ENGINEERING | AND | SCIENCE

JUNE / 1953

Commencement . . . page 16

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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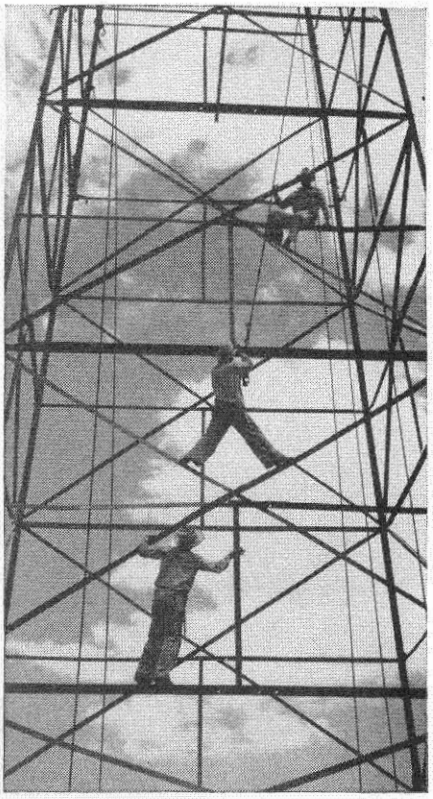

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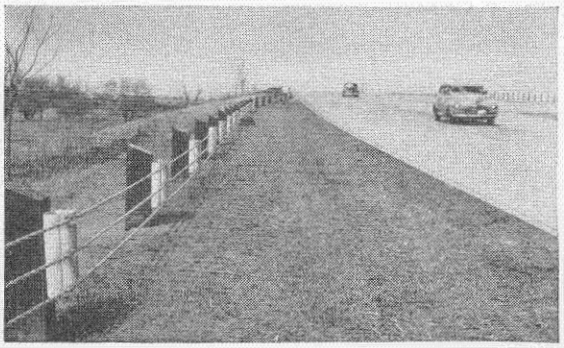

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Austin Bush, Rensselaer, '50, Helps Develop New Pump

AUSTIN BUSH, inspecting stuffing box assembly on boiler feed pump.

Reports interesting project engineering assignments at Worthington

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ENGINEERING | AND | SCIENCE

IN THIS ISSUE

This month's cover shows the 1953 Commencement platform—at that point in the proceedings when His Eminence, James Francis Cardinal McIntyre, Archbishop of Los Angeles, was delivering the Invocation. You'll find all the most vital statistics on the 1953 Commencement on pages 14 and 15 of this issue; some biographical notes on the Commencement speaker, Arthur S. Flemming, Director of the Office of Defense Mobilization, on page 18; and the full text of his speech, "The Dedicated Citizen," on page 11.

Probably 90 percent of our readers will (or should) head for their dictionaries when they see the title of Albert G. Wilson's article on page 7—"Astronomy and Eschatology." Since we've already done this, we can tell you that eschatology is that branch of theology concerned with the ultimate destiny of man and the world. As you'll discover, in Dr. Watson's article, science has now moved in on the theologians. "Astronomy and Eschatology" is a lively discussion of what the astronomer discovers when he studies the cosmic disasters ("Sunday Supplement" disasters is what Dr. Wilson calls them) which could end the existence of mankind.

PICTURE CREDITS

Cover	Ed Bryan '54
p. 9	George Stranahan '53
p. 13	Barry Bieler '51
pps. 14, 15	George Stranahan '53
pps. 16, 17	Margaret Stovall Pasadena *Star-News*

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CONTENTS

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

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LETTERS

Response to Hunter Mead's article on "The Caltech Student" was 100 percent pro. Here are a couple of samples:

Dear Dr. Mead:

Re your April '53 article on Tech students' psychology—you are 100% right. And there is so much more you might have said!

Seriously, it's good to see this recognition of the problem where it's most likely to do some good—and publication where it may influence the thinking of men the students respect, and whose attitudes they may copy. More power to you!

K. B. Howard '41
Lindsay, Calif.

Dear Dr. Mead:

I thought your analysis of Techmen and their limitations was excellent, and — having confronted the hard, cruel world and its lack of structure both in natural and social matters — I find that I agree with you completely.

Richard V. Henry '45, M.S. '51
Glendale, Calif.

How to spend the summer

Sirs:

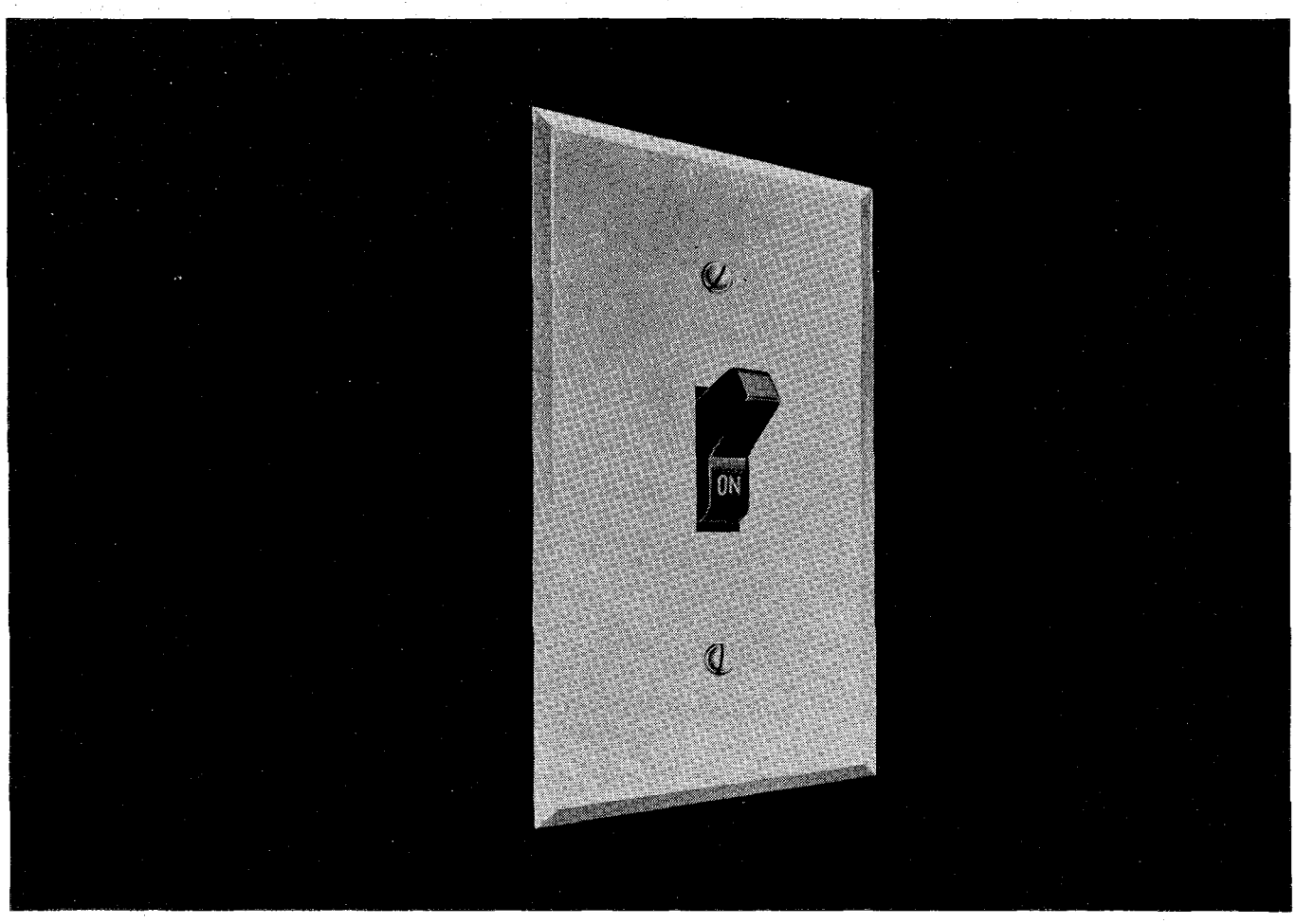
I'm sending along an interesting brain puzzler which you may want to use sometime in *Engineering and Science*. Since you'll probably be swamped with the correct answers—and since this is rather a lengthy process anyway—I won't try to include the correct solution. But it's a problem that has kept plenty of soldiers busy, and even helped ease their lack of enthusiasm for being in the Army.

Brown, White, Gray, Green, and Black are playing poker. They are smoking Luckies, Camels, Kools, Old Golds, and Chesterfields, but not necessarily in that order. At the start of the game the players had among themselves packs with 20, 15, 8, 6, and 3 cigarettes in them. Later, at a time when no one was smoking,

Clue 1 White asks for 3 cards.
Clue 2 Black has smoked ½ of his original supply, or 1 less than Gray has smoked.
Clue 3 The man smoking Chesterfields had as many more, plus half as many more, plus 2½ more cigarettes than he now has.
Clue 4 One man drawing to an inside straight lights the tip end of his fifth cigarette, the last that he smokes.
Clue 5 The man smoking Luckies has smoked 2 more than anyone else, including White.
Clue 6 Brown draws as many aces as he originally had cigarettes.
Clue 7 No one has smoked all of his cigarettes.
Clue 8 The man smoking Camels asked Green to pass Brown's matches.

Question: How many cigarettes and which brand did each player possess at the beginning of the game?

—Frank J. Wolf '48



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ASTRONOMY AND ESCHATOLOGY

By ALBERT G. WILSON

What the astronomer finds when he studies the cosmic disasters which could end the existence of mankind

AFTER PASSING SEVERAL centures in a state of neglect, the ancient art of prophesying is again becoming quite fashionable. This is easily verified by going into any book store and looking over the drove of books currently appearing on such subjects as human destiny, the next million years, the end of the world, etc., etc. The men behind these books, the modern Jeremiahs and Daniels, do not get their source material from handwriting on walls, but from the data science has accumulated concerning the evolutionary processes of stars, rocks, and living organisms. And unlike their ancient predecessors, modern prophets generally avoid forecasting the time and place at which a specific event will occur; they prefer to confine their prophesying to the delineation of rough bounds within which future events must lie.

But in spite of this dilution, prophecy is still as popular as ever. For example, an informal sampling of the thousands who every year visit Palomar to view the world's largest telescope reveals that most of these people look on Palomar as a sort of 20th century Delphi, and are primarily interested in those phases of astronomy which are relevant to the old questions of the purpose, significance, and destiny of man in the universe.

Traditionally such questions as these have been the monopoly of theologians, who have gone into these matters in great detail, even giving a name to the subject—eschatology, the study of the ultimate destiny of man and the world. But with the great progress which science has made during the past few decades in disentangling evolutionary processes, it was inevitable that scientists should invade this field.

Though science has accumulated enough facts to enable certain types of long-range predictions to be made, the picture is still extremely fragmentary and fraught with uncertainties. The largest uncertainties in the predictions do not arise from the incompleteness of science's picture of nature and its evolutionary processes, but from the fact that intelligent life, through its increasing control over nature, can alter the course of future development to conform with its own purposes. If man's control of his environment were complete, and if his goals were well established and intelligently pursued, then a prophet could simply say that the future is circumscribed by these goals and he would be close to being right.

But this is not the case. The present situation is somewhat between that of the past, in which the laws of organic and inorganic evolution alone determined the course of events, and the case described above in which an intelligent organism possessing complete control of itself and its environment determines the future.

This uncertainty factor imposed upon evolutionary development by the impact of intelligence is negligible in those areas of the natural order which lie beyond the control of men. In such areas science may predict the future from natural laws with confidence.

The extraterrestrial universe stands as a region wherein man's influence will in all likelihood forever remain of minute importance. When the limited extent of man's domain is compared to the background of the vast distances of space, it is quite evident that the cosmic stage is almost completely unaffected by what man does on this planet. Even if he should choose to blow the earth to bits, the effects would be of no cosmic consequence. The cosmic order remains indifferent to the aspirations and efforts of man. And though man may eventually completely subdue nature on this planet, his ultimate destiny on earth is circumscribed by the earth's destiny in the cosmic order. And the earth's destiny, in turn, is circumscribed by the evolutionary processes of the universe.

The role of astronomy

It is then the role of astronomy, in science's prophecy of the future for man, to ascertain the earth's probable future as determined by the action of cosmic forces. Specifically, astronomy must seek to discover what the prospects are for the earth's continuing as a suitable abode for life, and study those events which could end the existence of mankind.

It is difficult to imagine life being obliterated by purely terrestrial forces. Cataclysmic earthquakes or meteorological changes which would terminate all human life could occur only as a result of a change in our cosmic environment.

What, then, are the cosmic events whose occurrence would either directly by their own action, or indirectly through the triggering of terrestrial forces, effect a termination of the delicate conditions necessary for life? Two types of such cosmic disasters are conceivable: first, a collision or a close encounter between the earth and another celestial body which could disrupt the earth, or cause gigantic earthquakes, tides, and/or loss of the earth's atmosphere, or perhaps even cause the earth to assume a new orbit which would alter its mean temperature; second, a change in the intensity or nature of radiation received by the earth from the sun, as for example would occur if the sun's luminosity or temperature were to change.

This array of "Sunday Supplement" material has been carefully considered by astronomers and it is now possible to make some evaluations and predictions.

First, the likelihood of collisions and encounters: Every day the earth's mass is increased by several thousand tons through its collisions with meteoritic material. For the most part, this accreted material consists of fine dust or of small grains which, striking the earth's atmosphere with velocities of the order of 30 miles per second, are immediately consumed by friction. Larger particles, weighing up to about 200 pounds, may strike the earth with frequencies of perhaps five or six each day. But this material poses no threat to human life, although a meteorite about the size of a fist struck a garage in Illinois a few years ago and, passing through the top of a car, came to rest in the car seat.

But larger masses frequently strike the earth. Twice during the present century two large meteorite falls have occurred, both fortunately in relatively uninhabited regions. In 1908 a group of large meteorites, estimated as having a mass of a few hundred tons, struck in the Tunguska River region in Siberia. The resulting hot air blast devasted an area of some 3000 square miles. And again in 1947 a fall of comparable size occurred in eastern Siberia. It has been estimated that meteorite falls of this size occur once every 50 to 100 years.

But what is the chance of the earth's colliding with a really large body? Within the past few years about a dozen new asteroids have been found whose orbits cross that of the earth. In October of 1937 one of these objects passed at a distance only three times that of the moon, a near miss on the celestial scale. If the number of these asteroids whose orbits bring them close to the earth is no greater than the number observed up to the present time, E. J. Opik (of the Armagh Observatory in North Ireland) then estimates that a direct hit would occur about once every 30 million years. If, as is more likely, there exist several hundred such asteroids, the estimate is every two million years.

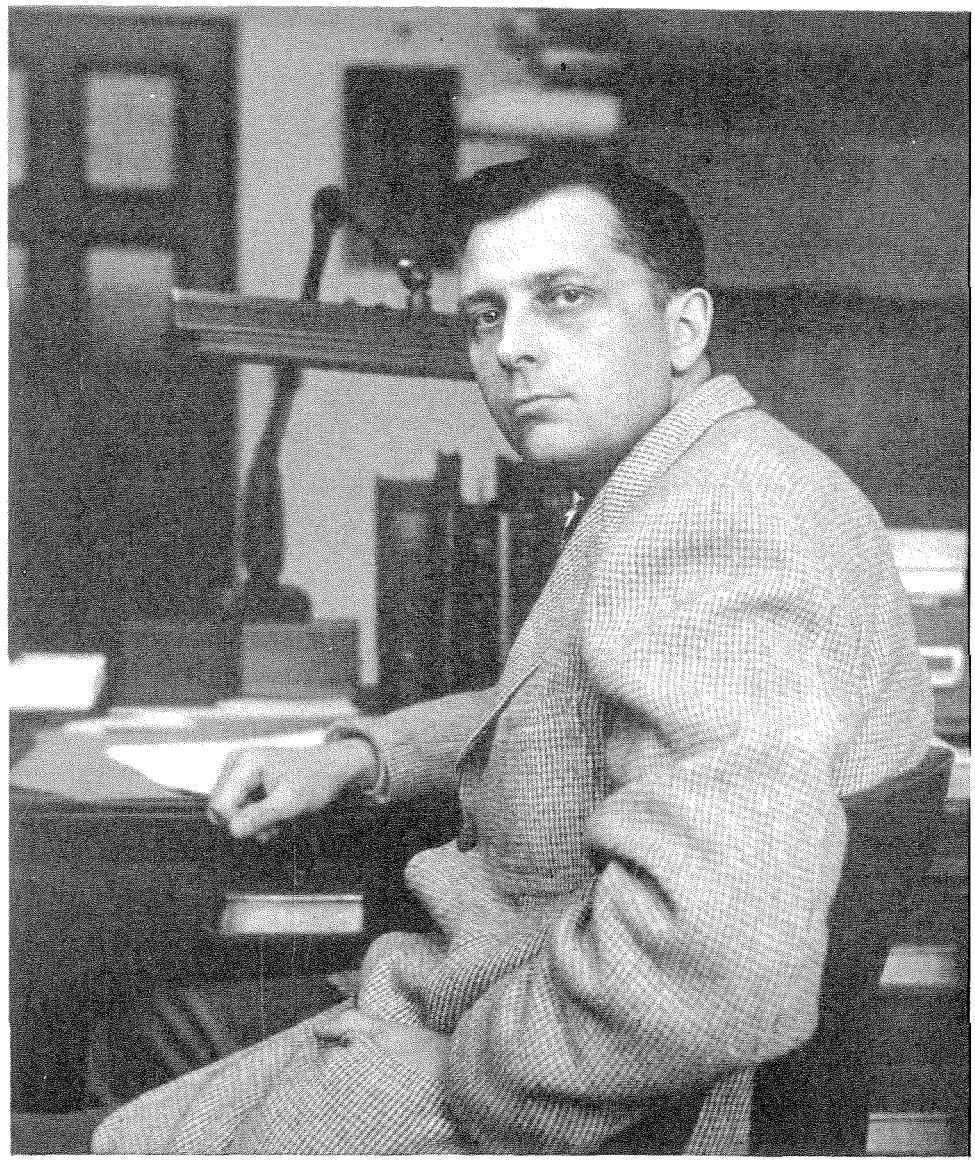
But even a collision with one of these asteroids whose mass is comparable to that of a mountain would not be a total disaster. One recently discovered at Palomar is the smallest yet observed, having an estimated diameter of only a quarter of a mile. A collision with such a body would create a crater perhaps 25 miles across and devastate an area about the size of Texas. This is about the worst that could happen. The orbits of all objects significantly larger are known, and none come near the earth.

Strangers from outer space

This survey takes care of visitors from within the solar system, but what of strangers from interstellar space?

A subject very popular with writers of science fiction is the destruction of the solar system by an encounter with a passing star. This idea used to be popular with astronomers too, not for the destruction of the solar system, but for its creation. A once highly regarded theory would have the planets formed from pieces of the sun torn out by the tidal action of a passing star. But when the probability of such encounters was computed it was found that even among the hundreds of billions of stars in the galaxy, only one or two encounters would have occurred in the 3,000,000,000 years believed to be the galaxy's age.

A remaining possibility in this field of Sunday Supplement disasters is the disintegration of the moon, resulting



Dr. Albert G. Wilson, Staff Member, Mount Wilson and Palomar Observatories.

in huge pieces raining down from the sky, leaving the earth dead and pock-marked like its late satellite. Actually this event could happen. Sir George Darwin and Harold Jeffreys have worked out the effects of tidal friction on the stability of the earth-moon system. If the loss of energy through tidal friction continues at the present rate, the month and the mean lunar distance will increase. The maximum will occur when the earth's sidereal day and the month are equal to 47 of our present days. After this time the effect of tidal friction will be to shorten the month and bring the moon closer. When the moon comes within a distance of about 2.4 times the earth's radius it will be torn apart by gravitational attraction, parts falling to the earth and parts going into the formation of rings like Saturn's. If this theory is correct, the date at which the disaster will occur is January first, 100,000,000,000 A. D.

The second type of cosmic event which could affect the existence of life on earth is a change in the sun's integral properties, such as its size, luminosity, or temperature. It is estimated that the atomic furnaces in the sun's interior have been operating for roughly three billion years, helping to maintain the earth's surface at a nearly constant temperature. How much longer the sun's thermo-nuclear reactions will continue to operate and what will happen when the fuel supply is exhausted are problems studied by a branch of theoretical astronomy called "stellar interiors."

The present theories of the structure of the sun do not pretend to be definitive and revisions are constantly being made. However, some zero order ideas concerning the sun's future can be derived from these present models.

One idea is to represent the sun by a model consisting of two zones: a core, whose temperature is sufficiently high to enable thermo-nuclear energy generation processes, such as the carbon cycle, to be operative; and a cooler surrounding envelope in which no energy generation occurs. Initially, a star is composed almost entirely of hydrogen. Within the core the hydrogen is being converted into helium, accompanied by convective currents which keep the substances thoroughly mixed. The envelope, cooler and less disturbed, remains hydrogen rich. As long as there exists an adequate supply of

hydrogen in the convective core, there is little change in the star's integral properties. Eventually, however, the hydrogen in the convective core becomes exhausted and within the core there no longer exists nuclear energy production. The central core becomes an extremely hot isothermal core, and at the interface between the core and the hydrogen rich envelope, nuclear energy generation occurs in a thin shell. The isothermal core grows in mass and radius as the thermo-nuclear shell eats its way out through the hydrogen envelope. Chandrasekhar and Schönberg have shown that this process cannot continue until the shell traverses the entire envelope, but must terminate when the isothermal core acquires a mass about 12 percent that of the entire star. During the time of growth of the isothermal core, the star increases somewhat in luminosity, but remains constant in temperature. Schwarzschild and Sandage have developed an evolutionary sequence which comes into operation after the 12 percent limit has been reached. According to their theory, after the isothermal core reaches the critical mass it begins to contract, and through contraction gravitational energy is released. During this phase the total luminosity of the star remains nearly constant, but the envelope becomes greatly extended. Later, when the contracting helium core reaches a much higher temperature a thermo-nuclear reaction in which helium nuclei form carbon becomes operative. Then the star becomes more luminous. After this stage, the star may collapse and become what is known as a white dwarf star. These are stars whose matter is in a degenerative form. The nuclei of the atoms, devoid of their electronic shells, are pressed together, giving densities of the order of tons per cubic inch.

Theories and observational data

These are theories. But some very remarkable agreements have obtained between the consequences of these theories and the observational data. The rate at which a star consumes its hydrogen depends on its mass. The most massive stars burn their fuel at the highest rates and are therefore the most luminous. It follows that massive stars reach the Chandrasekhar-Schönberg limit earlier than less massive ones and start out earlier on an evolutionary track such as that proposed by Schwarzschild and Sandage. In a large aggregate of stars, such as a globular cluster, containing stars of all masses, there should be some which are still consuming the hydrogen in their cores and some which have reached the post-12 percent evolutionary stages. Sandage, at Mount Wilson and Palomar, has studied the luminosities and temperatures of several hundred stars in the globular cluster M3, and finds that all the stars heavier than 1.2 solar masses have taken off on an evolutionary track resembling that predicted by the theory.

If the universe is in the neighborhood of 3,000,000,000 years old, as is derived from several independent observations, and stars down to 1.2 solar masses have consumed the hydrogen available to them, how much time remains before stars of mass 1.0 reach this critical evolutionary stage? Assuming that our sun is of the same age as the stars in M3 and is subject to the same interior processes, then it should continue to radiate more or less as in the past for another four or five billion years.

We may now relax. Based on what has been observed of the cosmic order, it appears that man will not be exterminated by nature before he can perfect the means of doing the job for himself.

Our prophecy may well end here, but it is usual for the prophet to tell first what the future will be, and then tell how this future can be avoided by following his advice. In the present discussion, the future described can be avoided by simply constructing a different sort of stellar model.

Further, according to the best traditions of prophecy, the predictions must be supplemented by exhortations and admonitions. Whereas the predictions themselves are usually well received, the sermons which prophets insist on giving with their forecasts have always made them unpopular. (First-rate prophets have never measured their success by the success of their predictions, but by how unpopular they can become.) Therefore, both in order not to disappoint anyone and to help crystallize reader opinion, I shall conclude with some brief admonitions and exhortations.

A difficult problem of choice

Mankind today is in the position of the child who has spent his life thus far under rigid parental guidance, but now coming of age, suddenly acquires freedom and means. The laws of evolution which developed intelligence on this planet are now at the disposal of that intelligence. The knowledge of the processes of nature and the ability to utilize these processes for his own ends have come to man at the same time. But like the child with newly acquired freedom and means, man is faced with a difficult problem of choice: What shall he do with his control of nature? What ends shall he seek? What destiny should he wish?

Perhaps no better advice can be given than that the child should continue to pursue those ideals and principles laid down by its parents, at least until it acquires sufficient maturity to evaluate all the courses open to it. Man can set no better goal for himself than to emulate the goal of nature: To develop a species with the maximum possible survival potential. In the past, survival potential has depended on adaptability to environment; in the future it will also depend on control of environment. So man must use the understanding and control which his science affords him to increase further his control and to establish those conditions which enhance the long-range survival of his own or derivative species.

The astronomer can only assure man that cosmic forces give him a green light for whatever he plans. To others he gives the task which is the most important of all—to derive from the above general goals and principles the specific rules and patterns for action.

THE DEDICATED CITIZEN

He's the man who is ready to serve when called on — by his government, or by his neighbors

By ARTHUR S. FLEMING

I REGARD IT as a real honor to have the opportunity and privilege of addressing the members of the class of 1953 of the California Institute of Technology.

I have long admired the outstanding contribution that this institution has been making to the Nation. We are more dependent on the number and quality of graduates from this and other similar institutions than ever before in our history. We have been and still are confronted with serious shortages in the field of scientific and technical manpower. We need men and women who have had the finest kind of scientific and technical training and who, at the same time, are equipped to provide us with the leadership in the field of management which will result in our utilizing our limited resources in the most intelligent and effective manner. I know that, as a result of your work at this Institute, you will in the years which lie ahead provide us with that kind of leadership.

I also consider it to be a high honor to have the opportunity of being associated with your President in this Commencement program. As many of you know, Dr. DuBridge is the Chairman of the Science Advisory Committee of the Office of Defense Mobilization. This is just one of many connections that he has with the Government. In connection with all of these assignments, he has given and is giving of his time, energy and talents to the Nation during one of our most critical periods. He is the type of citizen who goes the second mile in his determination to recognize and discharge the duties of citizenship.

In an address to the Midshipmen at the United States Naval Academy just a few weeks ago, the President of the United States said:

> "There is something special about dedicating your lives to the United States of America that lives with you, and, what is more important, in my opinion, with your children as long as they shall live."

The President was addressing, of course, a group of men who in many instances will serve in the United States Navy for most of their active careers.

But the President's remarks are applicable to each one of us. There is something special about dedicating our lives to the United States of America. And no matter what our vocation may be, we can dedicate our lives to our Nation in just as real a sense as the man who takes an oath of office in the United States Navy.

And here are some of the ways in which we can make such a dedication.

First, we can place our duties as citizens ahead of our own personal desires and selfish interests.

If we do, we will always vote; and before we vote we will always do everything we possibly can to obtain the information which will enable us to arrive at intelli-

gent conclusions regarding both candidates and issues.

The man or woman who fails to do both of these things is deliberately placing personal desires and interests ahead of the best interests of his Nation.

We need the contributions that men and women trained in scientific fields can make to the solution of our major political issues. There is no way in the world in which you can satisfactorily rationalize your failure to make such a contribution. You are either going to strengthen your Government by becoming a participant in the affairs of Government or you are going to undermine your Government by standing on the sidelines as spectators. You can't be neutral.

He serves his neighbors

Second, we can help our neighbors realize their highest possibilities.

The surest way in which to undermine the foundation on which our Nation rests is for citizens to decide that they will take care of themselves and let the other fellow take care of himself.

The dedicated citizen is one who always is ready to utilize his time, energy, and resources in the interest of assisting, for example, the Red Cross, Community Chest agencies, and above all, the church of his choice.

And the dedicated citizen is one who believes that he must have the same concern for his neighbor 5,000 miles away as he has for his neighbor five blocks away. He may argue about the best way in which to express that concern, but he will never contend that he and his fellow citizens should not be concerned.

When the Master of us all told us "to love our neighbor" he was stating a law of life which, if obeyed, will bring us satisfaction that just cannot come to us in any other manner. If we follow this Commandment we will lose our lives in service to others and in so doing we will find joy and peace. Also, in so doing we will be strengthening our Nation. When we dedicate our lives to our fellow human beings, we dedicate our lives to the United States of America.

He serves his government

Third, we can respond quickly and enthusiastically when we have the opportunity to serve our fellow human beings through Government.

I know that this point has special meaning for at least some of the men of this class. You know that for a specified period of time you will be called upon to dedicate your lives on a full-time basis to the United States of America.

And I hope that those of you who find yourselves in this position will not let anyone persuade you to become cynical about this period of service.

We are confronted with the most serious challenge to freedom that has ever faced our Nation. The Undersecretary of State, the Honorable Bedell Smith, provided us with a brief but accurate analysis of that challenge when, in an address a few days ago, he said:

> ". . . . we confront a ruthless, barbaric, and power-hungry clique who seek to subject the world to their tyranny. And I speak as one who spent three years in Moscow."

Personally, I just can't understand those who, referring to our mobilization program and the war in Korea, ask "What is it all about anyhow?" I can understand differences of opinion as to the best methods to use in meeting this challenge to our freedom. I can't understand, however, a failure to recognize the existence of the challenge.

We can deal with this challenge to free men effectively only as we proceed from a position of strength.

It is the hope and prayer of all of us that by proceeding from such a position we can avoid all-out war. Unless, however, our efforts to avoid all-out war rest back on a foundation of strength, the freedom that we cherish will perish from the earth.

Maintaining a position of strength

And that position of strength must be maintained even though there is a cessation of hostilities in Korea. To quote again from Undersecretary of State Smith:

> "If we gain an armistice, we should beware of letting down our guard. We cannot relax. Korea is but one flank of a conflict that girdles the world. Danger spots are many. We must remain alert and ready.

In other words, an armistice in Korea cannot possibly eliminate, or even diminish, the challenge to our freedom. We will still be dealing with a "ruthless, barbaric and power-hungry clique." And we can only deal with such a clique by proceeding from a position of strength. That is why the members of this graduating class who will be called upon to serve for a period of time in the armed forces will have the high privilege of dedicating their lives to the United States of America and, in so doing, will be making their contribution to the preservation of freedom.

But the men who will be serving in the armed forces are not the only persons who will have the opportunity of serving their fellow human beings through Government. Each one of us, at one time or another in our lives, is very likely to be brought face to face with such an opportunity.

A clear decision

We may be asked to serve the political party of our choice. We may be invited to stand for election to the city council, the state legislature, or the Congress of the United States. Officials of our city, state, or federal governments may urge us to accept appointment to a position of trust.

When we are confronted with the opportunity of serving in such capacities let's make our decision, not on the basis of what we would like to do, but on the basis

Arthur S. Fleming, Director of the Office of Defense Mobilization, delivering the 1953 Commencement address at Caltech on June 12.

of whether or not we can render a real service.

One of America's greatest weaknesses is the unwillingness of qualified citizens to serve their Government when called upon to do so. Citizens are very willing to complain about the weaknesses they find in Government. And they should be. But many of them are unwilling to make a positive contribution in the direction of eliminating those weaknesses.

Incompetence and responsibility

Whenever the spotlight is turned on an incompetent Government official you can be almost sure of the fact that, in the background, there is a story of a qualified person being asked to assume office and refusing to do so because it interfered with some of his own selfish interests.

We can dedicate our lives to the United States of America by deciding here and now that when we are called upon to serve our Government, we will respond to that call.

Fourth, we can decide that at all times and under all circumstances we are going to look to the God and Father of us all for strength and guidance.

Unless we do, it is idle for us to talk about dedicating our lives to our Nation. It has been and must always be "this Nation under God."

Congressman Rabaut of Michigan underlined this fact a few weeks ago when he introduced a joint resolution calling for a change in the wording of the pledge of allegiance to the flag of the United States so that it would read as follows:

> "I pledge allegiance to the flag of the United States of America and to the Republic for which it stands, one Nation, under God, indivisible, with liberty and justice for all."

It is a source of inspiration to all of us to know that, at the opening of each meeting of the Cabinet, all present are asked to join with the President in a period of silent prayer for Divine guidance and strength.

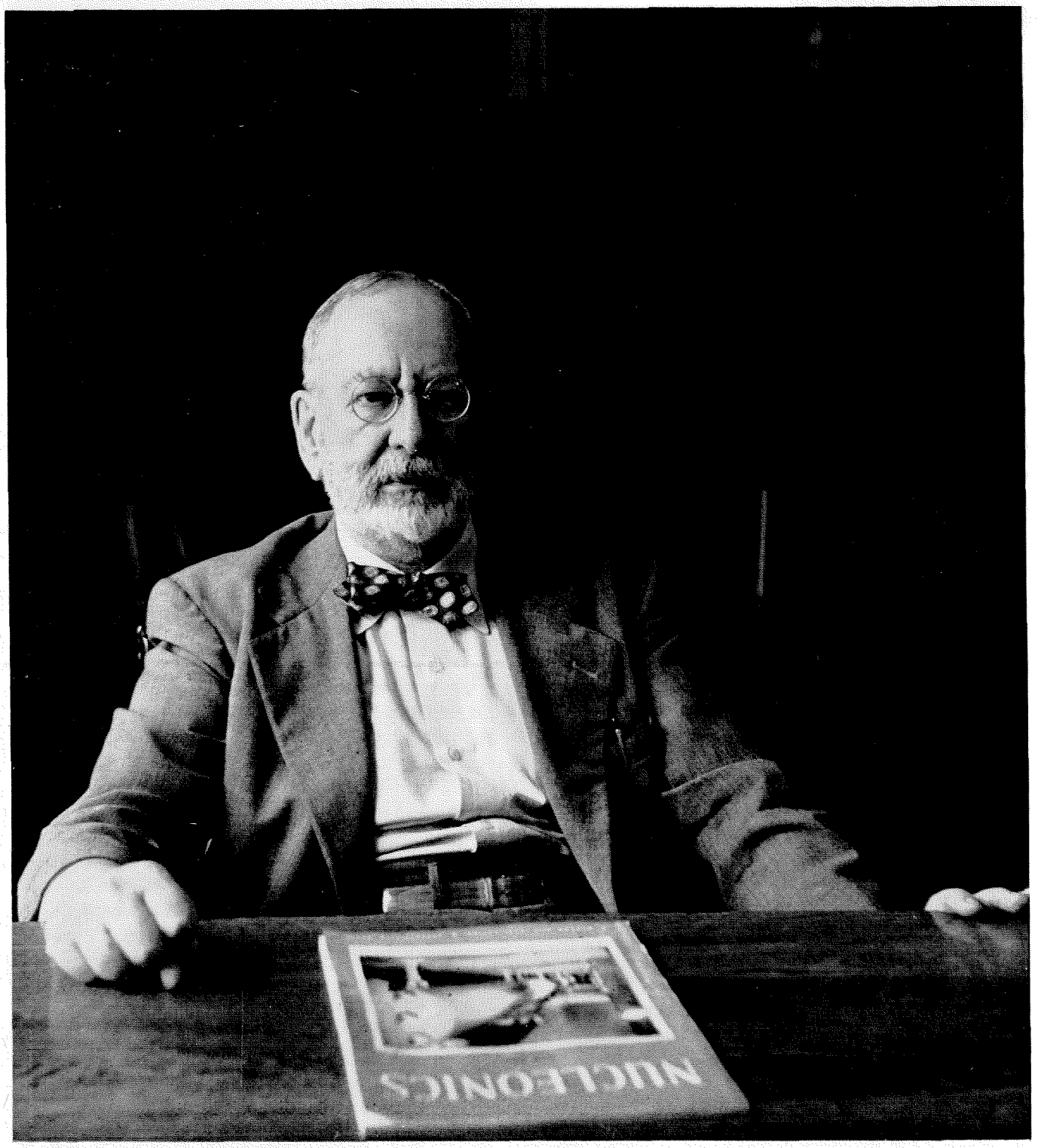
But that isn't enough. We, as citizens of this Nation, must also constantly ask for such guidance and strength. Unless we do we will not place our duties as citizens ahead of our personal desires; we will not help our neighbors realize their highest possibilities; and we will not respond quickly, enthusiastically and in a sacrificial spirit when we are provided with the opportunity of serving our fellow human beings through our Government.

The rewards of service

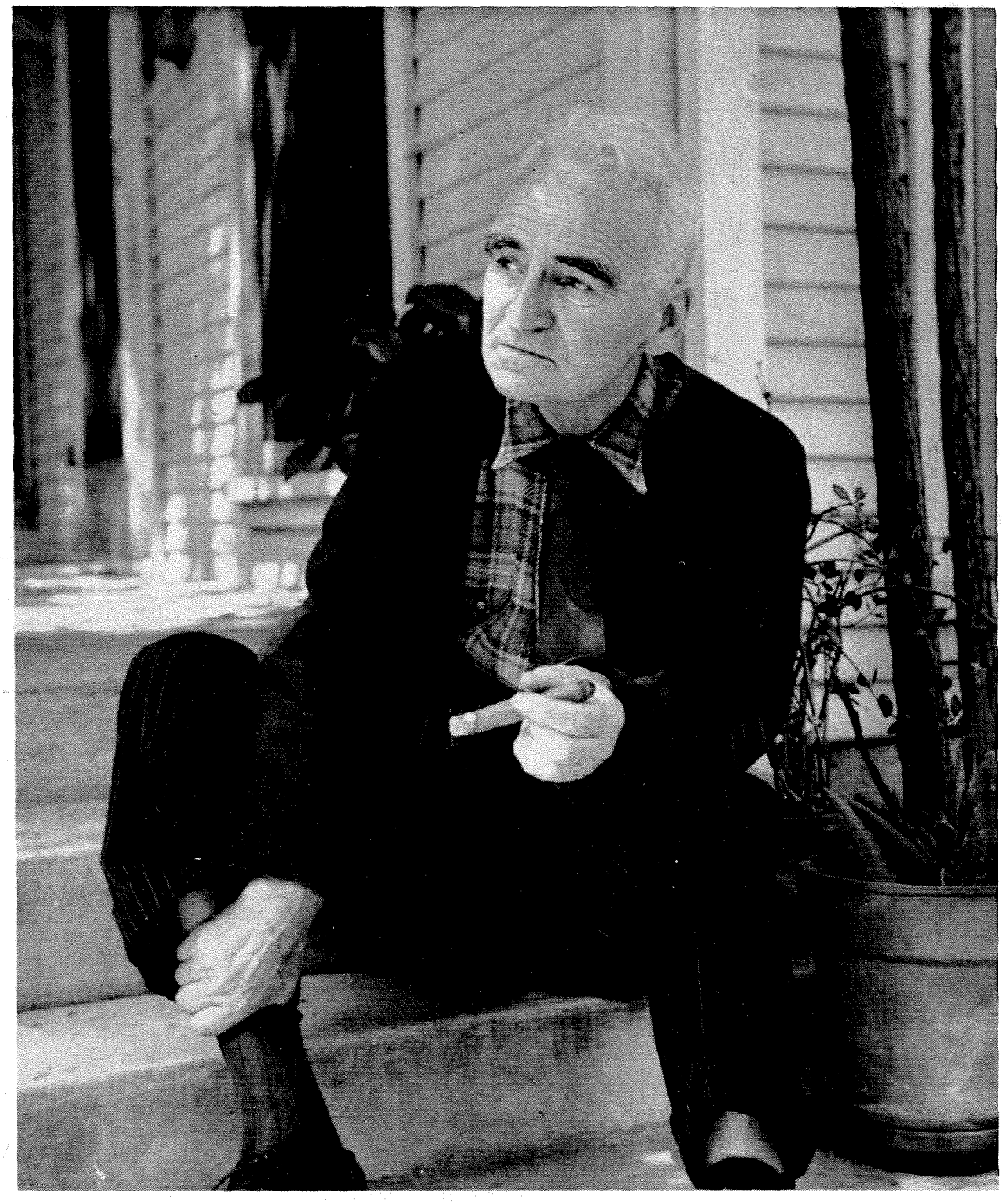
It is God and God alone who can give us the strength that will enable us to make the decisions that in turn will bring us to the place where we discover that we obtain real satisfaction from living only as we dedicate our lives to the service of others. We must live under God, if our Nation is to live under God.

Members of the Class of 1953 of the California Institute of Technology:

> "There is something special about dedicating your lives to the United States of America that lives with you and, what is more important, with your children as long as they shall live."



PAUL S. EPSTEIN, Professor of Theoretical Physics, retires this month after serving for 32 years on the Caltech faculty. Born in Warsaw, Poland, in 1883, he received his B.S. from the University of Moscow in 1905, and his M.S. in 1908. He took his Ph.D. at Munich in 1914. He was teaching at the University of Zurich in 1921 when R. A. Millikan persuaded him to come to Caltech.



E. T. BELL, Professor of Mathematics, retires this month after 26 years at Caltech. Born in Aberdeen, Scotland, in 1883, he received his B.S. at Stanford University in 1904, his M.S. at the University of Washington in Seattle in 1908, and his Ph.D. at Columbia University in 1912. He was a member of the University of Washington faculty for 15 years before coming to Caltech.

THE MONTH AT CALTECH

Commencement

A TOTAL OF 306 students received degrees from the Institute at the 59th annual Commencement on June 12. Bachelor of Science degrees went to 135 men. Seventy-four men received the B.S. in Science—13 of them with honors; and 61 received the B.S. in Engineering—13 with honors.

Of the 26 men graduating with honor, one—James LaTourette—coupled this distinction with "exceptionally effective participation in extracurricular activities," for which he was awarded a Student Body Honor Key. Honor Keys were awarded to 13 men in all.

Master of Science degrees went to 90 men. Thirty men were given the M.S. in Science—7 in chemical engineering, 6 in the geological sciences, 3 in geophysics and 14 in physics.

The M.S. in Engineering went to 60 men—10 in aeronautics, 14 in civil engineering, 15 in electrical engineering, and 21 in mechanical engineering.

Nineteen men were awarded Engineer's degrees—12 of these graduates being officers in the armed forces who were assigned to Caltech for advanced work in aeronautics.

Sixty-two men received the Ph.D. degree.

James R. Page, Chairman of the Board of Trustees, presided at the Commencement ceremonies. Commencement chaplain was His Eminence, James Francis Cardinal McIntyre, Archbishop of Los Angeles. Degrees were conferred by President DuBridge, who also delivered the charge to the graduating class.

The Commencement speaker was Arthur S. Flemming, director of the Office of Defense Mobilization in Washington, D. C. Mr. Flemming is on leave of absence as

President of Ohio Wesleyan University in Delaware, Ohio. He has been with the Office of Defense Mobilization since 1951, when he was appointed Assistant to the Director, in charge of manpower problems. Shortly after President Eisenhower took office this year, he named Mr. Flemming to membership on the President's Advisory Committee on Government Organization and on the Defense Department Organization Committee, and recently nominated him as Director of the Office of Defense Mobilization.

Appointed by the late President Franklin D. Roosevelt as the Republican member of the U. S. Civil Service Commission in 1939, Mr. Flemming was placed in charge of the Commission's activities in connection with World War II. He also served as a member of the War Manpower Commission and was chairman of its Labor-Management Policy Committee. After the war he served on the Hoover Commission to study the organization of the executive branch of the federal government.

In the field of journalism, Mr. Flemming has been a newspaper writer, editor of *Uncle Sam's Diary*, a current events publication, and an editorial staff member of the *United States Daily* (now *U. S. News and World Report*).

He was an instructor in government at American University in Washington, was named director of the School of Public Affairs there, and later became executive officer of the University.

Mr. Flemming has been prominent in Methodist Church affairs, serving as a lay leader of the Ohio Conference of the Church and formerly as lay leader and superintendent of the Church School in Foundry Methodist Church, Washington. He is past treasurer of the Committee on Religious Life in the Nation's Capital, an inter-faith group, and served two terms as president of the Washington Federation of Churches.

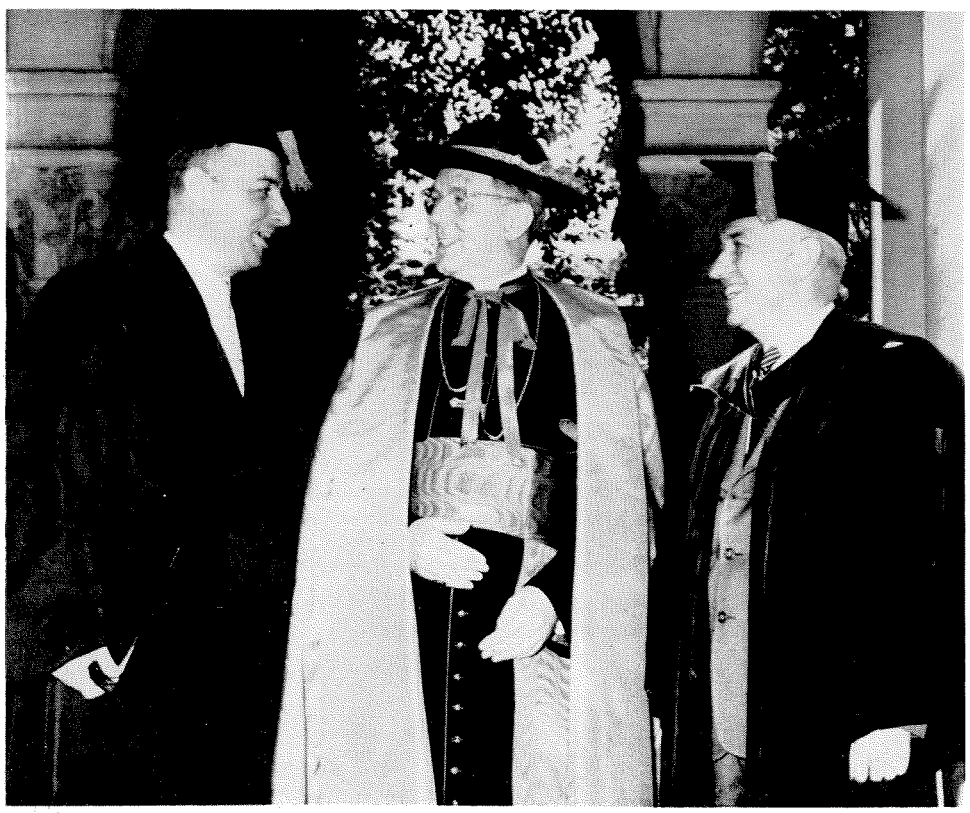
A native of Kingston, New York, Mr. Flemming was graduated from Ohio Wesleyan in 1927, received an M.A. from American University in 1928, and an LL.B. from George Washington University in 1933. Ohio Wesleyan, American University, Temple, Wesleyan, and Oberlin have conferred LL.D. degrees on him.

Hinrichs and Morgan Awards

JOHN D. GEE of Albuquerque, New Mexico was named winner of the Frederic W. Hinrichs, Jr. Memorial Award at the Commencement ceremonies.

The award is made annually to the senior who, in the judgment of the undergraduate Deans, has made the greatest contribution to student body welfare and who has shown outstanding qualities of character, leadership and responsibility. It was established by the Caltech Board of Trustees in memory of Professor Hinrichs, faculty member and Dean of Upperclassmen from 1921 until his death in 1944.

Gee, who received $100, a certificate and a desk pen, majored in mechanical engineering at Caltech. He was president of the student body last year and treasurer the previous year. Active in athletics, he received three varsity letters each in football and basketball and won the 1953 Senior Service Award in baseball. As a freshman and sophomore, he was athletic manager of his class.



Arthur S. Flemming, Commencement speaker; His Eminence, James Francis Cardinal McIntyre; President L. A. DuBridge.

Sherman H. Ripley of Natal, Union of South Africa, was announced as the winner of the $100 Thomas Hunt Morgan Award. 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.

Ripley, who received the B.S. degree at the University of South Africa in 1947 and the M.S. at the University of Natal in 1949, came to Caltech in 1950 and majored in animal physiology. He has been appointed senior lecturer in physiology at the new medical school of the University of Natal in Durban, and plans to return home next month.

Aristotle Michal

DR. ARISTOTLE D. MICHAL, 54, Professor of Mathematics, died of a heart ailment June 14, in the Huntington Memorial Hospital. He had been a member of the Institute staff since 1929.

"His long illness and death has robbed the Institute and the world of a brilliant mathematical mind at a time when it was at the height of its productiveness," said President DuBridge. "His passing is a loss to science and a sorrow to his colleagues and friends."

Michal was born in Smyrna, Asia Minor, May 1, 1899, and became a U. S. citizen in 1924. He received the A.B. and A.M. degrees at Clark University in 1920 and 1921, respectively, and the Ph.D. from the Rice Institute in 1924.

He was a teaching fellow at Rice from 1921 to 1924, and an instructor in mathematics there the following year. He spent two years at Harvard, Chicago, Rice, and Princeton as a National Research Fellow, and was Assistant Professor of Mathematics at Ohio State University from 1927 to 1929. He came to Caltech in 1929 as Associate Professor of Mathematics and became a full professor in 1938.

He was noted for his contributions to functional analysis, modern differential geometry and other fields of advanced mathematics. During the war he was in charge of advanced training in mathematics and mechanics in the Engineering, Science and Management War Training Program at Caltech. He also served as advisor and consultant to the Navy in connection with the mathematics section of the Naval Ordnance Test Station at Inyokern.

DuBridge Honored

CALTECH PRESIDENT L. A. DuBridge received the honorary degree of Doctor of Laws at the University of Rochester's 103rd annual commencement on June 7. Dr. DuBridge, who also delivered the commencement address, served as Chairman of the University of Rochester's Physics Department from 1934-1946, and was Dean of the Faculty from 1938 to 1942. In 1938, he supervised the construction of a 7,000,000-volt cyclotron at the University, and played a major role in obtaining the 250,000,000-volt cyclotron, financed by federal funds, which was built by the University of Rochester after World War II.

Hansen Medal

DR. GEORGE W. BEADLE, Professor of Biology and Chairman of the Division of Biology, has been awarded the Gold Medal of the Emil Christian Hansen Foundation of Copenhagen, Denmark.

The medal has been awarded only 11 times since its inception in 1914, to European and American scientists who have made significant contributions to the field of microbiology. A memorial to Dr. Emil Christian Hansen, director of the physiological department of the Carlsberg Laboratory, Copenhagen, until his death in 1909, the medal is accompanied by a prize of 5,000 Danish crowns ($722).

Professor Beadle received the award for his research in biochemical genetics using the red bread mold *Neurospora*. The research has led to important generalizations about the role inherited factors play in controlling the chemical reactions that make up metabolism. This work was started by Drs. Beadle and Edward L. Tatum at Stanford University in 1941. They were aided by Drs. David Bonner, now of Yale University, and Norman H. Horowitz and H. K. Mitchell, now of Caltech.

Professor Beadle also has received the Lasker Award of the American Public Health Association and the Dyer Lectureship Award of the National Institutes of Health. He has been a member of the National Academy of Sciences since 1944. A past president of the Genetics Society of America, he is currently a member of the Divisional Committee for Biological Sciences of the National Science Foundation.

A graduate of the University of Nebraska, he received the Ph.D. degree from Cornell University in 1931. Nebraska, Yale and Northwestern have awarded him honorary D.Sc. degrees. He was a research fellow and instructor at Caltech from 1931 to 1936. After a year at Harvard as Assistant Professor of Genetics, he went to Stanford as Professor of Biology in 1938. He returned to Caltech in 1946 as Chairman of the Division of Biology.

Page Portrait

A DINNER WAS HELD at the Athenaeum on May 25 to celebrate Mr. James R. Page's tenth anniversary as Chairman of the Board of Trustees of the Institute. As a highlight of the occasion, a portrait of Mr. Page by the prominent artist, Arthur Cahill, was presented to the Institute by Mr. Cahill. The portrait, which will be hung in the lobby of the Athenaeum, was accepted on behalf of the Institute by President DuBridge.

"'An institution is but the lengthened shadow of a man,'" said Dr. DuBridge. "For many human institutions, this old saying is literally true. However, at the

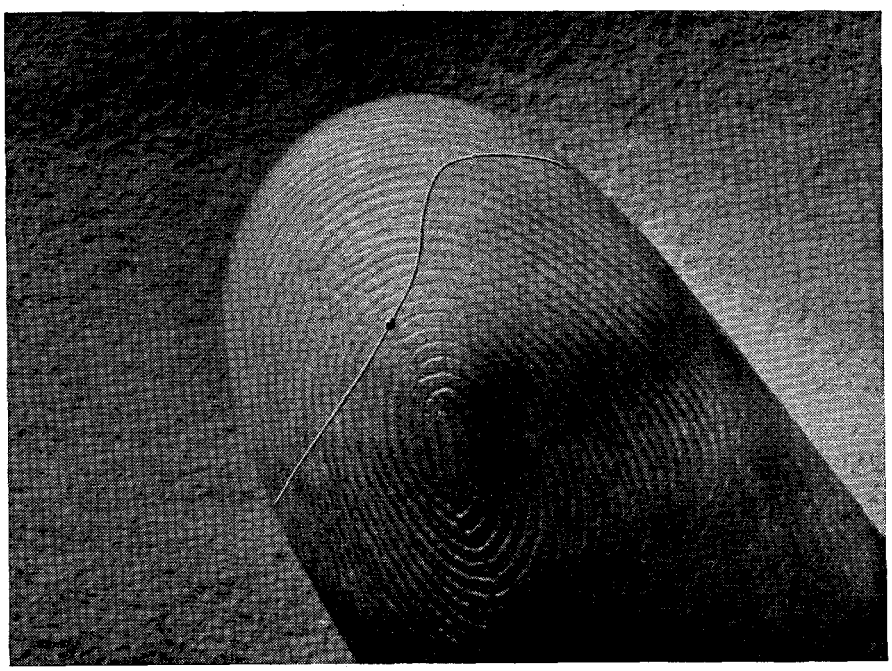
CONTINUED ON PAGE 20

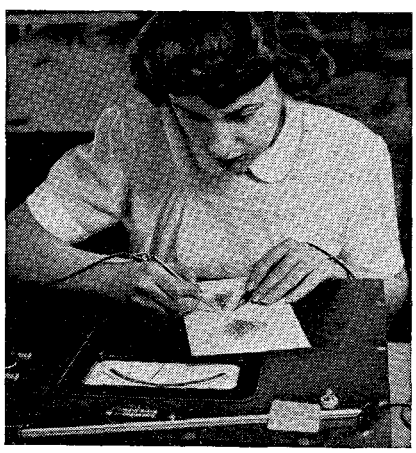
It took 100 years of engineering

See that tiny speck of oxide on a hair-like wire? It's called a thermistor, and it's the first practical *thermally* sensitive resistor. It's so sensitive it will measure temperature variations within one-millionth of a degree. As a circuit element and control device, this small, stable and rugged unit has a place in a variety of electrical circuits.

Although the thermistor is the smallest and, in appearance, one of the simplest devices made by Western Electric—manufacturing unit of the Bell Telephone System—it was more than 100 years in the making.

Back in the 19th Century—some time before Western Electric was founded in 1869—Michael Faraday studied a curious thermally sensitive resistor material similar to that used in 20th Century thermistors. As Faraday and others after him discovered, the trouble with making effective use of this material was that different units made by what seemed to be the same process, showed large variations in their behavior. The problem of how to control the amount of impurities present in the material was finally solved a few years ago by our research team mates at Bell Telephone Laboratories.

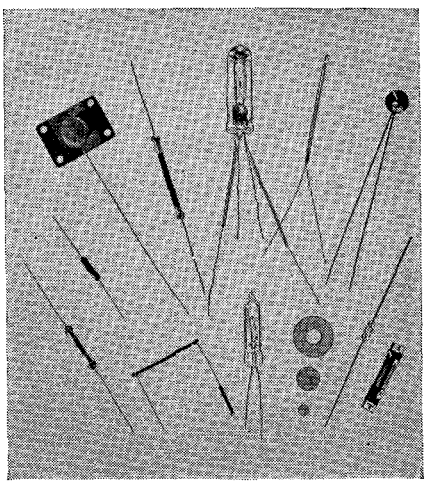




At Western Electric's Allentown (Pa.) Plant hundreds of minute thermistor components are electrically tested and sorted every day. The basic component, an oxide, has a large negative temperature coefficient of resistivity.

Once beyond the laboratory stage, Western Electric's engineers tackled the job of *mass-producing* the hard-to-handle oxides. After many trials they got a pilot line in operation—then a full scale production line through which compressed powders of thermistor material could be sintered into a strong, compact and homogenous mass. Today reliable thermistors are being made in many shapes and sizes—small beads, rods, discs, washers—to meet varying circuit and design problems. To make this possible, Western Electric engineers had to find new ways to apply a slurry of oxides on wire; new ways to extrude and mold oxide mixtures.

At every turn, the thermistor has presented fresh challenges to our engineers. Engineering is like that at Western Electric—where technical men of varied skills pool their knowledge in a constant search for new and better ways to do things.



The thermistor takes many forms depending on the resistance and power-handling capacity needed in a particular circuit.

WANT TO KNOW MORE?

Send the coupon below for a copy of the 16-page technical monograph entitled, "Thermistors as Components Open Product Design Horizons."

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California Institute of Technology, as at many other institutions, the shadow is in reality the shadow of many men. No man single-handedly could have converted the Throop College of 1910 into the California Institute of 1953. Nevertheless, a very large share of the credit can be divided among a relatively small number of men. It is our pleasure on this occasion to honor one of this small company.

"The men who are responsible for managing the Institute financial affairs are the members of the Board of Trustees. The small group of devoted men who have over the years been members of this Board have contributed more than most of us can ever know to making the Institute what it is today. A particularly heavy responsibility falls upon the Chairman of the Board. Only three men have held this position in the past 25 years; Arthur H. Fleming, Allan C. Balch, and James R. Page. We celebrate tonight Mr. Page's tenth year of service in this capacity.

"Another institution which Mr. Page has faithfully served is the Henry E. Huntington Library and Art Gallery. He has been both a trustee and Treasurer of the Library since 1945. However, to none of his other interests and activities has Mr. Page devoted more sustained and devoted efforts than to the California Institute of Technology. In 1926 at the invitation of Mr. Henry M. Robinson (whose invitations were said to be most persuasive) Mr. Page became one of the original group of 100 men and women to organize the California Institute Associates. As everyone here knows, this organization has been one of the principal factors in the financial success of the California Institute. It was not long before Mr. Page was the president of the Associates and a key figure in its program and activities. By 1931 he had so exhibited his interest in the Institute that he was elected to its Board of Trustees. In 1943, following the death of Allan C. Balch, he became the Chairman of the Board.

"If an institution survives at all the Chairman of its Board can take considerable credit. If it not only survives but prospers the credit should be publicly recognized."

Mr. Page is director of the I. N. Van Nuys Building Company, the Gladding-McBean Company, the Consolidated Steel Corporation, Southern California Edison, Ltd., and the Union Oil Company of California. He has wide interests in educational, cultural, religious and civic affairs, and besides being a trustee and Treasurer of the Henry E. Huntington Library and Art Gallery, he is also a trustee of the Cate School in Carpinteria, the Good Samaritan Hospital, the Episcopal Church Foundation, and the Barlow Sanitarium.

Arthur Cahill's portrait of James R. Page

Guggenheim Fellow

DR. J. HAROLD WAYLAND, Associate Professor of Applied Mechanics, received a $4000 John Simon Guggenheim Fellowship last month to conduct special research in complex fluid flows.

Dr. Wayland will investigate engineering aspects of the technique of fluid flow visualization by streaming double refraction. This technique is being widely used in physical chemistry to help determine molecular sizes and shapes.

Dr. Wayland will spend most of the 1953-54 academic year at the University of Strasbourg, France, but he will also visit other institutions, including the University of Cambridge, England, and the University of Upsala, Sweden.

A physicist, a mathematician, and an engineer, Dr. Wayland is noted for his work on underwater ballistics. He holds the ordnance development award of the Navy's Bureau of Ordnance, and at present is a consulting physicist to the Navy and other governmental and commercial agencies.

He did pioneering work in the use of ship models in the field of demagnetizing ships as protection against

CONTINUED ON PAGE 22

Things are different—up there!

You would be amazed at the tricks nature plays in the stratosphere

As aviation progress has carried man farther into the upper air, he has found that nature has many tricks up her sleeve in the stratosphere. Many things that worked well on the ground wouldn't do as well, or failed completely, in the space beyond the clouds. Things are truly different up there.

CARBON BRUSHES ARE AN EXAMPLE—These brushes are the contact points that carry electricity between moving and stationary parts of motors and generators. They're in electric razors, sewing machines, huge diesel locomotives—and in modern aircraft.

THEY COULDN'T STAND ALTITUDE—Today's high-flying planes require literally hundreds of small electric motors and many carbon brushes. Here was one of nature's quirks, for brushes which worked well on the ground and at lower altitudes couldn't take the thin, dry air of the stratosphere. They'd spark and quickly disintegrate. And if the brushes failed, the motors also would fail.

UCC FOUND THE ANSWER—The people of Union Carbide attacked this problem. Through research they developed special carbon brushes that worked uniformly well at all altitudes, making stratosphere flying a practical reality.

OTHER AIDS TO FLYING—Better carbon brushes that keep motors and generators running, alloy metals that stand the terrific heat of jet engines, plastic insulation for high-altitude wiring, and oxygen that provides the breath of life in the upper air—these are but a few of the many UCC products that are helping aviation reach new heights.

STUDENTS and STUDENT ADVISERS: *Learn more about the many fields in which Union Carbide offers career opportunities. Write for the free illustrated booklet "Products and Processes" which describes the various activities of UCC in the fields of* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Ask for booklet C-2.*

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magnetic mines, and installed the ship demagnetization station at Los Angeles Harbor. Before coming to Caltech in 1949 he was head of the underwater ordnance division of the Naval Ordnance Test Station in Pasadena.

A 1931 graduate of the University of Idaho, he received his M.S. from Caltech in 1935 and his Ph.D. in 1937. A teaching assistant in physics at the Institute, he returned to Idaho in 1934 as Instructor in Mathematics. In 1936 he went to Denmark as an American Scandinavian Foundation Fellow to study neutron absorption problems at Professor Niels Bohr's Institute for Theoretical Physics.

From 1938 to 1941 he divided his time between research at Caltech and teaching at the University of Redlands, where he was Assistant Professor of Physics. In 1941 he joined the Naval Ordnance Laboratory in Washington, D. C.

Rockefeller Grant

DR. FRITS WENT, Professor of Plant Physiology, has received a grant of $42,600 from the Rockefeller foundation for a three-year study of water relations in plants. Dr. Went, who is in charge of the Earhart Plant Research Laboratory, will study conditions under which plants lose and take in water. One of his purposes is to determine how much water a plant needs besides that necessary in photosynthesis. Some plants use approximately 1000 times as much water in evaporation as is needed for photosynthesis. If it can be determined how much of this is necessary, the possibility of plant growth with less water in arid and semi-arid climates can be examined.

New Geologists

TWO NEW FACULTY MEMBERS will join the Division of the Geological Sciences this fall—Dr. Thane McCulloh as Assistant Professor of Geology, and Francis G. Stehli, as Assistant Professor of Invertebrate Paleontology.

Professor McCulloh will teach courses in petrology and field geology. A 1949 graduate of Pomona College, he received the Ph.D. in geology at UCLA last year. During one of his graduate years he held a Fulbright Fellowship for study at the renowned Mineralogical Institute at Oslo, Norway. Currently he holds a National Science Foundation postdoctoral fellowship in geology and is also the recipient of a special research grant from the Institute of Geophysics at UCLA.

Professor Stehli will teach courses in invertebrate paleontology and historical and field geology. A National Science Foundation Fellow at Columbia University, he receives his Ph.D. degree this month. He received the B.S. degree with honors in biology from St. Lawrence University in 1949 and the M.S. in geology there in 1950.

Prof. Lees

PROFESSOR LESTER LEES, 32, of Princeton University, has been appointed Associate Professor of Aeronautics and Applied Mechanics at the Institute. He will join the Caltech faculty about July 1. Associate Professor of Aeronautical Engineering at Princeton since 1948, he has been in charge of its hypersonic and supersonic research projects for more than six years. He has been at Caltech as a visiting lecturer since February 1, delivering a series of special lectures in fluid mechanics.

He was graduated from M.I.T. in 1940 and received his M.S. there the following year. In 1941-42 he served as an aeronautical engineer for the U.S. Air Force at Wright Field in Dayton, Ohio, where he built and tested a scale model of its high-speed wind tunnel and conducted high-speed flow research. He was at Caltech from 1942 to 1944 as a Research Fellow in Aeronautics and Instructor in Mathematics. From 1944 to 1946 he worked on boundary layer and subsonic flow problems for the National Advisory Committee for Aeronautics at Langley Field, Virginia. He has been a member of the Princeton faculty since 1946.

Geophysical Officers

DR. HUGO BENIOFF, Professor of Seismology, and Dr. Vito A. Vanoni, Associate Professor of Hydraulics, have been elected officers of the American Geophysical Union. They will serve for a three-year period ending in 1956—Dr. Benioff as vice-president of the Section of Seismology, and Dr. Vanoni as a member of the Pacific Southwest Regional Committee.

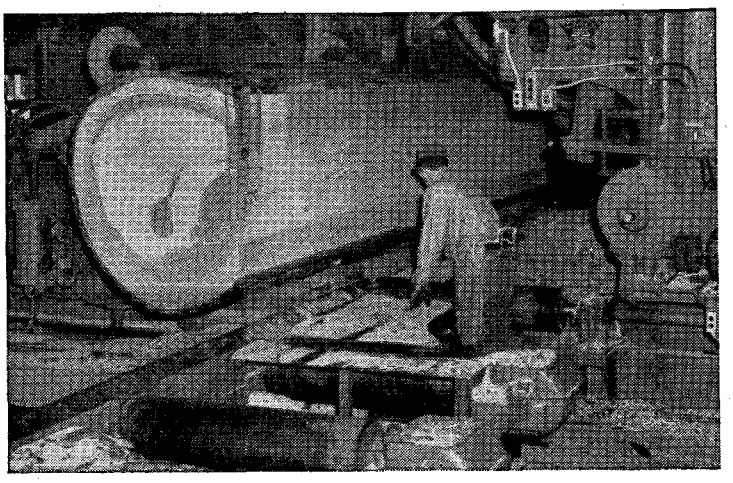
Dr. Benioff was also recently appointed to serve for a one-year term as a member of the Advisory Panel for Earth Sciences of the National Science Foundation in Washington, D. C.

Turin Academy

DR. A. ERDELYI, Professor of Mathematics, has been elected a Foreign Member of the Academy of Sciences of Turin, one of the leading academies in Italy.

Only two other Americans hold foreign membership in the Academy's division of the mathematical and physical sciences, which is restricted by statute to 10 foreign members. They are Drs. Theodore von Kármán, Caltech Professor of Aeronautics, Emeritus, and Adolf Busemann of the National Advisory Committee for Aeronautics.

Another page for **YOUR BEARING NOTEBOOK**

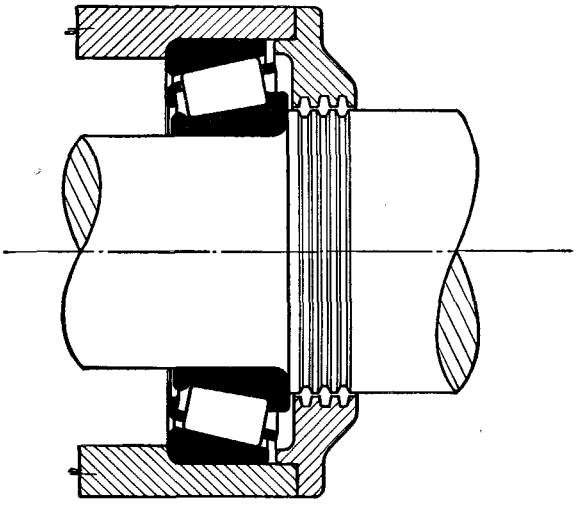


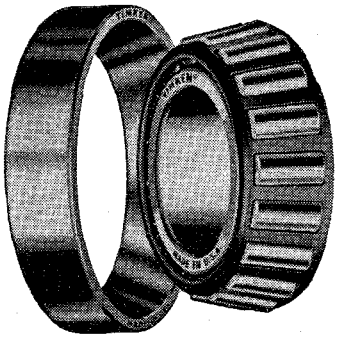
How to help a band mill cut 11,625 board feet per hour

Sugar pine logs are cut at a rate of 11,625 board feet per hour by this 9-foot band mill. To keep it running smoothly under high speeds and heavy loads, designers specified Timken® tapered roller bearings for the band wheel shafts. Because of tapered construction, Timken bearings take radial and thrust loads in any combination. Band wheel shafts are held in positive alignment. Breakdowns are prevented, maintenance costs cut.

TIMKEN® bearings help keep dirt out, lubricant in

Because Timken tapered roller bearings hold shafts concentric with housings, closures are made more effective. Lubricant is retained. Dirt, dust and moisture are kept out. Maintenance and lubrication time are minimized.





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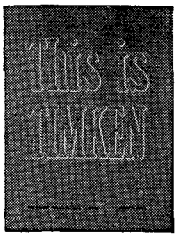

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ALUMNI NEWS

Family Picnic

THE LAST EVENT on the Alumni Calendar for this school year—and one of the biggest events of all—is the Annual Family Picnic, Saturday June 27, at the San Diego Zoo. Make your reservation at the Alumni Office if you want to take the trip on the Special Train.

Annual Banquet

A RECORD NUMBER of 340 alumni met at the Elks Club in Pasadena for the Annual Banquet and Meeting of the Alumni Association on Wednesday evening, June 10.

President DuBridge reported on activities and developments at the Institute over the past year, ending his remarks with a candid consideration of the value and meaning of academic freedom. Alumni President John E. Sherborne '34 reviewed the Association's accomplishments for the year—the most notable of which, of course, is the Alumni Swimming Pool, made possible by contributions to the Alumni Fund.

The speaker of the evening was Dr. Arnold O. Beckman, whose subject was "Instrumentation—A New Field of Engineering." Dr. Beckman is president of Arnold O. Beckman, Inc., scientific instrument manufacturing company; and president of Beckman Instruments, Inc., its Berkeley Scientific Division, and the Helipot Corporation, a subsidiary. He received his Ph.D. at Caltech in 1928, and served as Instructor and Assistant Professor of Chemistry here until 1940, when he went into business for himself, manufacturing scientific instruments. Dr. Beckman was President of the Instrument Society of America last year. A California Institute Associate since 1948, Dr. Beckman was elected a trustee of the Institute in February of this year.

Gerald P. Foster '40 took over as 1953-54 president of the Alumni Association. New vice-president is Kenneth F. Russell '29. Donald S. Clark '29, and George B. Holmes '38 remain as secretary and treasurer.

Newly-elected members of the Alumni Board of Directors for two-year terms are Willard E. Baier '23; Robert R. Bennett '45; Douglas G. Kingman '28, and C. Vernon Newton '34. Reunion classes this year included 1898, 1903, 1913, 1918, 1923, 1928, 1933, 1938, 1943, and 1948. Reports from these are presented below.

1898

The one living member of the class of '98, R. B. Blackman, was unable to attend. The distance was too great; he lives in the Philippines.

1903

The fiftieth anniversary of the class of '03 was completely successful. R. W. Shoemaker, the only living member of the class, came all the way from Grass Valley to give a 100% attendance.

1913

Everyone attended this year's alumni dinner, and we had Dr. Sorensen with us. We think that makes 120%. You see, he attended all our electrical classes; however, he did not graduate! We are still going strong and there is every indication that we will be able to repeat this attendance ten years from now.

Ray Gerhart—Pasadena—General Contractor (One of the more common forms of gamblers).

C. R. Hovey—South Pasadena—Chief Estimator, Tucker, McClure Corporation, Contractors (He creates the betting information).

L. J. Koch—Beverly Hills—Senior Master Mechanic, Los Angeles County General Hospital (Boss Mechanical Engineer to you!).

R. W. Parkinson—Fort Myers, Florida—Executive Officer (BIG BRASS) Asiatic Petroleum Company (retired), Shell Oil Foreign Service.

H. S. Wood—Pasadena—*Director* (for latest definition refer to Internal Revenue Bureau) Los Angeles Trade Technical Junior College.

—Ray Gerhart

1918

Eight members of the class were present at the Alumni Banquet. Seven of these were in the War '18 class, which is 54 percent of the 13 living members. Letters were received from Corliss Bercaw, Louis Esseck, Embert Nelson and Munson Dowd. Professor Lucas was a most welcome guest at our table. It is planned to have a War '18 class reunion in September, and details will be forthcoming during the summer.

—Edison R. Hoge

1923

The class of 1923 takes justifiable pride in its achievements of the past five years. Howard Lewis received honorable mention for his work in sparking the Alumni Swimming Pool Fund into being, and in doing yeoman service in the campaign which started in the Hot Rivet of about 1921, when some of the editors anonymous nearly went elsewhere because of a little ditty about an ambitious young student whose health suffered because of "too much physics and too little gym." The well-rounded education we all strove for will soon come to pass, and it is well that we have done something about it in a financial way.

Willard Baier took his place on the Board of Directors this year and will be glad to hear all your pet ideas and give them just consideration.

Seventeen members of the class of 1923 were able to attend the annual meeting and visit for an hour or two. Bernie Evans is due to get back into his Marine uniform in a few weeks, but after 30 years it appears to the ocular integrator that the gross displacement is

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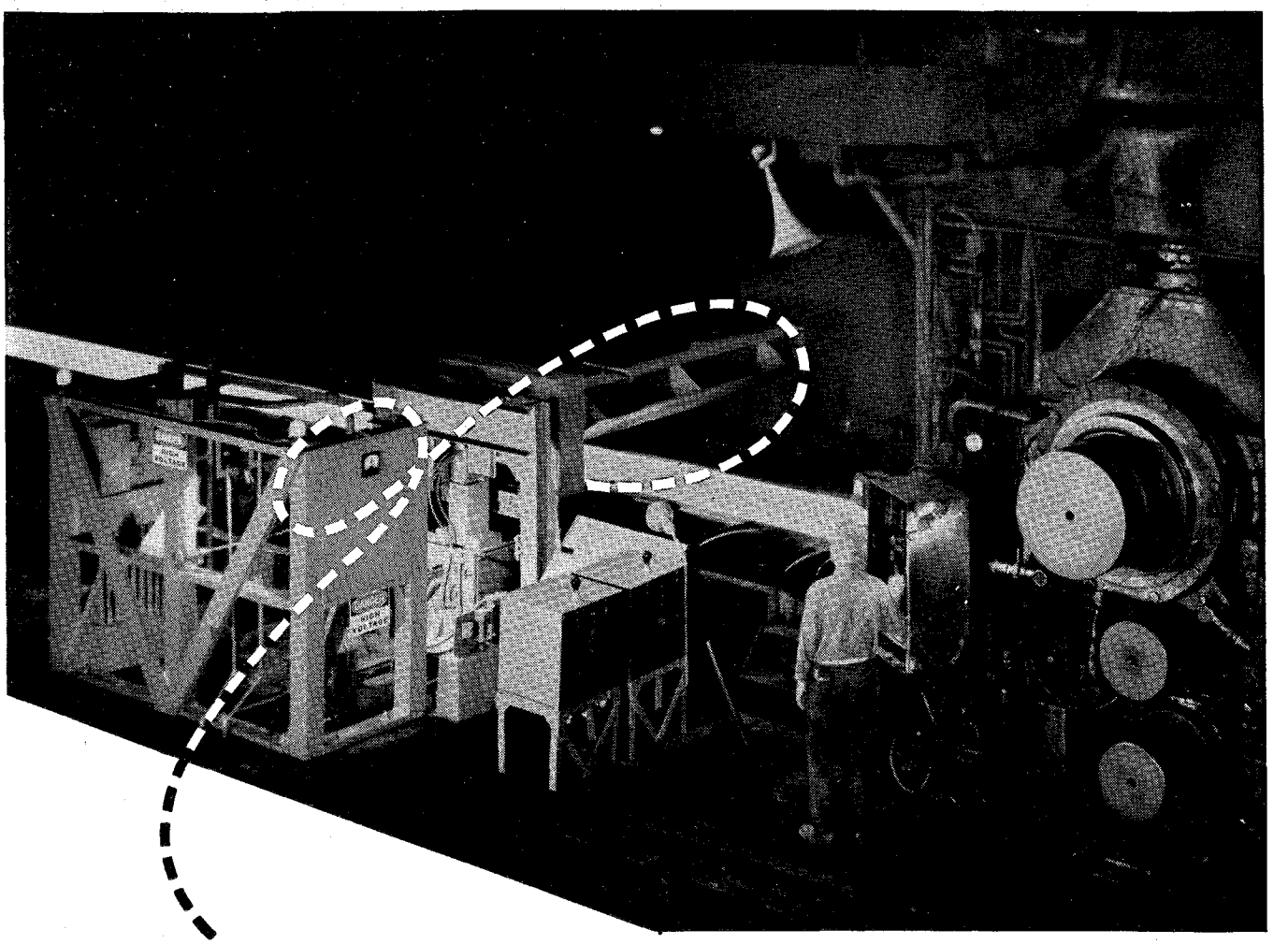

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between 10 percent and 15 percent greater per man than in 1923. Some of the chests which then were suitable for medals may have drooped a bit, but what of it—it's more comfortable this way!

Replies to the Class Questionnaire have been received from 31 members and were enjoyed by all present. Replies from the rest of the class are needed to work up our class report and more detailed news letter.

—Loren E. Blakeley

1928

The 25th reunion of the class of '28 brought together 14 of the aging veterans, specifically: Armstrong, Berman, Billig, Crane, Cutler, D'Arcy, Kingman (Doug), Kuhn, Love, Preble, Robinson, Templin, Thatcher, and Westphal; representing a total of 30 kids and one Cadillac. All are still in engineering work except Drs. (M.D.) Armstrong and Billig.

Greetings were received from Ed McMillan and Ken Crosher, and a swell letter from Dick Folsom was enjoyed by all present. No word from any of the remaining 55 members of the original group! The 14 send greetings, and would like to hear from those who could not be present.

—Ralph W. Cutler

1933

The twentieth reunion had a good representation of those alumni living in the southern California area. Of the 55 members contacted, 17 were present, or approximately 30 percent.

Wendal Morgan sent a letter from New York with his regards, and Robert MacDonald, the same from Washington, D. C.

The members present included 8 CE's, 6 ME's, 2 EE's and 1 ChE.

Ted Mitchel, in from Denver, qualified as the one having travelled the farthest distance to attend this reunion. (Confidentially, we found out he had a business meeting to go to in Los Angeles on the following day.)

All members appeared to be in a good state of repair; all had hair and lots of it, and only one was grey. He was the ChE, which only goes to prove what?

We were very pleased to have Professor R. L. Daugherty join us at our table.

Merrill Berkley sparked our table by saying, "Let's do this more often."

—John Meskell

1938

The 15th Reunion of the class of '38 raised the biggest gathering of the class since graduation. Thirty were present, about 40 percent of those who live in the local area. Unfortunately, none of the class members who live outside the Los Angeles area were present, but we did receive letters from Carlton Horine (China Lake), John G. McLean (Boston), Frank B. Jewett (Minneapolis), John R. Woolson (Fairbanks, Alaska), Carl F. Friend (Marietta, Ga.), and Sidney Bertram (Arlington Heights, Mass.).

Members of the class present at the meeting each contributed $1.00 to the Alumni Fund, making an extra contribution of $30.00 to our ever-growing fund. In spite of this, everyone had a little money left for a drink or two at the bar after the meeting, where we held a good old-fashioned 'bull session.'

We were honored by the presence of two faculty members, Hal Musselman and Dr. William N. Lacey, at our table.

—Charles W. Clarke

1943

The class of '43 celebrated its tenth anniversary with several events which spanned five days. At the alumni dinner 15 were on hand to greet faculty members Bill Corcoran '41, Ph.D. '48, and Dr. Untereiner. The reunion festivities continued the following Friday with a stag dinner at the Biltmore Hotel which was attended by 35 classmates. That the evening was an unqualified success can be judged by the fact that the Biltmore management will probably disfavor accepting future reservations from the class of '43. An equally enjoyable cocktail party and dinner dance was held at Lawson Jones' San Marino home the next evening and was attended by 34 classmates, wives and fiancees. The festivities were concluded with a potluck beach party at the Hermosa Beach home of Ted Lawrence on Sunday, June 14. Understandably, the preceding debaucheries did not stimulate wide attendance at the beach party. The heartfelt thanks of the class go to George Kendall, Ted Lawrence and Oscar Terrell for having produced a memorable "Frolics of '43."

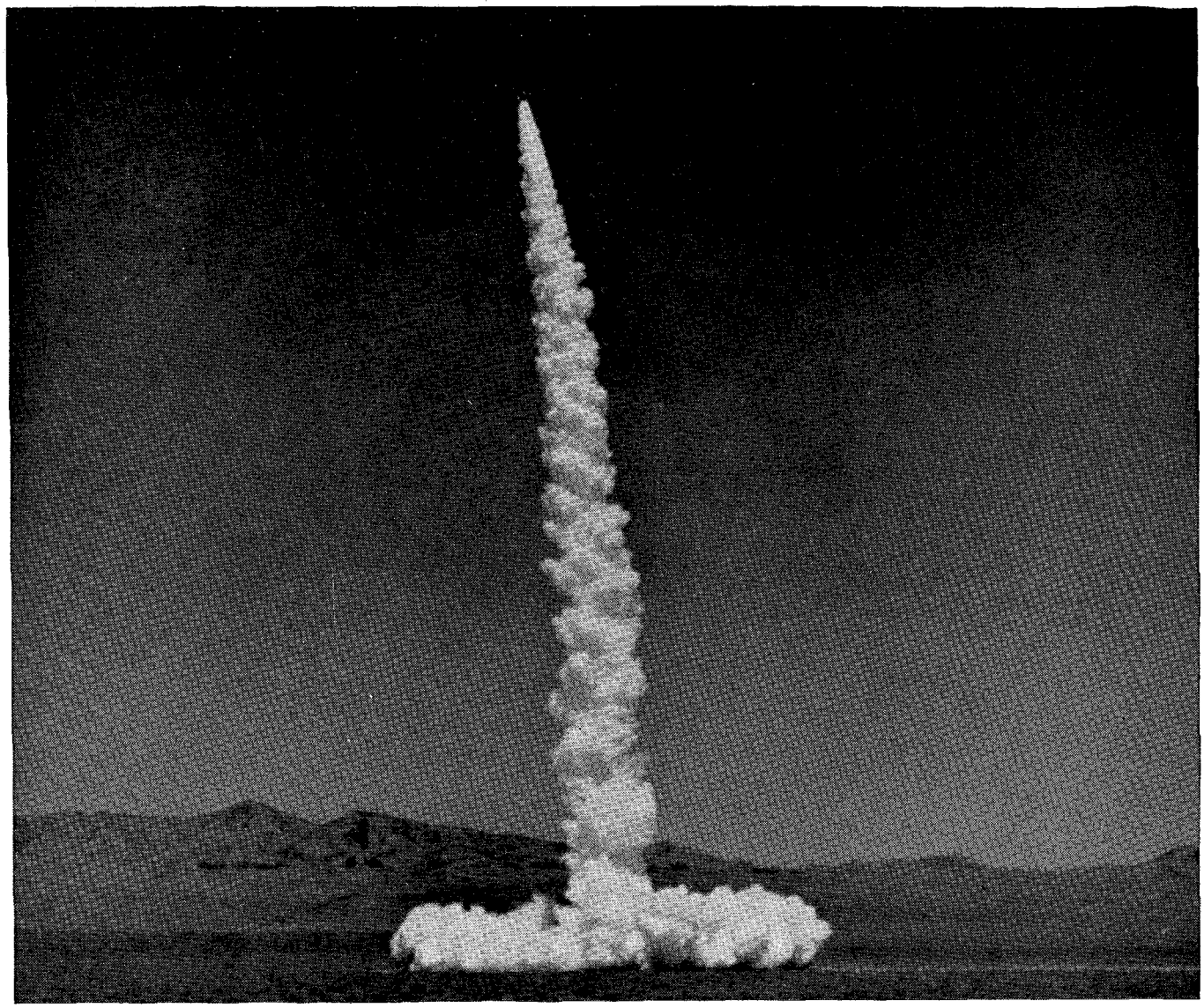
—E. J. Macartney

1948

The class of 1948, one of the largest to graduate from Tech, provided 32 men for its first reunion. The general reaction was shock on the passage of the first five years. An amazing number in the class are directly or indirectly associated with instrumentation, the subject of Dr. Beckman's talk. An informal individual reunion was held at the Ship Room of the Huntington Hotel Saturday night, June 13, where reminiscences were exchanged, congratulations given on children and jobs, and commiserations shared on baldness, increased weight, and other signs of advancing age. There can be no question but that the first five years are the worst in this respect.

Return postcards requesting pertinent vital statistics were sent to all members of the class before reunion. Some of these were read at the June 13 reunion party. The total returns will be published as a blanket report on the Class of '48 in an early fall issue of *E&S*.

—Tom Tracy



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LOOKING BACKWARD

A senior reflects on what he's been through

MUCH HAS BEEN WRITTEN in recent issues of *Engineering and Science* about Caltech undergraduates and the education they receive. This column is devoted to the same subject for certain very special reasons: first, some important things were left unsaid; and second, the topic appeals to this writer as the subject of his last column before graduating. It may be that the goldfish is not in the best position to get a perspective on the goldfish bowl, but his views at least deserve to be considered.

Caltech, in common with all other institutions of higher learning, is not perfect. The first and most serious drawback to an undergraduate education here is the fact that students are so busy doing home-work, keeping up with courses, and worrying about grades that they find themselves in a mad race to graduate before they lose all their interest in science or engineering. They do not have enough time to think; they have insufficient leisure to contemplate the world around them or even to realize the significance of their own studies.

The successful student

The successful student is the one who can answer the right questions; and Caltech students are generally successful as students. But the truly creative scientist, while knowing how to *answer* questions, must, in the course of his work, be able to *ask* the right questions. The extent to which the rush, pressure, and grinding competition of a student sojourn at the Institute foster the type of creative thought indispensable to real achievement in science is at least open to question.

On the personal side, the fact that an undergraduate participates in some extracurricular activities in no way guarantees that he is learning anything from them; extracurricular activities are ultimately more profitable from the experience gained than from their value as an escape mechanism for relaxation. And leisure time is as necessary for the proper conduct of extracurricular activities as for the proper assimilation of the theories and facts of the classroom.

In response to the argument that Tech students cannot find sufficient leisure time, it can be said that a person cannot ask the right questions unless he knows what he is talking about. Thus everything an undergraduate studies would correspond to the long lists of vocabulary a first-year German student must memorize before he can sink his teeth into Goethe. In other words, to eliminate this greatest defect in our undergraduate education would take the "Caltech" out of Caltech.

It's homogenized

The second major drawback to an undergraduate education at Caltech lies in the intellectual homogeneity of the student body, collectively speaking. It may be that the average Caltech student is more well-rounded intellectually than the average science or engineering major in other schools — and recent examinations strongly suggest that he is more well-rounded intellectually than the average college student in *any* field. This does not mean, obviously, that the entire undergraduate student body is more well-rounded. The Caltech student body can be compared to a magnet in which no particular molecule seems different from any other, but when considered collectively they tend to have a common orientation, and can even produce an effect on other molecules. The fact that this writer uses a scientific analogy serves to illustrate the point.

This criticism can easily be answered, but not denied, by pointing out that it would be impossible to have a school with non-technical students, and with Tech's standards in technical subjects, without sacrificing the many advantages offered by Tech's small size. Once again we see that for every "heads" there must be a "tails."

Of the three major drawbacks of a Tech education, perhaps the least important in the long run is the absence of coeds. This is most easily rationalized away by trying to imagine what the girls would be like if they were interested enough in science and engineering to come to a school like this.

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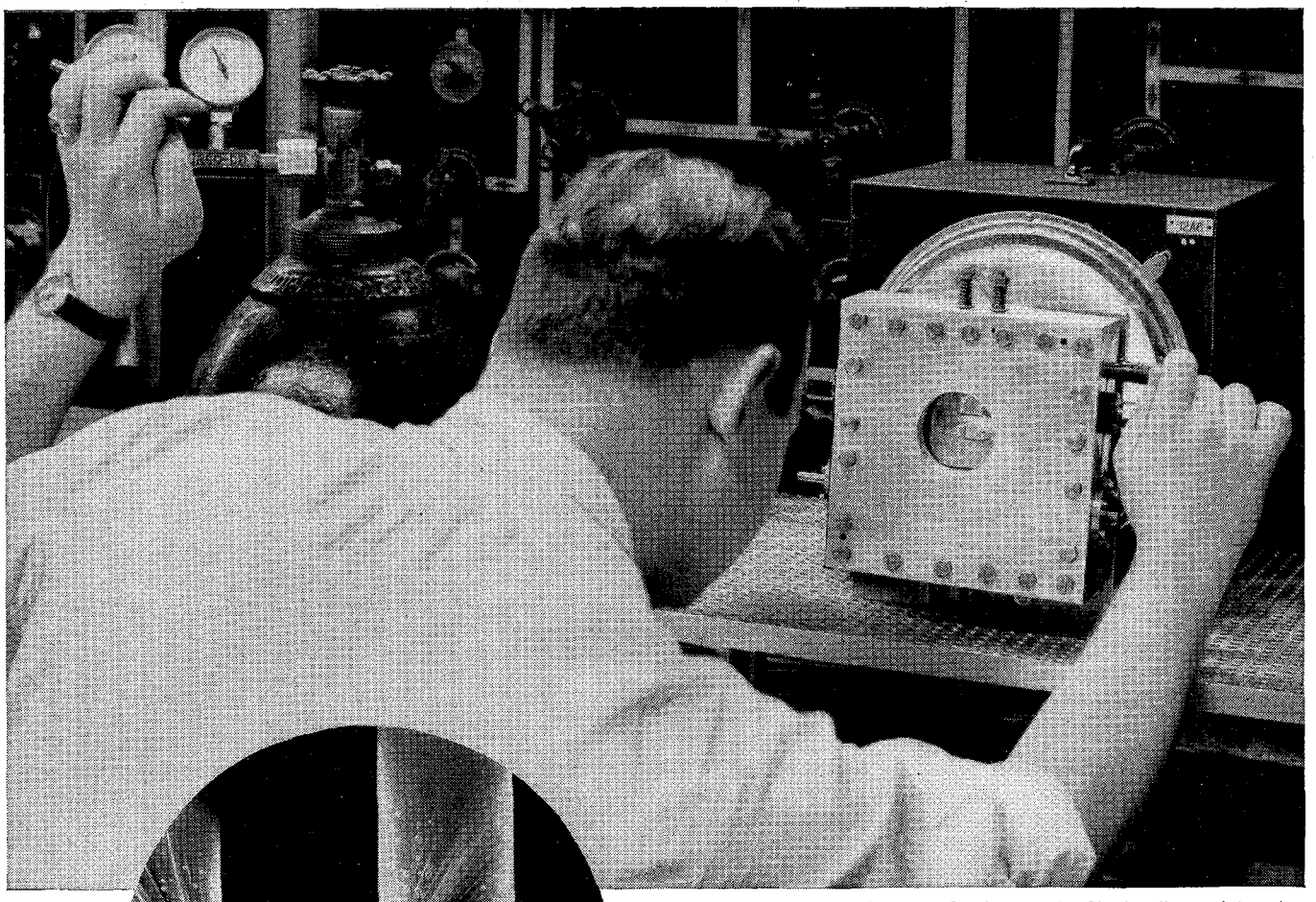
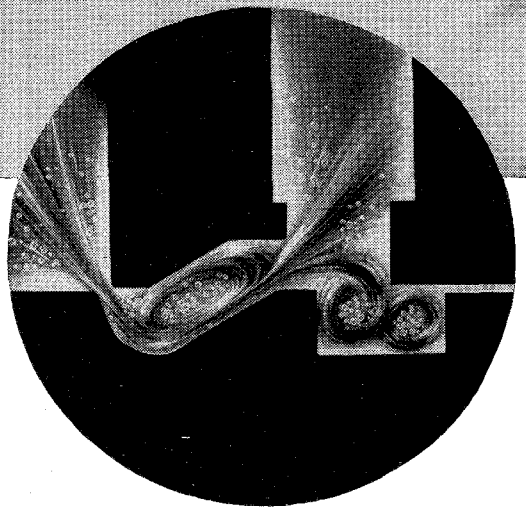


This Sperry engineer is applying the fundamentals of hydraulics to determine oil flow characteristics at high pressure. Here he introduces nitrogen to the hydraulic fluid in a complex valve to make flow patterns visible for study.



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STUDENT LIFE . . . CONTINUED

This column very rarely draws conclusions, even when it does say something. But we are forced to the conclusion that these shortcomings of our education are inherent in the very nature of the raison d'etre of Caltech. One possible defect has not been mentioned: the quality of the teaching. Because quality of teaching is seasonal as well as subjective, it would be difficult to prove that there is any real cause for griping. It must be remembered that because of the greater pressure of studies at Tech, students would be expected to be hypersensitive to deficiencies in their teachers. This idea is corroborated by the observation that students here can tolerate and almost like a poor teacher who grades easy, whereas an equally poor or slightly better teacher who gives lower grades is a pedagogical ogre.

They all come back for more

The last point to consider is that Caltech students, despite their griping, almost always seem to come back for more (when they are allowed to). Even if Tech students gripe more than students in other colleges, it does not necessarily mean that there is more to gripe about here. It is significant that Tech students spend more time talking (and writing) about what is wrong with our school than what is right with it. No matter what school a person attends, he will be missing something.

If it is true that a chain is as strong as its weakest link, then Tech undergrads know where the weak links lie, and can thus compensate for them. If we have been exposed to a one-sided environment, nothing is more healthy than to politely and carefully revolt from it. This helps to explain the existence on our campus of a team for every major sport and most accepted minor ones, a drama club, a glee club, and even a literary magazine. This also explains the very sensible and healthy attitude of our students toward many of these activities, especially athletics. To pursue this line of reasoning any further would take us into the advantages of a Caltech education, which, as the reader may have guessed, were not chosen as the theme of this essay.

An optimistic note

We can, therefore, end this discussion on a note of optimism: Caltech students are at least keenly aware of what they are missing. It reminds one of the story of the former office girl who returned to the office after her honeymoon and said to her girl friend: "Married life is really wonderful. You just don't know what you are missing!"

To this the girl friend replied, "Oh, yes I do."

—Al Haber '53

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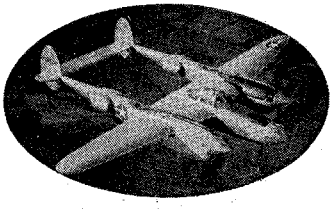

The P-38 Lightning – first 400 mile per hour fighter-interceptor, the "fork-tailed Devil" that helped win World War II.

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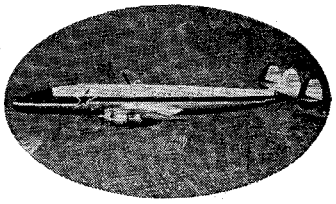

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PERSONALS

1920

Harold R. Linhoff took his own life on May 8 in San Marino. Harold was manager of the natural gas operations of Richfield Oil Company and had been recently transferred to the Bakersfield office. He had been associated with Richfield for 29 years. He is survived by his wife, Alta; a son, Ralph Stratton Linhoff of Balboa; a daughter, Mrs. Janet Warren of Corpus Christi, Texas; and his mother, Mrs. Lena Linhoff of Pasadena.

1923

Donald H. Loughridge, Ph.D. '27, will become Dean of the Technological Institute at Northwestern University in Evanston, Illinois, on July 1. Don joined the physics staff of the University of Washington in 1931, becoming a full professor in 1942. In 1948 he was chosen senior scientific adviser to the Secretary of the Army and in 1951 was appointed assistant director of the reactor division of the AEC.

Elmer L. Smith has been appointed Assistant Chief Engineer of the Water Department of Pasadena. From 1925 to 1947 Elmer was Assistant Engineer, and in 1947 became Principal Engineer of the department. During World War II, he was an instructor at Caltech in highway engineering and plane-table topography. His wife, Matilda, teaches music in the Sierra Madre Elementary School.

1928

Guy L. Chilberg, M.S. '29, of the Pacific Telephone and Telegraph Company, will head the United Good Neighbor campaign fund drive in several public industries, for the second successive year. The industries include utilities, transportation services, advertising and printing, newspapers and radio stations, hotels, office buildings, entertainment, packing and refrigeration, plumbing, heating, electrical products, dairies, restaurants, bakeries, laundries, dry cleaners and special services. Guy is general plant manager for the Washington-Idaho area of the telephone company. He and his wife and two children live on Mercer Island, Washington.

1932

C. C. Cawley, M.S. '33, is the author of a new book, *Fool's Haven*, published on May 21 by House of Edinboro in Boston. Though this is Cliff's first published novel, it's his second work of fiction; *No Trip Like This*, a book of his short stories was published in 1951. There'll be a review of *Fool's Haven* in the first fall issue of *E&S*.

1933

Ammon S. Andes, M.S., has been acting as chairman of the aeronautical engineering department at the University of Kansas for the last three semesters.

He and his wife have two daughters—Mildred, 18, and Mary Ruth, 9. Ammon worked for three years at Convair in Fort Worth, and seven years at Washington State College before coming to Kansas University, where he has been for the past seven years. Last summer he worked at the Boeing Aircraft Company in Wichita, and the summer before at McDonnell Aircraft Company in St. Louis, Missouri.

L. Eugene Root, M.E., A.E. '34, has been appointed Director of Development Planning at Lockheed Aircraft in Burbank. As such, he will head a new top-level program to push aviation development years ahead of the airplanes of today. Gene has had 19 years of varied experience in aviation progress. He has served as aircraft panel chairman of the Scientific Advisory Board to the Air Force Chief of Staff, chairman of the aircraft panel at the AEC's Sandia Laboratory in New Mexico, as adviser to the U. S. Air Force Institute for Air Weapons Research at the University of Chicago, as a member of the specialist groups of the National Advisory Committee for Aeronautics, and as head of the aviation section, U.S. Navy technical mission in Europe. Within the aircraft industry, Gene has held positions as chief aero-dynamicist at Douglas Aircraft's El Segundo plant; design consultant for Hughes Aircraft; and chief of the aircraft division of the Rand Corporation.

Robert Smallman has been elected Vice-President in charge of Sales of the Consolidated Engineering Corporation in Pasadena. Bob was formerly Director of Sales for Consolidated, having joined the firm in 1947. In his present position he will direct the operations of both sales divisions of the firm, with offices in Chicago, New York, Philadelphia, Washington, D.C., Dayton and Dallas.

1934

Fred B. Kurata is now a professor in the department of chemical engineering

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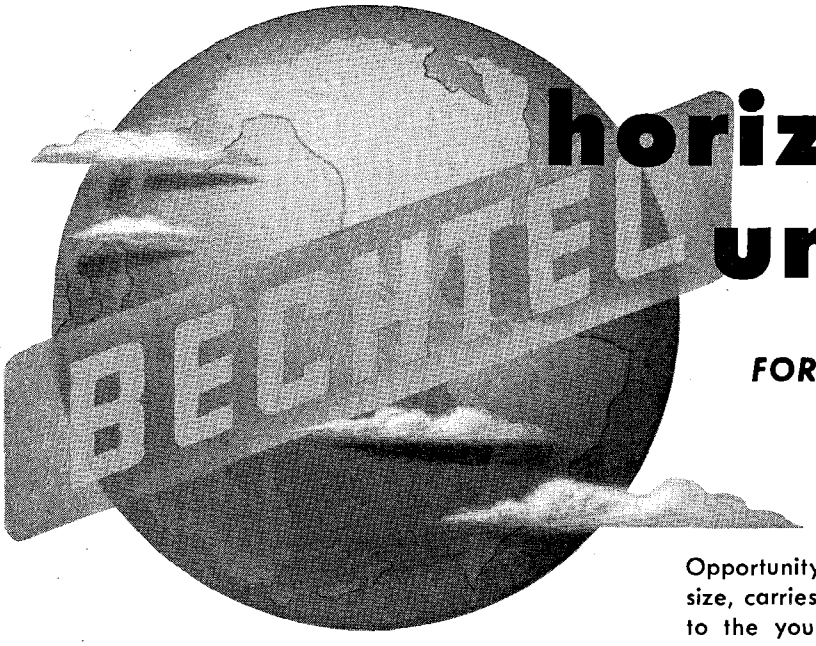

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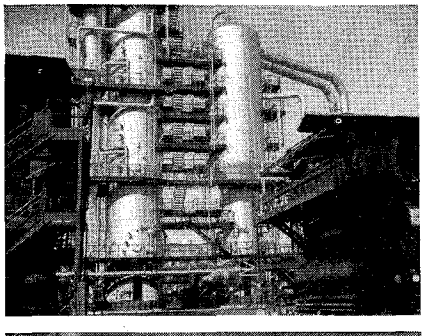
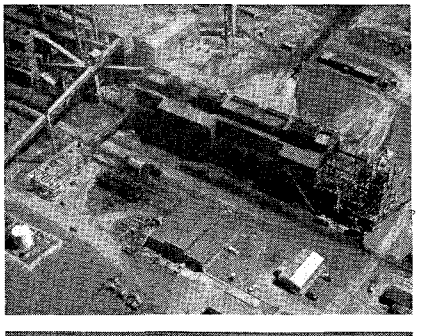
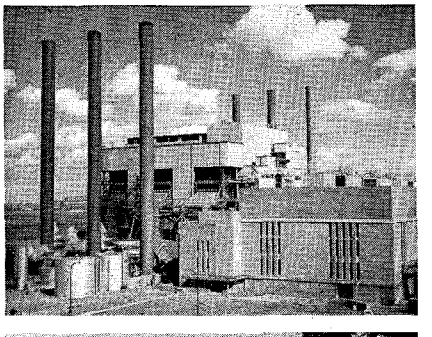
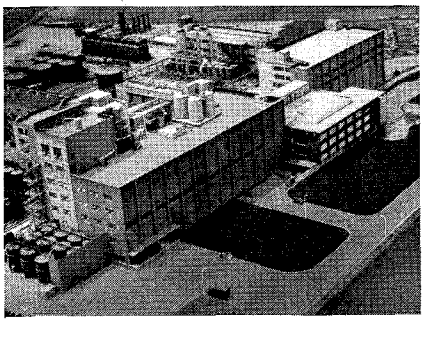
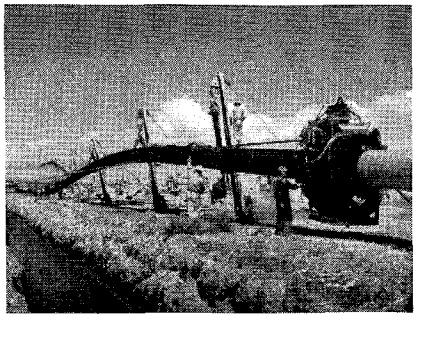







at the University of Kansas, where he has been teaching since 1947. The Kuratas now have four children—three male, one female.

Edward B. Doll, M.S. '35, Ph.D. '38, who is chairman of the physics department of the Stanford Research Institute, was recently named director of the military effects group of the joint AEC-DOD test organization at Yucca Flats, Nevada. He was responsible for coordinating and evaluating the various technical and scientific programs being conducted at the project.

1935

T. J. Deahl, M.S. '36, is on a special one-year training assignment with the Shell Development Company at its Houston, Texas, Refinery.

Herbert S. Ribner, M.S. '37, is now an aeronautical research scientist at the National Advisory Committee for Aeronautics, the U. S. Government's aeronautical research agency. Herb joined the staff of the Langley Aeronautical Laboratory at Hampton, Va., in 1940 and transferred to the Lewis laboratory in Cleveland, the nation's principal propulsion research center, in 1949. He is head of the boundary layer section in the Supersonic Propulsion Division.

1936

Hugh F. Colvin has been promoted to Vice-President and General Manager of the Consolidated Engineering Corporation in Pasadena. Hugh joined the company in 1947 as Treasurer and Assistant to the President, and was elected Vice-President and Treasurer last January.

John Klocksiem announced the arrival of a third child, James Andrew, on April 21, 1953. James has a sister, Bonnie Ann, 8, and a brother, Steven John, 4½.

1938

George G. Wald, M.S. '39, and his wife, Anne, have a son, George Jr., born on April 7, 1953. George Sr. has worked at Lockheed for 13 years, and is a research engineer in the materials and process group.

1939

Charles F. Carstarphen, M.S. '40, brings us up to date on some important events of the last two years. His two daughters, he says, were glad to see the arrival of a baby brother in June '51. In July of that year the Proctor and Gamble plant in Kansas City, where he was production supervisor, was flooded out. The next five months were spent repairing flood damage. In January '52 he transferred to Baltimore as supervisor of the Proctor and Gamble plant there. He and his family plan to spend this summer in Portland, Oregon, and he hopes to drop by the campus in July on his way out.

Philip E. Smith is now assistant manager of the Eastman Kodak Company's Chicago processing laboratories. Phil joined the technical staff of Kodak's cine-processing laboratory in Rochester in 1939. In 1941 he was appointed technical staff supervisor and later assistant manager of the company's film processing laboratory in Washington, D. C. From 1942 to 1946 he was manager of the Washington laboratory, and since 1946 has served as manager of Kodak's film processing laboratory in Flushing, New York.

Curtis M. Lee has been in Baltimore for a year now as project engineer with Rheem Manufacturing Company at their Sparrows Point plant. The Lees' third child—Thomas Elliott—was born on May 23, making it two boys and a girl.

1940

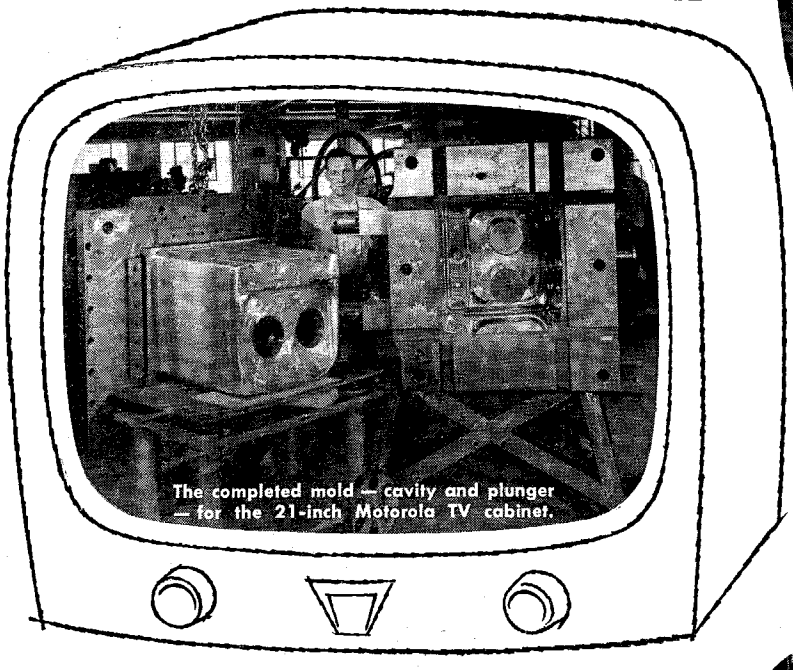
Frank Streightoff, Ex., and his wife, Ann, have three girls and two boys. They live in Franklin, Indiana, a half hour's drive from Indianapolis, where Frank

CONTINUED ON PAGE 36

What's Happening at CRUCIBLE

about plastic mold steel

The production of mold steel for the plastics industry is not a new operation at Crucible. But to manufacture the special seven-ton mold used by Chicago Molded Products Corporation in producing 21″ Motorola TV cabinets presented a unique, though typical problem in the field of specialty steelmaking. The block from which the mold was machined is probably the largest mold steel forging ever produced in this country.



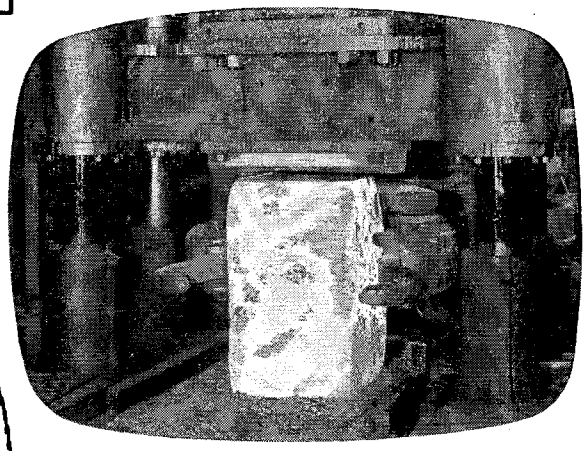
The completed mold — cavity and plunger — for the 21-inch Motorola TV cabinet.

type of steel used

The steel used in making this mold was Plastic CSM2 — a Crucible special mold steel produced in accordance with tool steel standards. It is especially uniform in composition and structure to provide superior machining and polishing characteristics, dependable response to heat treatment and a high degree of dimensional stability.

forging the mold

The 14,000 pound forging required for the mold was produced from a 25,000 pound ingot. In the upsetting operation the 70″ axis of the cropped ingot was reduced to 28″ in a 1500 ton press. The heating, forging, and slow cooling phases

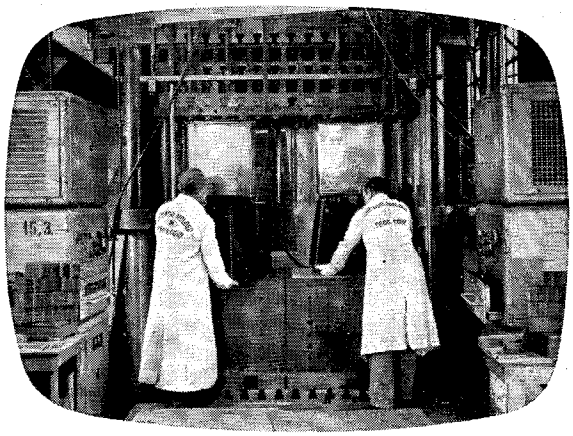


Crucible Plastic CSM2 Mold Steel in final forging stage.

took a total of 14 days. Seven more days were required in the annealing operation. The forging was then planed to its finished size of 40″ x 28″ x 43″.

engineering service available

To build a precision mold like this requires the combined skills and experience of several specialists. That's why Crucible maintains a staff of field engineers to help work out specialized metallurgical problems. If you have an application problem for mold or any other special purpose steel, don't hesitate to call in one of our engineers. And if you need mold steel, you'll be glad to know that it is carried as a stock item in Crucible warehouses conveniently located throughout the nation.



Two TV cabinets being molded in one operation.

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National Drawn Works, East Liverpool, Ohio • Sanderson-Halcomb Works, Syracuse, N. Y. • Trent Tube Company, East Troy, Wisconsin

PERSONALS . . . CONTINUED

works. He's been with Eli Lilly and Company now for 12 years. Last year he had a hand in some of the research on the new versatile antibiotic "Ilotycin," and now he's working with high vacuum low temperature drying of biological substances.

Don Kupfer announced the arrival of Madeleine Louise on April 28.

1941

Brig. Gen. Richard E. Ellsworth, M.S., and 22 other men lost their lives in the crash of an RB-36 plane, according to a brief report which reached us last month. No specific date or further details were given in the report.

1942

Wayne MacRostie has recently been transferred from the California State Division of Water Resources to the staff of the State Water Project Authority in Sacramento as supervising hydraulic engineer. The MacRosties' third son was born on February 7.

1943

Alfred G. Knudson, Jr. is back at Caltech as a grad student holding a Guggenheim Fellowship. Al got his M.D. degree in 1947 from Columbia Medical School, then interned at the Huntington Hospital in Pasadena. He held a pediatrics residency at New York Hospital one year, and at Children's Hospital, Los Angeles, the next—followed by a year's research fellowship at Children's. He plans to work toward a Ph.D. in biochemical genetics and study the metabolic diseases of children.

1946

John O. Nigra, M.S., plans to spend the summer in California. He's an Associate Professor of Geology at Tulane University.

1948

Robert J. S. Brown is finishing up his degree in physics at the University of Minnesota and plans to work for the California Research Corporation in La Habra. His wife, Phyllis, gets her M.D. this month and plans to intern at the Harbor General Hospital in Torrance, Calif.

1949

Arthur E. Bryson, M.S., Ph.D. '51, was recently appointed Assistant Professor of Mechanical Engineering at Harvard University. He was previously a research physicist with the Hughes Aircraft Company.

Carl Price says he's successfully avoided going to work for one more year. He has a National Science Foundation postdoctoral fellowship for study in Sheffield, England for 1953-54. Liz Price and their toddler will conduct a study on the composition of Yorkshire Pudding.

Robert D. Forester, M.S. '50, became the father of a baby girl, Teri Lynn, on April 25.

Jack L. White, who was at the University of California's Division of Mineral Technology on an AEC predoctoral fellowship, plans to spend next year at the Imperial College of Science and Technology, Division of Chemistry, in London, England.

1950

John R. Reese, M.S., became a father on May 15. It's a boy—Charles Pearson. John's wife is the former Virginia Pearson of Atlanta, Ga., whom he married in September, 1951. In April the Reeses returned to New Orleans from California, after John spent six months on a temporary assignment with the California Research Corporation in La Habra. He is now working as a geophysicist with the California Company in New Orleans.

Harry L. Masser, Jr., I.D., is being transferred back to California to work at the Whittier Research and Development Laboratories. During the two years which he spent in Baltimore, he says, their group grew into a new division of the Rheem Manufacturing Company—the Equipment Container Division (shock and weather protective containers for shipping and storage of ordnance material, aircraft engines, missiles, components).

Richard A. McKinnon and his wife, of Artesia, Calif., were blessed with "another income tax deduction" on May 10, 1953. They call him Douglas Alexander, and expect he will make the class of '73 or '74. Dick recently accepted a position with the International Paper Company as plant engineer.

Ens. Arthur R. Benton, Jr. has been in the U. S. Coast & Geodetic Survey since graduation from Tech. He has spent the last three summers aboard the USC&GS Ship *Pioneer* doing hydrographic surveying of the Bering Sea and the Aleutian area. Mighty cold, he says, but the fishing was unbeatable. During the winter they tied up in Oakland, Calif. Since last January, he has been doing geodetic surveying on the stateside, and his particular triangulation party does its winter work in Florida and summer work in Wisconsin. They have been working their way up from Miami and West Palm Beach along the East Coast, and will switch to the Wisconsin project this month.

Robert B. McClure, M.S., has a daughter, Jennifer Robbins, born last August 22. The McClures live in Indianapolis.

Kazim Ergin, Ph.D., writes from Turkey that he became the father of a boy, named Bülent Yusuf Ergin, on April 25. Kazim was recently appointed Director of the Geology Department of the M.T.A. Enstitüsü at Ankara.

1951

Kent Stratton starts work for the AEC in Oak Ridge, Tenn., on July 1, 1953.

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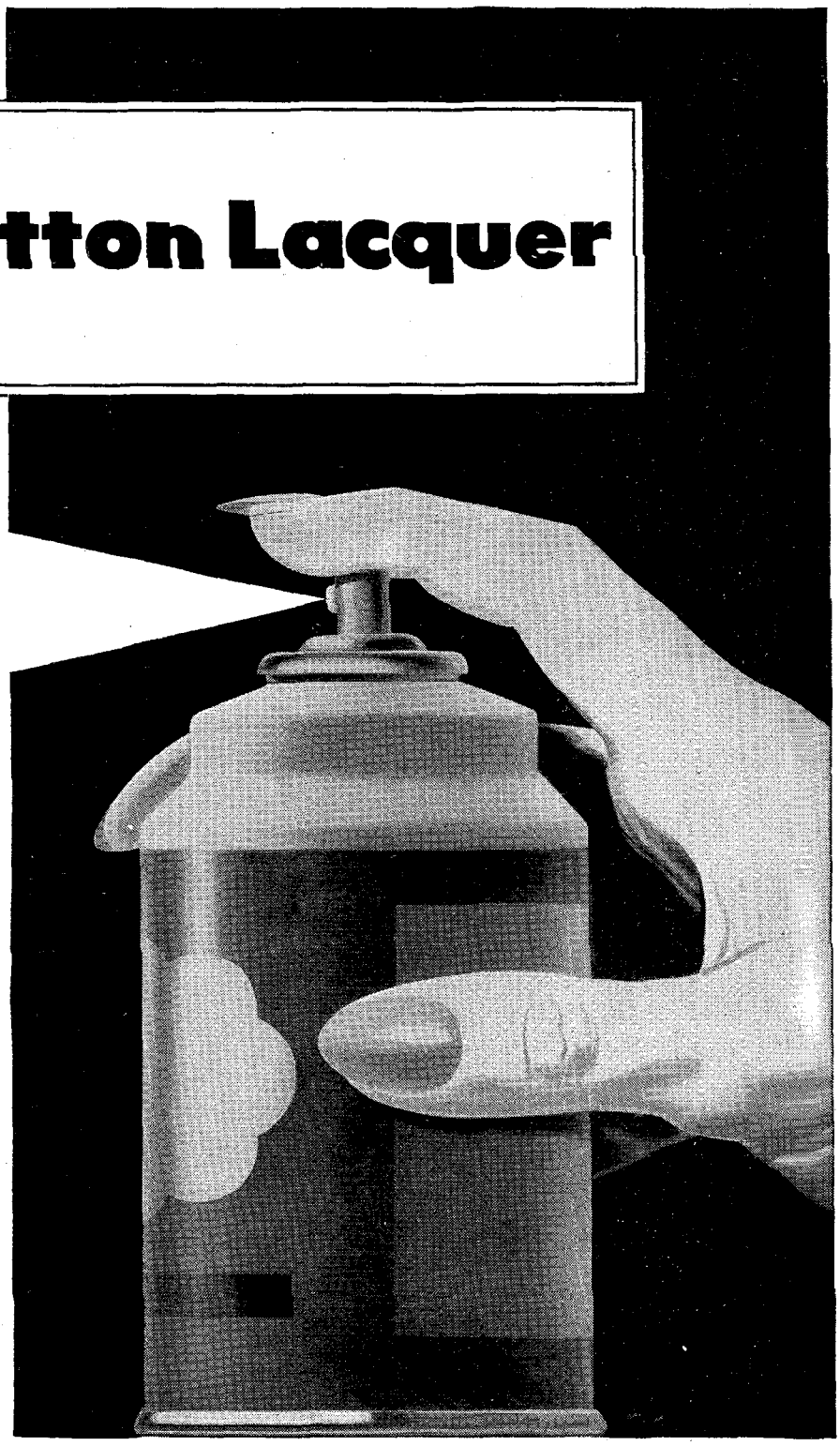
Push-Button Lacquer



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EC53-5

Louis G. Stallkamp is a design engineer with G. E. in Pittsfield, Mass. He says he's enjoying the East, is living with seventeen other engineers at a nearby lake this summer.

1952

William C. Pilkington was awarded a Fulbright scholarship for study in electrical engineering at the Norwegian Institute of Technology in Trondheim, Norway, for the 1953-54 academic year. Bill receives his M.S. from Caltech this June, then attends the University of Oslo this summer before enrolling in Trondheim. He also plans to marry Rosella Becker of Oakland before he leaves for Norway, and she will accompany him.

Louis M. Culp gets his medical degree from the University of Kansas Medical School this June, and plans to intern at St. Margaret's Hospital in Kansas City, Kansas, next year. He and his wife, Marion, have a daughter, Nancy.

Ernest R. Cram, M.S., is just finishing the first year of a two-year tour of duty in the Air Force Medical Corps. At present he is training at Fitzsimons Army Hospital in Denver, but expects to be shipped to some Air Force base next year. After June, 1954, he hopes to practice medicine somewhere in western Kansas. He and his wife have two children.

1953

Shortly before graduation the Institute Alumni Office made a check on the Class of '53 to see what plans they had for the immediate future. Undoubtedly—in the month or more which has elapsed since the survey was made—a lot of these plans have already changed. But here's how things stood at the end of May:

As usual, almost half the graduating class is going on to graduate work. These men will stay on at Caltech for theirs: *Hajimu Ogawa, Herbert Shear, Neil J. Stefanides, Manuel J. Crespo, John N. Delcamp, David J. MacDonald, Jr., Norman P. Wilburn, Paul E. Langdon, Jr., Thomas H. Applewhite, Robert Bixler, Walter R. Thorson, Rolf D. Weglein, George Moore, Kenneth F. Nicholson, Sheldon Rubin, Edwin J. Stofel, Keith R. Bardin, Robert Conine, Alan M. Haire, Rolf C. Hastrup, James Hendrickson, Alfred L. Johnson, Kenneth R. King, Earl D. Jacobs, Donald P. Snowden, Arthur J. Stasney and Roland H. Willens.*

Those doing graduate work elsewhere: *Richard D. Welsh*, Monterey Institute of Technology (Mexico); *Stanley Wilkes*, Stanford; *David J. Clark*, U.C.L.A.; *Stanton Eilenberg*, University of Washington; *James LaTourette*, Harvard; *Michael E. Lourie*, U. C. Berkeley; *William McCormick*, Duke University; *Gilbert Peppin*, Duke; *Walter Pilant*, U.C.L.A.; *Oliver Price*, U.C.L.A.; *Irwin Rubenstein*, U.C., Berkeley; *Bruce L. Scott*, University of Illinois; *Howard A. Shugart*, U.C. Berkeley; *Robert L. Smith*, Stanford; *George Stranahan*, Carnegie Tech; *James Wyman*, Duke; *Robert A. Koster*, Stanford; *Charles R. Tallman*, U.C.L.A.; *Perry Vartanian*, Stanford; *Donald O. Emerson*, Penn State; *Eugene Muehlberger*, University of Kansas; *Thomas B. Slodowski*, Princeton; *Robert J. Stanton*, Harvard; *John C. Wilson*, University of Kansas; *John Behnke*, University of Hawaii; *Alan Haber*, University of Wisconsin; *Ken Lunan*, University of Michigan or Iowa State; *Lawrence Starr*, M.I.T.; *Thomas Emery*, U.C. Berkeley (probably); *Theodore Einwohner*, Yale; *Richard Ham*, University of Texas; *Nobuyoshi Takahashi*, U.C.L.A.; *Robert H. Wood*, U.C. Berkeley; *Daniel Appleman*, Johns Hopkins; *Swaroop Bhanjdeo*, Stanford; *Leon Vickman*, University of Grenoble, France (Fulbright Scholarship); *Thomas J. Janssens*, entering seminary toward priesthood.

Men going into the armed services include: *Terry N. Thomas, Carl A. Rambow, Jack D. Walker, David F. Stevens, Lester Earnest, Douglas McLean, Carl G. Sauer, Jr., Nicholas Szabo, David Twining, Robert Easton*, and *Alfred Johnson.*

William D. Gardner and *Morgan J. Ogilvie* go to work for the U. S. Coast and Geodetic Survey.

Men going into industry: *Frank Ludwig* (JPL); *Harry Vincent* (Herrick L. Johnston Co., Columbus, Ohio); *George B. Cooke* (Aramco, Saudi Arabia); *George Gartner* (L.A. County Flood Control); *Raymond H. Greutert* (Shell Oil); *Arthur E. Britt* (Hughes Aircraft); *Edward H. Daw* (Sylvania, Palo Alto); *Duane Marshall* (Hewlett Packard, Palo Alto); *Clarence E. Miller, Jr.* (North American Aviation, Downey); *Noel E. Reed* (Kelman Elec. & Mfg. Co., L.A.); *John W. Cagle* (Continental Oil, Ponca City, Okla.); *Patrick J. Fazio* (Shell Oil); *Kim L. Hamberger* (Phillips Petroleum); *Richard A. Knapp* (Cerro de Pasco Corp., Lima, Peru); *Theodore D. Sheldon* (Seaboard Oil, L.A.); *Alfred H. Sturtevant* (Cerro de Pasco Corp., Peru); *William Averre* (No. Railway, Limon, Costa Rica); *Coy R. Cantrell, Jr.* (Lockheed, Burbank); *John Gee* (Bethlehem Pacific Coast Steel Corporation); *Robert E. Gillingham* (Douglas Aircraft); *Walter H. Hartung* (Douglas Aircraft); *Herbert E. Henrikson* (Caltech—design engineer); *Gene M. Jordon* (U.S.C. Aerodynamics Test Center, Point Mugu); *Budd LeTourneau* (Oak Ridge School of Reactor Technology); *Leon C. Michaelsen* (Shell Oil); *Norman Schroeder* (Kaiser Steel, Fontana); *Tom Stockebrand* (Sperry Gyroscope, Long Island); *Clair C. Veazey* (General Petroleum, L. A.); *Richard D. Welsh* (Douglas Aircraft, El Segundo); *William G. Blodgett* (Sperry Gyroscope, Long Island); *Richard Ireland* (North American, Santa Susanna); *Philip Bates* (Goodyear Atomic Corporation, Ohio); *Richard M. Jaffee* (J. P.L.); *Morris Robkin* (Oak Ridge School of Reactor Technology).

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Meet Leonard Harris and read his story. In many respects, the problems he had may parallel yours today. He made his decision six years ago, and he's glad he did.

Leonard Harris graduated from Ohio State University in 1943 with a degree in Chemical Engineering. After serving in the armed forces, he began looking into the organizations that offered promising civilian careers. And although he had many attractive offers, he chose Columbia-Southern because it gave him the opportunity to start training immediately in the field for which he felt most qualified. In his case, that field was plant operation.

Harris says, "I recalled the instructors in school had a high regard for Columbia-Southern. I knew the parent company, Pittsburgh Plate Glass, and was favorably impressed with it. Also, I was quite impressed with the sincere, down-to-earth attitude of the people with whom I made my initial contact and I wasn't disappointed on that score after joining the company."

Today, Leonard Harris is an important part of Columbia-Southern's management team. As superintendent of the Chlorine Area in the Barberton Plant the following departments come under his direct supervision: Chlorine, Caustic Soda, Pittchlor, Sodium Hypochlorite, Perchlorethylene.

Harris feels that a technical graduate should look for the following (1) a company in which he can produce and get real satisfaction from his work, (2) a company where opportunities are obvious, and (3) a company which shows no trace of employee stagnancy.

Columbia-Southern is such a company. We will be glad to discuss your interests. This pertains to graduates in all business and technical fields including engineering, research and development, sales, plant design, mining, construction, maintenance, production, accounting, transportation and related fields.

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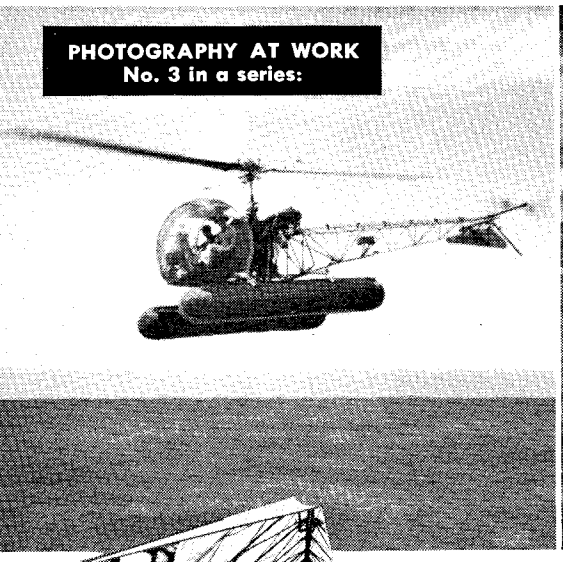
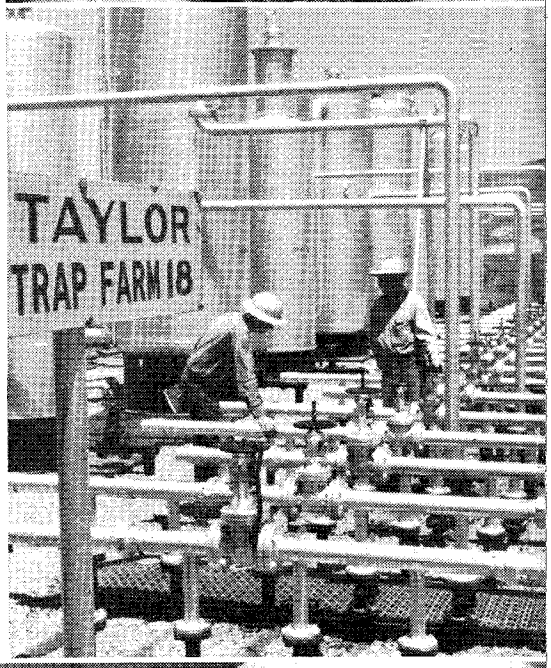


"Best Seller" gives people the picture of oil



Shell Oil used the camera to show the public what it takes to provide the quality gasoline and oil that mean so much to everyone. In co-operation with Rinehart & Co., the best pictures—a few of which are shown here—became "The Oilmen," a book which enjoyed a large sale in bookstores. Shell also distributed copies to employees, dealers, jobbers, civic leaders, and customers.

...to tell this story, to locate, refine, and sell its products, to train its workers, Shell Oil puts Photography to work.

Like thousands of other industries and businesses—large and small—Shell knows that good public relations pays off—and that the camera is a valuable partner in winning friends.

What's more it helps them increase sales, improve production and lower costs.

So, from the time a new employee enters the firm, to the moment when you buy a product at a Shell station, photography is hard at work—training workers, locating oil, aiding refiners and research men, testing, checking, making records, and speeding detail jobs in the business office.

It's an example of the way any business profits when photography gets to work. And it's an indication of the many ways photography is aiding engineering and business.

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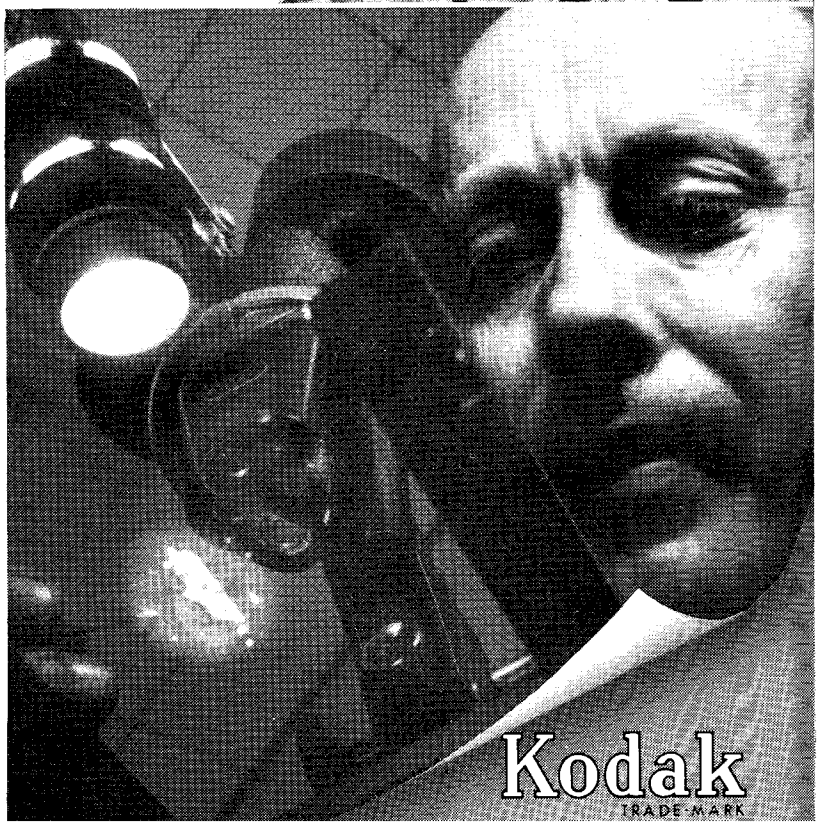
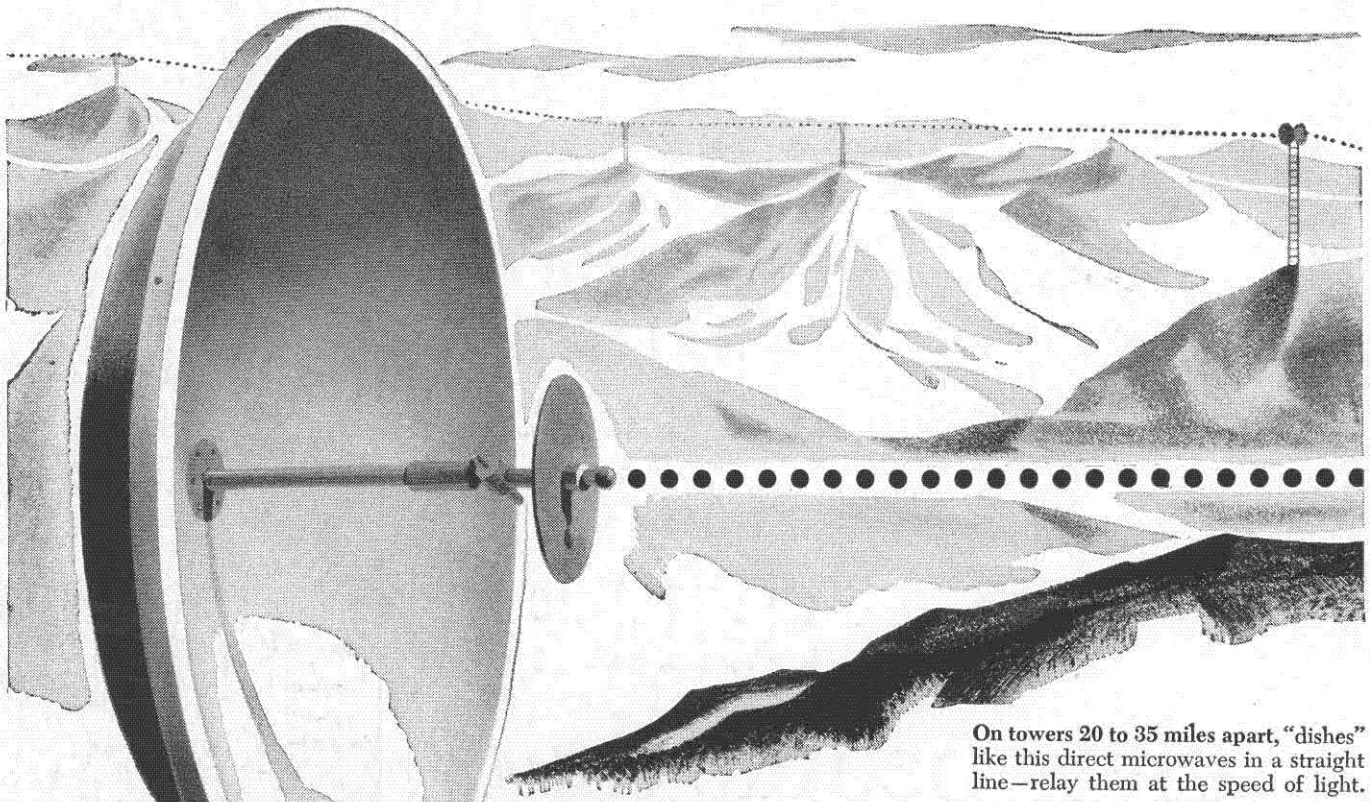
If you are interested, write to Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.



Kodak
TRADE-MARK

Eastman Kodak Company, Rochester 4, N.Y.



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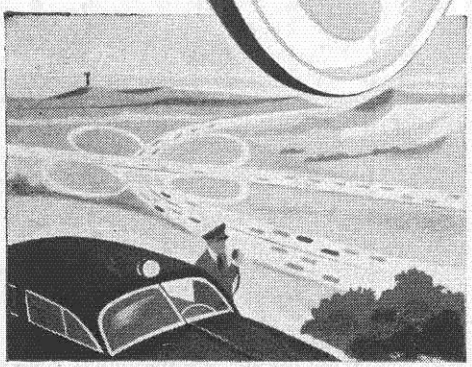
Out of this "dish" come service and safety



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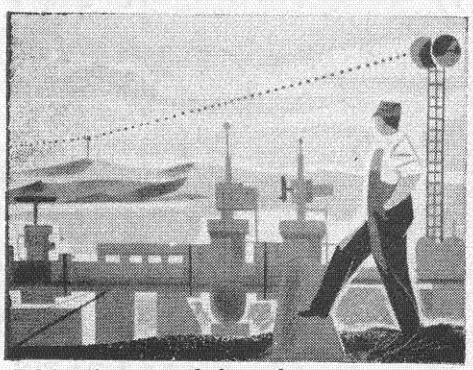

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