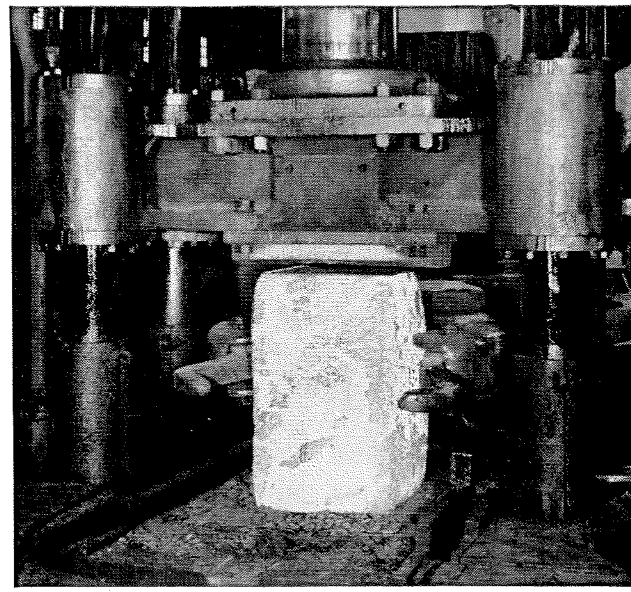
about tool steel forgings

Whether 1½ pounds or 7 tons . . . forgings get the same sensitive handling

Crucible's reputation as the specialty steel leader is built on a devotion to the smallest detail . . . regardless of the size of the order.

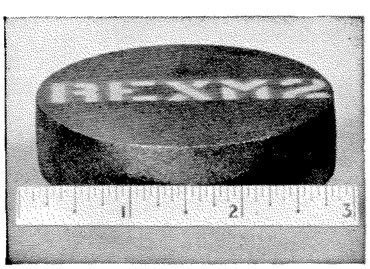
These forgings are good examples of Crucible specialists at work:

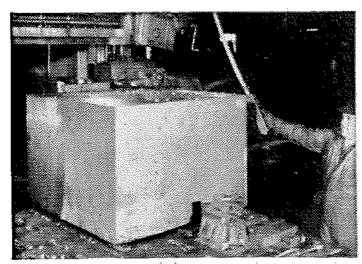




Rex M-2 High Speed Steel Disc Forging (1½ pounds)

Pancake forgings such as these are used extensively by small tool makers. Extreme care is taken in the preparation of the slug stock. The upsetting insures proper flow lines. Milling cutters, gear shavers and similar cutting tools that require maximum toughness, coupled with the best cutting ability, are made from these forgings.





CSM-2 Plastic Mold Forging (14,000 pounds)

This CSM-2 plastic mold steel forging was made from a 25,000-pound ingot. This block will be heat-treated and worked to produce a mold for the manufacture of large plastic parts. The finished weight of the forging is 14,000 pounds. And it is the largest mold forging yet produced by Crucible.

Engineering service available

Crucible's engineering service is geared to meet your research and development problems. If you use special forgings, or any special purpose steel, check with Crucible. Crucible Steel Company of America, General Sales and Operating Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

52 *years of* *Fine* *steelmaking*

Midland Works, Midland, Pa. • Spaulding Works, Harrison, N. J. • Park Works, Pittsburgh, Pa. • Spring Works, Pittsburgh, Pa. National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

State Department in refusing me a passport represents a different way of interfering with the progress of science and restricting the freedom of the individual citizen. In my opinion it reflects a dangerous trend away from our fundamental democratic principles, upon which our Nation is based."

Albert Merrill

ALBERT A. MERRILL, aviation pioneer and Instructor in Aeronautics at the Instiute, died on June 1, in Pasadena, following a long illness. He was 77 years old.

Mr. Merrill's illness had prevented his direct participation in work at the Institute for several years, but he had followed with interest reports on tests conducted with the 200-mile-an-hour wind tunnel named in his honor (*E&S*—October, 1950).

In tribute to him, Dr. Clark B. Millikan, Director of the Guggenheim Aeronautical Laboratory at Caltech, said: "He was one of the true pioneers in aeronautics in this country. He made a number of practical inventions, but I think the most characteristic element in his long life was a passion for the truth. This led him to develop a number of ingenious and powerful techniques for getting accurate and precise experimental data with inexpensive, simple tools."

Mr. Merrill came to Throop College in 1918 as an instructor in accounting and aeronautics, and was given supervision of the design, construction and operation of a small wind tunnel on the campus. This was the first wind tunnel on the West Coast and it continued operating until it was destroyed by fire in the 1930's. Mr. Merrill left the Caltech staff in 1930 to engage privately in aircraft design, but returned as an instructor in 1940.

One of his numerous projects was the development of a small wind tunnel which one man could operate by himself and so produce scientific data inexpensively and quickly. In the late 1930's and early 1940's two such tunnels were built at Pasadena Junior College and operated by Mr. Merrill. They were used extensively by scientists and industrial concerns and dozens of PJC and Caltech students were trained on them. A tunnel of this type was built at Caltech in the late 1940's and was dedicated to Mr. Merrill in August, 1950. It has been used primarily for instruction, for various research projects and for the testing of new ideas still too much in the pioneer stage to warrant use of one of the bigger tunnels.

Stuart Mackeown

DR. SAMUEL STUART MACKEOWN, Professor of Electrical Engineering at the Institute, died in Pasadena on May 29. He was 57 years old.

Dr. Mackeown had been at Caltech since 1923. After graduation from Cornell University in 1917 he served as a Second Lieutenant in the U.S. Army Signal Corps, working in the Bureau of Standards, during World War I. In 1918 he married Littie B. Uhrland. He became a research engineer for Western Electric in 1919, and in 1920 returned to Cornell to teach physics. He received his Ph.D. there in 1923, and came to Caltech as a National Research Fellow in Physics that same year. He was made Professor of Electrical Engineering in 1942.

Dr. Mackeown served as a Navy Lieutenant Commander in the Institute's Radio Development Section during World War II. At various times he was a consulting engineer and patent expert for such companies as General Electric, American Telephone and Telegraph, Standard Oil and Metro-Goldwyn-Mayer. He was a member of Sigma Xi, Tau Beta Pi, the American Physical Society, A.I.E.E., I.R.E., and the American Association for the Advancement of Science.

Success Stories

CALTECH MAKES an excellent showing in two recent magazine articles which provide data on the relative success in life of the graduates of various colleges and universities.

The first article, in *School and Society*, presents figures on the number of college graduates who are listed in *Who's Who in the West*. By dividing the total number listed from each college by the total number of living graduates of that college, the following figures are obtained:

Institution	Number listed per 1000 living graduates
California Institute of Technology	26
Stanford University	15.6
University of California (Berkeley)	11.5
Pomona College	9.1
University of Redlands	8.3

The second article appears in the *American Journal of Physics* and lists the undergraduate sources of American physicists who have attained sufficient prominence to be listed in *American Men of Science*. In this case, the number of listed physicists from a given school is divided by the number in that school in 1935-36 (on the assumption that, in general, listing in *American Men of Science* is attained by men who are about fifteen years out of school). The figures for the first five institutions are as follows:

Institution	Number listed per 1000 enrolled
California Institute of Technology	78.3
Massachusetts Institute of Technology	53.9
Case Institute of Technology	47.6
Kalamazoo College	41.8
Clark University	39.7

If one ignores enrollment and lists institutions in order of their largest contributions to the physicists of the country Caltech ranks ninth, preceded in order by M.I.T., Harvard, California, Chicago, Michigan, Wisconsin, Cornell and City College of New York.

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an AIRCRAFT engineer?
But I haven't majored in aeronautical engineering

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It's your aptitude, your knowledge of engineering principles, your degree in engineering that count.

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But Lockheed offers you more than a career. It offers you a new life, in an area where living conditions are beyond compare. Outdoor living prevails the year-'round. Mountains, beaches are an hour from Lockheed.

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If your Placement Officer is out of the illustrated brochures describing living and working conditions at Lockheed, write M. V. Mattson, Employment Manager

Lockheed Aircraft Corporation
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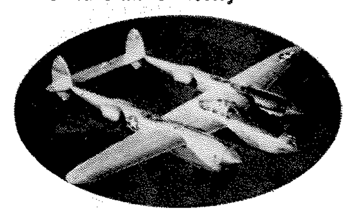
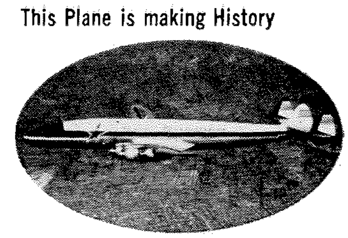
This Plane made History



The P-38 Lightning – first 400 mile per hour fighter-interceptor, the "fork-tailed Devil" that helped win World War II.

This Plane is making History



The Super Constellation – larger, faster, more powerful; the plane that bridges the gap between modern air transport and commercial jet transport.

This Plane will make History

The jet of the future – the plane you will help create – belongs here.

This plane – which exists only in the brain of an engineer like yourself – is one reason there's a better future for you at Lockheed. For Lockheed will always need engineers with ideas, engineers with imagination, engineers who build the planes that make history.

ALUMNI NEWS

Annual Banquet

A TOTAL OF 220 ALUMNI met at the Los Angeles Athletic Club for the annual Alumni Banquet on Wednesday evening, June 4. The featured speaker of the evening was Milton Katz, Associate Director of the Ford Foundation. His talk on "The Question of Peace" appears in full on page 9 of this issue.

President DuBridge reported to the alumni on events of the past year at the Institute, and Alumni President Robert P. Sharp delivered a short year-end report on the Association's activities—promising a full written report in the first fall issue of *E&S.* A highlight of the Sharp report was the news that the Alumni Fund had its biggest year in 1951-52. It now stands at just over $116,000. Plans have been drawn up for a swimming pool, and a permit to start construction on the campus has been applied for from the Federal government. As soon as this comes through—and it is expected sometime this summer—construction of the first unit of the Alumni Fund gymnasium project will get underway.

John E. Sherborne '34, Assistant to the Vice-President of the Union Oil Company of California, took over as 1952-53 president of the Alumni Association. Gerald P. Foster '40 becomes vice-president, and D. S. Clark '29 and H. R. Freeman '25 remain as secretary and treasurer of the Association, respectively. New members of the Alumni Association Board of Directors include Fred H. Felberg '42, Francis M. Greenhalgh '41, Allen R. Ray '35, Kenneth F. Russell '29, and Richard W. Stenzel '21.

Reunion classes this year included 1902, 1907, 1917, 1922, 1927, 1932, 1937, 1942 and 1947. Reports from some of these are presented below.

At the annual Alumni Banquet, held in Los Angeles on June 4, John Sherborne '34 takes over from Bob Sharp '34 as President of the Alumni Association for 1952-53.

1902

Neither of the two living members of the Class of 1902 were able to show up for this year's 50th reunion. Distance kept Kirk Dyer away; he lives in Cromwell, Connecticut. And illness prevented James Gaylord from attending. He's retired chief electrical engineer for the Metropolitan Water District, living in San Marino.

Oldest-timer at the dinner was Irving C. Harris '00, of Temple City.

1917

The class of 1917 had a 44 percent representation at this year's Alumni Banquet. Apparently retirement tends to increase the number of graduates in the class who plan to reside in southern California. Of the nine living members, six are already in this area. Four of these—Kemp, Kensey, Searl and Youtz—were present at the Alumni Banquet. Fred Poole sent his regrets because of the very considerable distance between his home in Ventura County and the Los Angeles Athletic Club. Roy Richards of Phoenix, Arizona, disappointed us all by not being heard from this year.

—Paul Youtz

1922

We hoped to have 30 at the 30th reunion, but didn't quite make it. However, 25 of the class of '22 were there, which is about 40 percent of our surviving members. A good time was had by all, and we were particularly pleased to have Dean Franklin Thomas join us at our table.

The only representative from outside California was W. F. (Shorty) Wilson, from Houston. He brought along some real Texas hospitality, for on the day after the banquet he was host at a cocktail party at the Athletic Club.

Much-appreciated messages were received from several who could not attend—including Ed Groat in Chicago, and Harold Ogden in Erie, Pennsylvania. There was also a cable from Howard Vesper, sent from Paris, and explaining that he and Ruth are taking in the sights of Europe. Ray Preston phoned his regrets to Linne Larson from Portland, Oregon, where he has a flourishing practice as an electrical engineer.

In checking on the activities of those present, it was learned that Don Darnell is now Chairman of the Board of the Fluor Corporation, and Gerald Spencer is Superintendent at the Fricot Ranch School for Boys of the California State Youth Authority, at San Andreas.

—Al Knight

1927

Our 25th reunion was considered sufficiently important to merit a dual celebration. There were 29 members of the class present at our special reunion held on the night of June 3, and 20 were present at the class table at the Alumni Banquet the following night—which speaks very well for our recuperative powers.

Jim Boyd travelled from New York to act as our reunion chairman. Ralph Watson came all the way from his home in New Jersey. Dave Gardner made it

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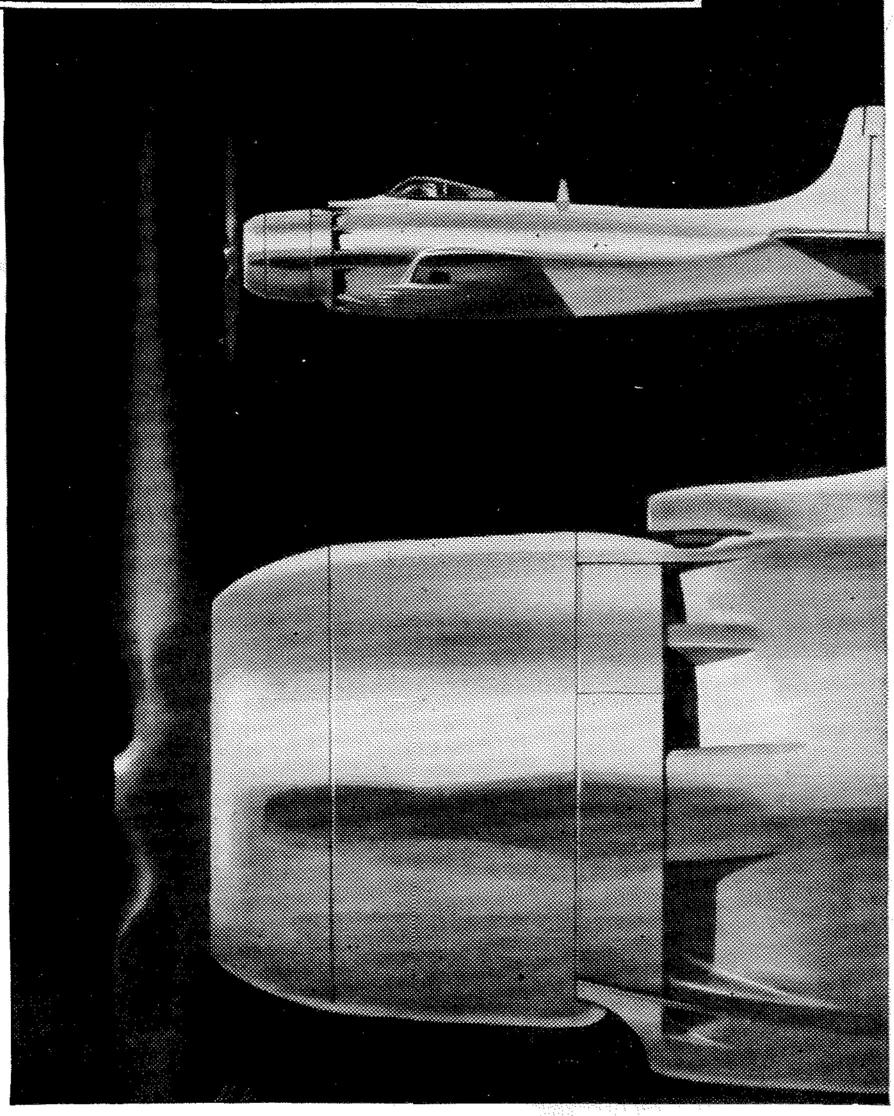
No Faster Finish



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. . . finishes for aircraft and other military needs which can be applied fast, dry fast without baking, and stand up under severe service conditions.

SOLUTION . . .

. . . hot-spray lacquers now made by many companies from Hercules® nitrocellulose. These new lacquers, thinned by heat rather than solvents, permit more actual lacquer to pass through the spray gun. Now, one hot coat frequently does the job where two coats had been used.

COLLEGE MEN . . .

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

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

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

HERCULES

HERCULES POWDER COMPANY INCORPORATED *Wilmington 99, Delaware*
Sales Offices in Principal Cities

from Winslow, Arizona; four came south from the San Francisco area for the occasion, and the rest could be classed as local boys. Altogether, 38 percent of the living members of the class made their appearance.

This year is doubly significant to the Class of '27, for in addition to being our 25th reunion year it marks the maturity of the Class of '27 Gift Fund, which has been slowly but surely accumulating from contributions by the members of the class ever since our graduation. It was with considerable pride and pleasure that we listened to Chairman Boyd present this Fund, presently amounting to some $4,800, to Dr. DuBridge, for the establishment of an undergraduate scholarship.

—*Rolland A. Philleo*

1932

For the depression class, we had a very good showing at the annual meeting. Of the 95 living recipients of the 96 B.S. degrees awarded in '32, 25 were present at the meeting, or 26 percent.

—*Howard W. Finney*

1937

There were 17 men from the Class of '37 present at the 15th reunion, representing about 30 percent of those in the southern California area. Of those on hand, the average families included two children—with girls predominating two to one. Occupational fields represented included engineering, education, insurance, psychiatry and law.

Messages were received from George Dorwart of Bakersfield, Tom Harper of New York, Walter Moore from Texas, Martin Webster and Bruce Lockwood from Los Angeles and Glendale.

—*Paul Schaffner*

1947

A gang of 15 only slightly aged members represented the class of '47 at its first reunion. Those present in the flesh were: Bearson, Eimer, Felberg, Hawthorne, Linam, Mason, Richeson, Reidel, Rosner, Scull, Van Dierling, Vieweg. Notes were received from Caldwell, Nevis, and Shipway.

—*Fred Eimer*

Family Picnic

The annual Alumni Association Family Picnic will be held at Mount Wilson on Sunday, June 29. There will be special guided tours of the TV stations there, starting at 1 p.m., and the Mount Wilson Observatory will be open for general inspection.

Families can either bring their own picnic lunch or buy sandwiches or dinner at The Mount Wilson Hotel dining room. Reservations for the affair are $1.75 per family—no matter what size. This includes the tours, the beer, soda pop and coffee which will be served throughout the day, and the entrance and parking fees.

Straw Vote

SHORTLY BEFORE THEIR final exams, Caltech seniors taking History 5—the required senior course in public affairs—were presented with sample ballots to discover their preferences among the present presidential hopefuls. The results were as follows:

Eisenhower	49
Warren	17
Stevenson	4
Harriman	4
Kefauver	2
Taft	2
McMahon	0
Russell	0
Stassen	0
Douglas	2 (write-ins)

As for the candidate preferred as the Republican nominee—with the voting restricted to a Taft-Eisenhower choice, the results were conclusive:

Eisenhower	68
Taft	4

Possible pairs of November opponents received the following votes:

Republican			Democrat	
Eisenhower	66	vs.	Kefauver	14
Warren	65		Kefauver	15
Taft	22		Kefauver	55
Warren	63		Stevenson	15
Taft	20		Stevenson	59

The eighty men who voted constitute about one-half the senior class. If we assume they are representative of the other half, and if we further assume that their four years here have been as enlightening as the Division of Humanities has, on other occasions, claimed—then we can be certain that Ike's the man. At any rate, these results illustrate the maxim that elections often consist more of voting against someone than for anyone.

Awards Assembly

The annual spring Awards Assembly this year held no surprises. Top scholastic honors among the student houses went to Dabney, which won the Goldsworthy

THE BEAVER . . . CONTINUED

Scholarship Trophy. Throop Club was second, followed by Blacker, Fleming, and Ricketts, in that order. This is the fourth consecutive year that Dabney has topped the other houses scholastically, having won the trophy every year since it was first awarded in 1949.

Athletic Trophies

As predicted in this column exactly one year ago, the two athletic trophies went to Fleming House. The Interhouse Trophy, awarded for supremacy in intramural competition for the year, returned to Fleming after a one-year leave of absence to Throop Club. The closeness of the race is indicated by the fact that no one of the five houses won more than two of the nine intramural sports. Final standings were as follows:

Fleming	120
Blacker	114
Dabney	107
Throop	105½
Ricketts	84½

Details of the riot incited by the members of Fleming House to celebrate their cinching the trophy after defeating Ricketts in football found their way into a number of newspapers in the Los Angeles area, and will long be treasured in the memories of Fleming men, even those who should know better.

The competition for the Varsity Rating Trophy, awarded on the basis of numbers of men participating on intercollegiate teams, was anything but close. For the tenth consecutive year, Fleming won the trophy, having 53.5% of its members on intercollegiate teams this year. Final standings were as follows:

Fleming	232
Throop	120
Blacker	120
Ricketts	118
Dabney	108

Inasmuch as it is impossible to participate on an intercollegiate team and an interhouse team at the same time, and since lettermen in a given intercollegiate sport are ineligible to participate in that same sport on the intramural level, Fleming's winning both trophies is all the more remarkable.

Sophomore Tests

Student readers of the Catalogue of the California Institute often feel that it is a great example of science-fiction writing. Many of its statements were upheld, however, by the recent 1952 National College Sophomore Testing Program. A series of examinations was given to 11,700 sophomores in various colleges. The tests were designed to measure objectively some of the men's abilities and interests in major areas of college study. The table below compares the average percentiles of Tech sophomores with those of the male sophomores who took the tests.

ENGLISH	National percentile of all male students tested	Tech Percentile
A. Mechanics of Expression	45	75
B. Effectiveness of Expression	45	82
Vocabulary	50	85
Speed of Comprehension	55	82
Level of Comprehension	50	88
C. Total Reading Comprehension	55	88
Total English (A+B+C)	50	82
GENERAL CULTURE		
History and Social Studies	50	88
Literature	55	65
Science	50	96
Fine Arts	55	85
Mathematics	55	97
Total	50	94
CONTEMPORARY AFFAIRS		
Public Affairs	50	82
Science and Medicine	50	92
Literature and Fine Arts	50	82
Total	50	88

Note that the Tech sophomores are significantly above the national average for male students in every area tested—especially (as would be expected), though not exclusively, in science and mathematics.

Clean Sweep

Waheed Khan Ghauri, a senior civil engineering student who came to Tech four years ago from Lahore, Pakistan, is never at a loss for words—in at least two languages. At a student paper contest recently, sponsored by the American Society of Civil Engineers' regional conference in San Diego, Waheed's speech on cloud seeding and artificial rainfall took first place among participants from about a dozen major colleges in this area. One week later, Waheed took first prize in the annual Mary A. Earle McKinney Prize contest in English at Tech, with his paper and speech on "What I Believe." A few weeks after *that,* he was named winner of the annual Conger Peace Prize contest for his oration, "Asia and World Peace." Waheed always has been a good man to have on your side in a bull session.

Old Story

Readers of this column (and I hope there are some that are still with me) may be surprised to find no criticisms this month. You might think nothing bad had happened to Caltech. But it has. This June we lost a fine senior class. The traditional question all seniors ask before they leave has been asked many times this year: "What in the world's going to happen to this school when *we* leave?" The answer, of course, is still the same: nothing.

—*Al Haber '53*

PERSONALS

1922

Warren A. Schneider is Director of the Bureau of Sanitation in the Department of Public Works in Los Angeles. The Bureau is responsible for city-wide collection and disposal of refuse, sewer and storm drain maintenance and operation, and incineration. In addition to directing these duties, Warren has recently been assigned the administrative direction of the operation of the new $43,000,000 Hyperion Activated Sludge Plant in L. A.

1925

Alfred L. Erickson is president of J. T. Thorpe, Inc., firebrick and insulation contractors. Their business of designing and constructing industrial furnace enclosures is handled through offices located in Los Angeles, San Francisco, and Houston, Texas. The Ericksons' oldest daughter was a freshman at Stanford this year, and their second daughter is in Junior High School.

1926

Sterling B. Hendricks, Ph.D., chief chemist of the Bureau of Plant Industry, Soils and Agricultural Engineering of the U. S. Department of Agriculture, was recently elected to the National Academy of Sciences.

1927

Clare Haserot has been with the Bray Oil Company as general sales manager for three years. Jerry, Haserot's oldest son, has just finished his first year in Petroleum Engineering at Stanford.

1928

Kenneth H. Robinson is now Associate Head of the Explosives Department at the U. S. Naval Ordnance Test Station in China Lake. Ken is a charter member of the China Lake Rotary Club, which was founded a year ago, and he's been elected Vice President for 1952-53. He is also chairman of the N.O.T.S. Concert Series Committee.

1929

Harlan Asquith is still a design group engineer at Lockheed, in Burbank, working on the P2U Neptune. He's married, has two children, and has taken a new interest in Cub Scouting.

1933

Ted Mitchell has been transferred by the Shell Oil Company to Casper, Wyoming, due to a tremendously increasing search for oil there. So far this year three finds have been made. Ted's wife and three children are still in Long Beach, awaiting the solution to a very difficult housing problem in Casper.

1934

James N. Gregory is now Area Production Superintendent for Shell Oil Company in Midland, Texas.

1935

Fred Allardt, M.S. '37, won first place in the District No. 1 Toastmasters annual humorous speech contest at the Los Angeles Breakfast Club on May 24. District No. 1 includes about 75 Toastmaster Clubs in the Los Angeles area.

Charles F. Thomas, after many years in the sales department at Lockheed Aircraft Corporation, now manages their military relations department. In this position he is responsible for maintaining contacts with all U. S. military activities, and spends much time in travel connected with his work. He and his wife, Gladys, and two daughters live in Glendale.

1936

Hugo Meneghelli is still working at the Naval Ordnance Test Station at China Lake, as head of the Ordnance Division of the Rocket Department. This summer he is taking a three-month vacation and business trip to the East Coast, going via New Orleans and returning via Boston, Chicago and Denver. The whole family is going along—including his wife, Virginia, and sons, Lance (11) and Leonard (7).

1937

Charles Woolsey has recently accepted a position as lead engineer in the materials group of the Process Development Division of the California Research and Development Company in Livermore, Calif. He was formerly assistant head of the Materials Engineering Division at the Naval Ordnance Test Station in Inyokern. The Woolseys have two children, Arthur, who is now 10, and Mary Beth, who is 4.

Elburt F. Osborn, Ph.D., has been named associate dean of the School of Mineral Industries at Pennsylvania State College. He will continue to serve as professor of geochemistry and head of the Department of Earth Sciences. Prior to his present position, he was a research chemist with the Eastman Kodak Company and during World War II served as a consultant on ballistic problems for Division 1 of the National Defense Research Committee.

1938

Joseph F. Ware, Jr. is a flight test group engineer at Lockheed Aircraft Corporation in Burbank, Calif. He is married and has two children, Carol Leslie, 7½, and Joseph F. III, 2.

Harrison Lavendar, M.S. '39, according to a brief report which reached the Alumni Office, died on March 21. He had been employed by the Phelps-Dodge Corporation of Arizona.

1939

Charles H. Townes, Ph.D., who has been a full professor of physics at Columbia University since 1950, has been appointed Chairman of the Department of Physics at Columbia beginning July 1, 1952. This summer he expects to lecture at the University of Michigan for about three weeks. The Townes now have three children, and have recently moved to the Riverdale section of New York City.

Alexis M. Eichelberger, Jr., M.S. recently resigned his position of Senior Research Physicist with the Field Research Laboratories of Magnolia Petroleum Company in Dallas, Texas, and is now residing in Rio de Janeiro, Brazil, where he is Division Manager for Brazil for Geophysical Service Incorporated of Dallas.

1940

Frederick M. Brose is employed by the Great Lakes Carbon Corporation in Los Angeles as Production Manager of the Perlite Division. The Broses have two daughters—ages one and three—and live in Arcadia.

Al Brewer is head of the Systems Research Section at Hughes Research and Development Labs. He and his family—his wife, Barbara; Greg, 5; and Pamela, 2½—have been living in their new home in Pacific Palisades, which Al designed and built, for a little over a year.

1942

G. R. Makepeace was made head of the Propellants Division at the Naval Ordnance Test Station at China Lake, Calif. Among his hobbies, there in the desert, is growing orchids. The Makepeaces have a daughter, Valerie Joyce, born last October, and a son, David Barry, now in the third grade.

Haskell Shapiro, M.S. '47, is an electrical engineer in the Hydrodynamics Lab at Caltech. He has two children—Lynn, age five, and Paul, age two.

Adrian Mayer graduated from Northwestern University Medical School in 1948. He married Betty Jo Williams in 1950 and his twin girls were born in 1951. He became Chief of Anesthesia at the Los Angeles County Harbor Hospital in 1951 and in July, 1952, will become Assistant Professor of Surgery (anesthesia) at U.C.L.A.

Carol M. Veronda is senior project engineer in the Product Development and Manufacture Electronic Tube Department at Sperry Gyroscope Company in Great Neck, New York. He presented a paper before the National Convention of the I.R.E. held in New York City in March.

1943

Donald H. Potts, Ph.D. '47, is now mathematician at the U. S. Navy Electronics Laboratory in San Diego. His family still consists of wife, Betty, son Robbie (3 years), daughter Polly (almost 2) and cat Cuppy (5 years). Don says he's glad to be back in California after five years in the Chicago area.

Chuck Strickland is an industrial sales engineer for the York Corporation, refrigeration and air conditioning manufacturers and contractors. In addition to conventional applications, they also get into special requirements such as low temperature work. Chuck is doing some traveling, but is mostly working in the "smoggy Central Manufacturing District." He and his family, including daughter Anita, live in Alhambra.

1944

Charles Almquist is still working as a sales engineer for Almquist Brothers in Los Angeles. His daughter celebrated her first birthday in February of this year. Charlie recently joined the San Gabriel Valley Chapter of the A.S.T.E.

1945

Clive Jackson has left the Atomic Energy Commission and its uranium exploration work in Utah and Colorado to take a job as Assistant Project Engineer with Steers-Grove in French Morocco. (Steers-Grove is an Eastern combination with a Navy contract to enlarge the Naval Air Base in Morocco.) Clive and his wife and three-weeks-old baby flew over there last September. Shortly after their arrival they managed to find a French villa to live in, and a few months later Clive won a 1950 Buick on a $10 chance—so the Jacksons feel they can't complain about their sojourn in Morocco. They expect to remain there at least until next September, and perhaps longer.

1946

Frederick C. Essig and his wife Lucie are the parents of a baby girl, Margaret Christine, born May 23, 1952.

1948

Thornton A. Wilson, M.S., who is aerodynamics supervisor at Boeing Aircraft, has been awarded an Alfred P. Sloan fellowship for the executive development program at M.I.T. The fellowship provides for an intensive one-year study of the economic, social and management problems of industrial administration. Nominated by Boeing, Thornton was selected after a

PERSONALS . . . CONTINUED

nation-wide competition with numerous other young executives from diversified industries. He joined the company in 1943 and has been given a year's leave of absence to attend M.I.T. The Wilsons have a ten-month-old son, Thornton A. *III*, and live in Seattle, Washington.

Pat Glover has been with the Shell Oil Company since August, 1948, and for the last two years has been working as a geologist in Long Beach. The Glovers two sons, John and Michael, are 2 years old and 10 months old, respectively.

1949

Douglas Brown is at present serving as Pfc. with the 29th Topographic Battalion of the U. S. Army in the Philippine Islands. He is party chief of a theodolite party working along the east coast of Luzon, supplying ground control for aerial photos. He hopes to return to his job with the California Division of Highways at the end of this year.

Samuel N. Domenico, M.S., is with the Stanolind Oil and Gas Company, and has been transferred from Tulsa, Oklahoma, to Fort Worth, Texas, where he has been named geophysicist in the company's division office.

Bill Muehlberger, M.S., according to the latest edition of the Caltech Geology Division's notorious house organ, *The Fumarole*, "has just been loosed on the civilian world again. It is rumored that while in the Marines, Bill had something to do with the mis-mapping of a drainage divide which was important to the Government's case in the big Fallbrook ground water squabble, and which may or may not have had something to do with the recent firing of Attorney General McGrath."

Neal Hurley expects to receive a Ph.D. degree from Stanford this summer, having nearly completed his thesis on problems connected with the secondary migration of oil. The year he spent at the Federal Institute of Technology in Zurich, Switzerland, studying structural geology and petrology, proved to be an interesting and valuable experience, Neal reports. Future plans are not yet certain, but all signs point to work with an oil company.

1950

James P. Heppner, M.S., is back at Tech working on his Ph.D. after a two-year sojourn with the Geophysical Institute of the University of Alaska.

Amasa (Herb) Forrester received his M.A. from Princeton in 1951 and is now teaching and working for his Ph.D. there. He was at Los Alamos last summer, and is to be there again this summer. Herb was awarded a predoctoral fellowship under the National Science Foundation for the academic year 1952-53.

Harry L. Masser, Jr. has been working in Baltimore since July '51 on jet engine containers and other ordnance items for Rheem Manufacturing Company. He has worked for Rheem since graduation, and transferred to Baltimore permanently when that office became the equipment and container division of the Company. Last January he was married in Los Angeles to Eleanore Neal of U.S.C. Harry occasionally sees two other Industrial Design graduates in Philadelphia—*Richard A. Wallace* '49, who's at the Franklin Institute (and recently became a father) and *James H. Crate* '49, who's now back in the Navy and was married this spring to a Philadelphia girl.

Joseph B. Alexander, M.S., was married on April 14 to Miss Rosa Sum Ching Yeuk at St. Andrew's Cathedral in Singapore.

1951

Clarence R. Allen has been awarded a National Science Foundation Fellowship to carry on his graduate work in geology at the Institute.

William E. Eilan reports the birth of a son, Ronald Craig, on June 2 at the Queen of the Angels Hospital in Los Angeles.

LETTERS

CONTINUED FROM PAGE 4

I spent about three months in the New York office before coming out here. There I spent some time working thermo problems (which, by the way, was anything but my forte in college) but out here the only place I can see where my technical knowledge helps me is in understanding somewhat the basic principles of what's going on and making sense out of drawings and technical conversations. Ah, yes, by looking at a chemical analysis of some well water I knew at a glance that the total dissolved solids content made it unsatisfactory as drinking water. Chalk up one for McKee's class in Sanitary Engineering.

I have come to the conclusion that the real benefit in a technical education is that, after four years of it, one requires less explanation and instruction in order to learn anything. This is true largely because, whether the student realizes it or not, he spends a good portion of his time learning to learn. This learning to learn is something that may or may not be acquired through practical experience. It's been my observation that it usually is not.

It's true that a good many students have the mental capacity to retain in their heads quite a bit of actual factual information. This is all to the good, as it allows these individuals to come to accurate conclusions about some problems with a minimum of lost time. But there are probably plenty of students who manage to struggle through Caltech, and feel as I did on graduation: "I just can't seem to think of a single fact." However, one of the things these men are soon to discover is that, given a problem of almost any nature, they will unhesitatingly launch off on its solution in a logical and sometimes methodical way that has its origin in the working of countless math problems, numberless problems in physics and chemistry, endless themes and papers on English and history, and thousands of arguments with instructors. It is surprising how often these men come to the right conclusions.

In its stress on a basic educational policy Caltech accomplishes what to me is a great thing; it teaches you just enough about a great number of things so that with very little research and study you can be fairly well informed on any one of them.

A little now about my plans for the future. One of the big factors affecting these, of course, is the draft. But forgetting about that for the moment (which isn't very easy), I'd like to say that I'm doing now just about what I had planned on before ever going to Caltech. I know that sounds hard to believe, but it's true. I am working for a company that is still young and expanding rapidly; I have a job that pays well and also gives me a maximum of varied experience, thus permitting me to branch out at any favorable opportunity; I'm working under men who, in every case, have proved to be capable, fair and easy to get along with; I am in close contact with the field and thus have the opportunity to be in the open, which is important to me; and the kind of work I am doing is so diversified that it is impossible to get in a rut.

I have in the back of my mind the thought that I'll try a couple of

LETTERS... CONTINUED

different jobs before I settle for any particular one, but that's something I can only speculate on now. I'm sold on California and, if it's at all possible, I'd like to end up there eventually. I've seen a little of the rest of the world and haven't as yet seen anything to approach the United States in general and California in particular.

Dean M. Blanchard '51
Indonesia

Sirs:

I was very much disturbed to read of Caltech's action in joining eight other colleges and universities in southern California which will choose liaison representatives to maintain relations with the State Senate's Committee on Un-American Activities (*E&S*—April, 1952).

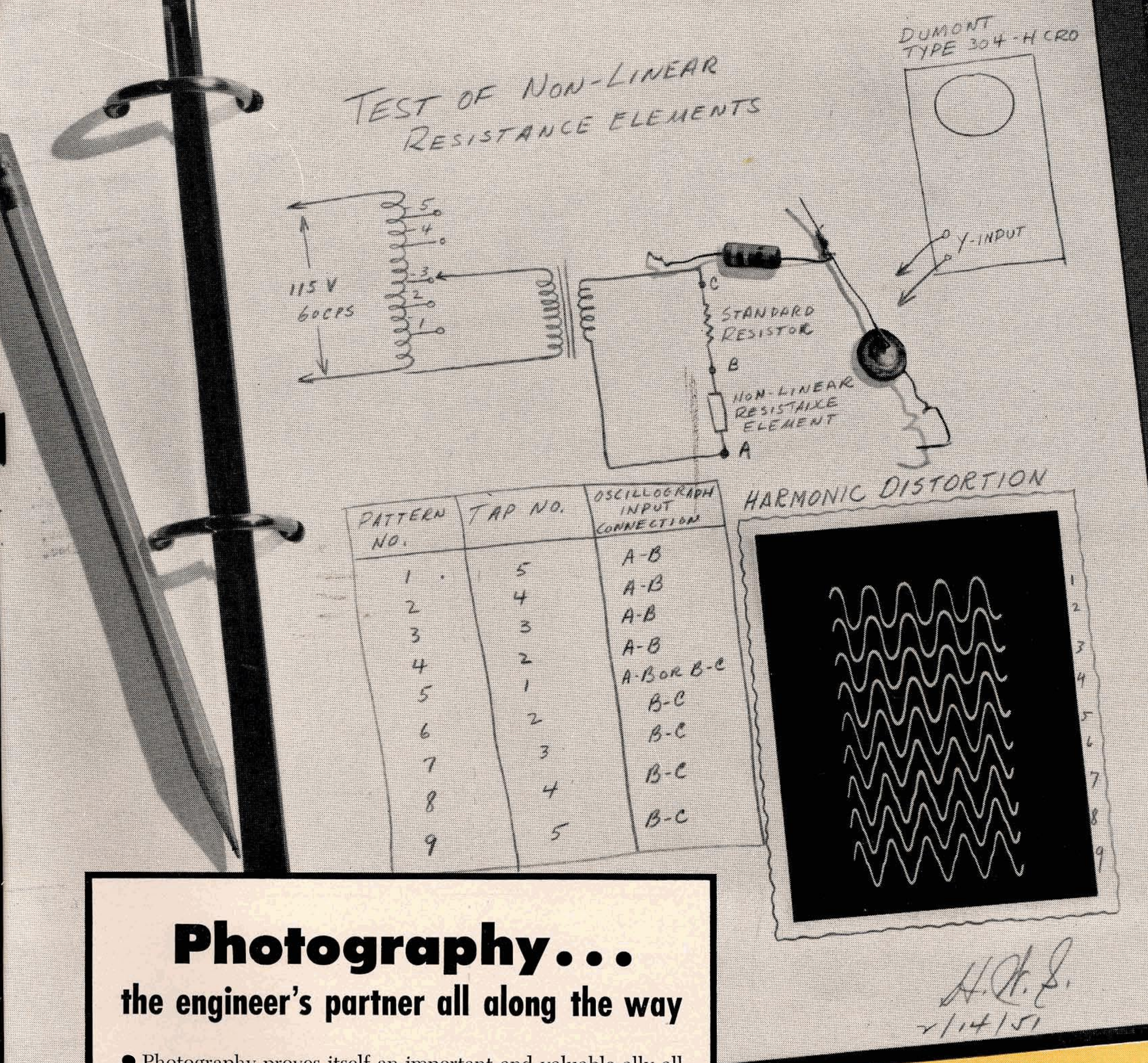
Fundamental to a sound educational program is a free interchange of ideas and facts. Naturally, a professor who forces the students to listen to only one point of view, or propagandizes in class on subjects far afield from those which he is paid to teach, is not doing a proper job and should be dealt with accordingly. However, outside of the classroom, the professor and the student should be treated as other citizens. The sole criterion of the worth of each in the academic field must lie in his actions in the academic field, not in his politics.

The State Senate's Committee on Un-American Activities looks only to the left. It has spent much time and money besmirching names. The purpose of such a committee is to investigate in order to provide information on which to base laws. The laws are their end; but they, as with their counterparts elsewhere, have forgotten this in an orgy of witch-hunting and headline haunting.

Therefore, I do not understand Caltech's position. Is it fear of spies that motivates? Since when have these committees replaced the FBI? Is it fear of criticism? How can you expect a man to lay down his life for the freedom for which you will not even stand up to be counted?

Must another good school be weakened to the extent that a man considers it an insult to be invited to teach there, before we learn the lesson of the University of California?

Richard Schoen '49
Los Angeles



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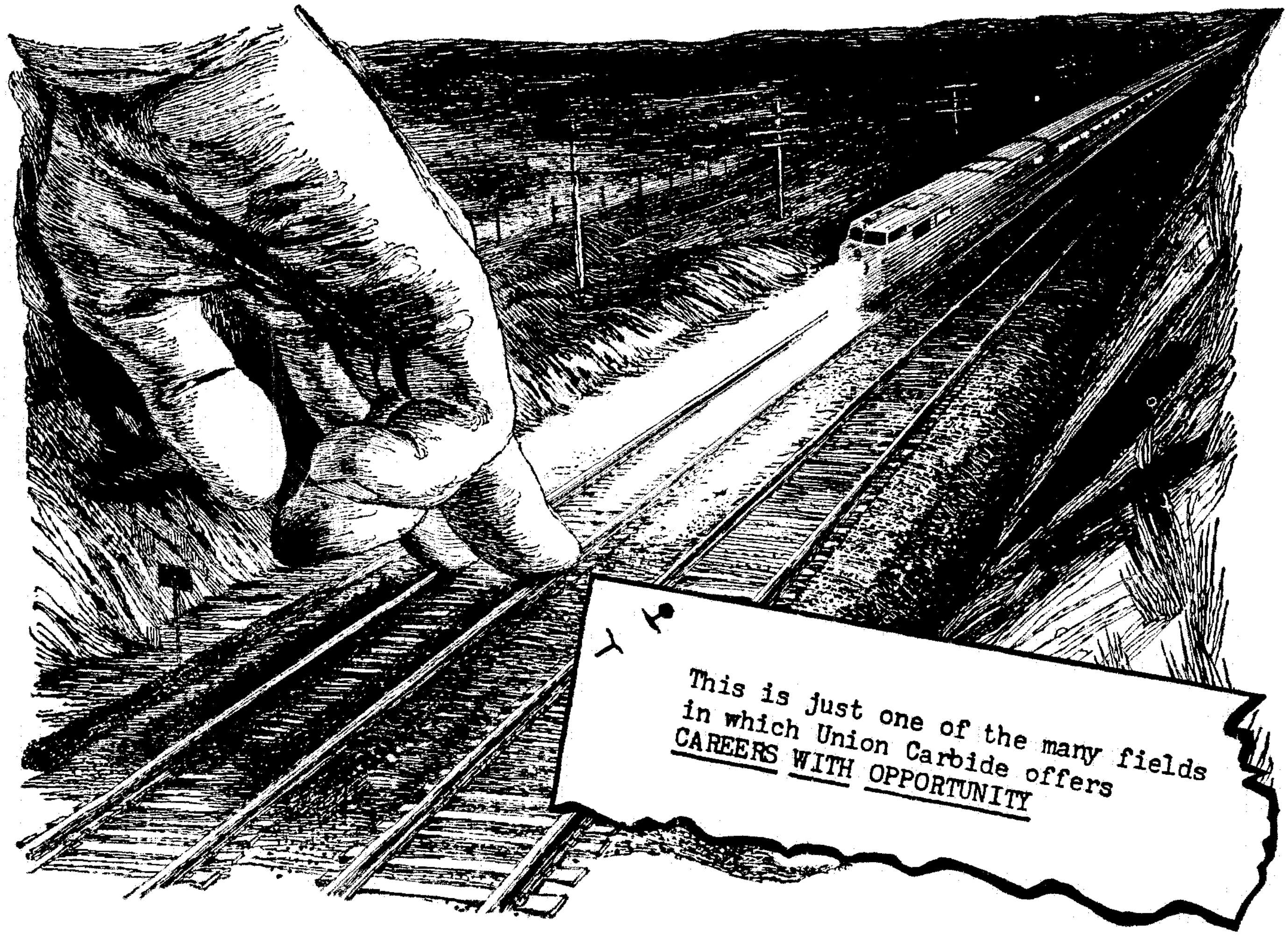

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