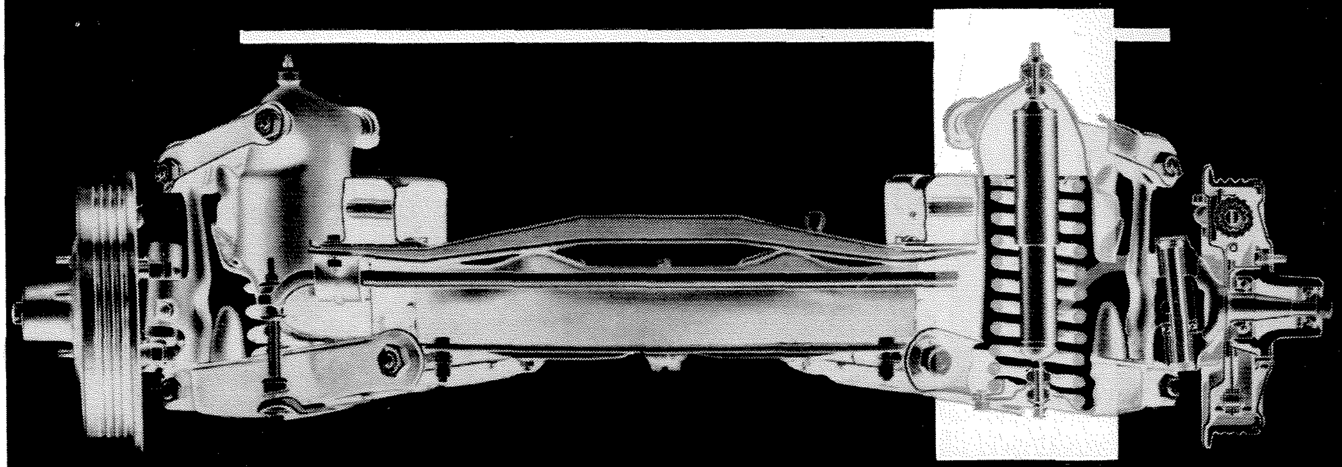
# ENGINEERING | AND | SCIENCE

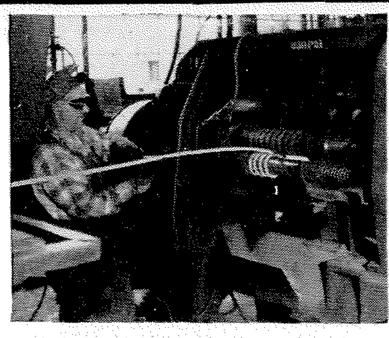
OCTOBER/1953

*Freshman Camp . . . page 23*

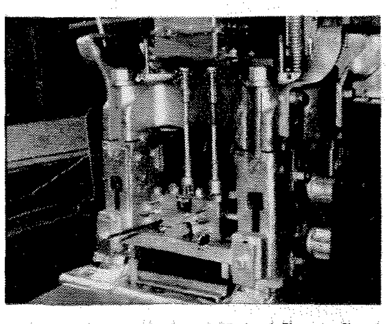
PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

# We gambled on the future and the auto industry cashed in





● Here, at Muehlhausen Spring Division of Standard Steel Spring Co., precision-rolled U·S·S CARILLOY Spring Rounds are coiled without centerless grinding. CARILLOY Rounds have minimum decarburization, and they cost less to use.



● At the Gary Works of United States Steel, this precision mill rolls CARILLOY Coil Spring Rounds with extreme accuracy. Tolerances are half of standard: .004″ on the diameter, instead of the usual .008″, and only .006″ out of round, compared to .012″ on ordinary rolled bars.

IN the early days of the development of coil springs for front suspensions of automobiles, the only steel that was available was an ordinary hot-rolled bar from which as much as .035″ of metal per side had to be removed by grinding to insure freedom from harmful seams, pits, and decarburization. This cost money, was wasteful and time consuming.

We at United States Steel felt there was a better way of doing this, so we put our best engineers on the problem.

Using a mill especially equipped for the purpose, they devised an ingenious method of producing hot-rolled bars to eliminate harmful defects and most of the grinding expense. Rolled by this method to half the standard tolerances, with half or less the amount of decarburization, these CARILLOY Precision Rolled Coil Spring Rounds can be used "as furnished" or with only a small amount of centerless grinding.

This exclusive development has paid off in two ways. It has paid off for the automobile manufacturer in that his costs are reduced and spring performance is of the highest order. And it has paid off for us because these CARILLOY Precision Rolled Coil Spring Rounds are now used in over half of the coil springs in new automobiles.

Here's just one more example of the better steel products being developed by United States Steel's vast research program. To keep pace with the ever-increasing demand for special steel, United States Steel is always looking for young men with exceptional ability and training in metallurgy, engineering and related fields. For more information, write United States Steel Corporation, Room 2816-C, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS

3-1817

UNITED STATES STEEL

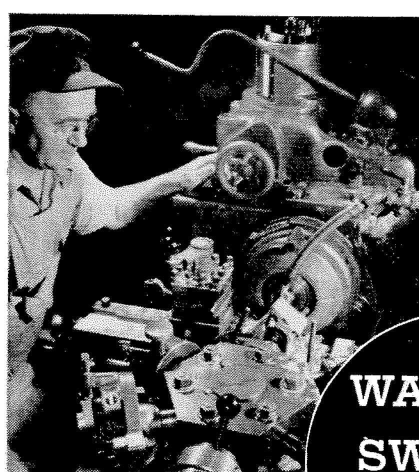
# You can't vote yourself security

THE GERMANS TRIED IT and lost their nation—the Russians pretended to try it and made themselves slaves.

You'll notice that security is always offered in return for your vote—"just a vote of confidence, so I can get for you what you want." So the worker votes for a union boss he never saw, the businessman votes for a subsidy or cost-plus government contract.

And for every inch they advance toward security, they retreat a mile toward regulation that is next to servitude.

But there *is* a way to enjoy security in America (and only in America, by the way). That is, to make yourself something the world must have—a skillful farmer, a productive worker, a sound businessman. In this country it is true that the more value you add to the world and the more you add to the world's goods, the more you will be paid in return. *That* is security with self-respect—the only kind of security Americans want.



*There are employment opportunities at Warner & Swasey for young men of ability and character who believe as firmly in the principles of Americanism as they do in the principles of sound engineering. Write Charles Ufford.*

WARNER & SWASEY
*Cleveland*
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY

# Strong When Wet

## CHEMICAL PROBLEM...

. . . paper that absorbs the maximum amount of moisture without falling apart.

## SOLUTION...

. . . Kymene®, a series of wet-strength resins produced by Hercules for paper makers. Kymene-treated paper has excellent absorbency and wet-strength. Manufacturers, for example, find that the use of Kymene produces a vastly improved paper towel at remarkably little extra cost.

## *COLLEGE MEN...*

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

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

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

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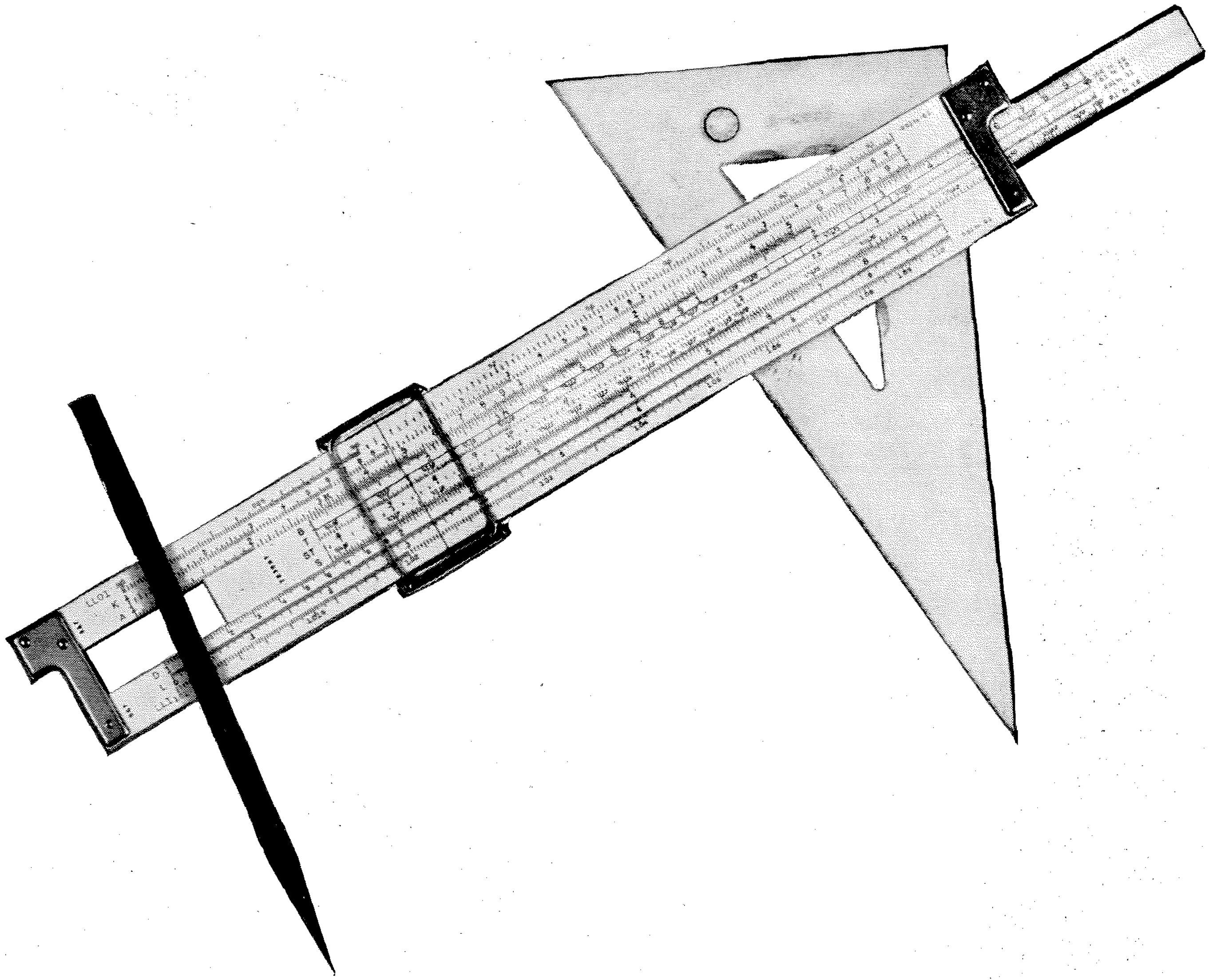

# ENGINEERING AND SCIENCE

## IN THIS ISSUE

**This month's cover** picture, taken at the 1953 Freshman Camp, shows the class of 1957 and Caltech's student body leaders making each others' acquaintance around the campfire and Down by the Old Mill Stream. For more news and pictures of this year's Freshman Camp, see page 23.

**W. A. Bussard,** author of "Engineering Models" on page 14 of this issue, got his B.S. in Mechanical Engineering at Caltech in 1944. After two years in the submarine service he joined the DuPont Company, where he spent six years in production and construction tie-in on the startup of new nylon and Dacron plants. In both these previous experiences he had a chance to use scale models in operator training—which led to his joining Industrial Models, Inc. several years ago. This five-year-old company now has shops in Wilmington, Cleveland, and New York.

**Last year** every Caltech alumnus got a bulky questionnaire survey to fill out for the Institute. Amazingly enough, most of them did it too. The results can be found on page 17 of this issue—the first comprehensive survey of Caltech alumni ever made. To everyone who cooperated in this job by filling out the questionnaire—our heartfelt thanks.

**PICTURE CREDITS**
Cover, 23-25 Tom Bergeman '56
11 George S. Stranahan '53
12, 13, 22, 27 Byron Johnson, Jr. '56

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## CONTENTS



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# BOOKS

### A BIBLIOGRAPHY ON METEORITES
**Edited by Harrison Brown**
**University of Chicago Press $10.00**

THIS CHRONOLOGICALLY arranged bibliography covers the world literature on meteorites and related subjects published between 1491 and 1950. It's the first of a three-volume series which will comprise an international catalogue of meteorites.

Harrison Brown, Professor of Geochemistry at Caltech, is editor of the series. Associate editors are Walter Nichiporuk, research assistant in the Division at Caltech, and Gunnar Kullerud of the Mineralogisk-Geologisk Museum in Oslo.

The project is financed by a Rockefeller Foundation grant. Its purpose is to promote international research on meteorites, and to provide a compendium of meteorite data which will expedite research in the field of meteorites.

The second volume in this international catalogue will include alphabetical, chronological and geographical indexes of all meteorites, and descriptions of stones and stony irons.

The third volume will have descriptions of iron meteorites, the chemical composition of all known meteorites, their trace element content, tables of location of meteoritic fragments, and an index of general subjects relating to meteorites.

Suffice it to say that nothing approaching this work has been done in the field of meteorites before.

### SCIENCE FICTION HANDBOOK: The Writing of Imaginative Fiction
**By L. Sprague de Camp**
**Hermitage House, New York $3.50**
*Reviewed by E. T. Bell*
*Professor Emeritus, Mathematics*

THE AUTHOR of this highly entertaining and authoritative book on the writing of imaginative fiction is a Caltech graduate in mechanical engineering (1930), who has been a patent consultant, draftsman, surveyor, naval officer, technical writer, and author of textbooks. He hit his natural stride in 1939, when he entered the field of imaginative fiction. Since then he has gone far indeed in his chosen profession, in which his is one of the best known names to innumerable fans. His educational and professional experiences—and above all his own success as a writer—make him the ideal candidate to tell those who wish to write imaginative fiction how to go about it.

This is not a stodgy book, like some of the killers inflicted on would-be writers in college courses on writing by men who have never learned to write themselves. It is, on the contrary, a fast-paced, practical account of such matters—to mention only a few—as modern imaginative fiction, markets and editors, readers and fans, preparation for a science-fiction career, "Where do you get those crazy ideas?", the plotting and writing of an imaginative story, and a scholarly account of the origins of imaginative fiction. In the last, Aristophanes and Plato, of course, are included among the great masters; God, strangely enough, is not mentioned.

Anyone wishing to learn something of this old yet new genre of fiction will find plenty in this fascinating book. Likewise those who may wish to break into a field which is by no means exhausted and sterile.

# "ACADEMIC FREEDOM"

by L. A. DuBRIDGE

ENGINEERING AND SCIENCE *printed in its April, 1953 issue the statement published by the Association of American Universities (of which Caltech is a member) on academic freedom and responsibility. In his remarks at the Annual Banquet and Meeting of the Alumni Association on June 10, President DuBridge referred to this statement and then gave further clarification of his own views on the subject. He emphasized that these were his personal opinions and that he was not speaking for the faculty or the trustees. Many alumni found these remarks so interesting, however that Dr. DuBridge was persuaded to release them for publication. For publication purposes he has made certain additions and editorial revisions to the statement given at the dinner.*

IN THESE DAYS when the problems of "academic freedom" are so much discussed, and are subject to so much controversy, it is well to re-examine just what it is that we are talking about. It would appear that some who attack "academic freedom" are actually attacking something else; and some who defend it are often confused as to just what they do defend.

In this country freedom of speech is guaranteed to all by the Constitution of the United States. The college teacher has no less and no more freedom under the law than any other citizen.

Academic freedom is not a matter of law. Rather, it is a privilege granted to a teacher by his university. It is not, of course, a privilege to violate the law—a privilege which no one has the power to give. It is a privilege granted to the teacher to retain his position in the university even though he expresses opinions or beliefs or makes statements, or engages in activities, which are unpopular with the public, or at variance with opinions of his colleagues or of the university administration or its governing board. A business organization may, if it chooses, dismiss employees whose opinions do not agree with those of "the company." A university denies itself this right. Indeed, a university does not have "an opinion." Since it exists to encourage scholarship, a university knows it cannot specify in advance the conclusions to which scholars may be led. It therefore takes special pains to assure the scholar that he shall be free to express his views, both as a scholar and as a citizen, without endangering his position. No law requires a university to extend this privilege; but scholars shun those institutions which fail to insure it. Through the action of scholars over the years and through the approval of public opinion every leading university in the United States has assured its faculty of this privilege. Thereby the progress of learning has been accelerated and assured—to the eternal benefit of civilized living.

## Unpopular views

Although no university either could or would protect its members against due process of law, many an institution has found itself resisting the public clamor for the dismissal of a professor who has expressed views which are at the moment unpopular. Much of the demand in this country a generation ago for the more explicit recognition of academic freedom came from the situation caused by the dismissal of biologists who taught the then unpopular theory of evolution. During World War I German scholars were under similar pressure. But though public clamor has at times been loudly and even violently insistent, the great universities of the nation (that is, those that have attracted and retained the greatest scholars) are those which, generation after generation, have resisted these temporary demands that scholars be persecuted or dismissed for their opinions.

## Privilege and responsibility

Now no privilege is possible without an accompanying responsibility. The responsibility of one who enjoys academic freedom has not always been explicitly described; it is no less real. It is implied in the very word "academic." An academic institution is one devoted to scholarship. Academic freedom can have no meaning except as applied to scholars. The privilege accorded a scholar to retain his appointment has never meant that one who is not a scholar has a right to retain his job. Academic tenure is designed to protect scholarship, not to shield incompetence, dishonesty, or any illegal or immoral action. Thus a person who has lost or abandoned the qualities of a scholar has abdicated his right to claim the privilege of a university position—and hence the right to academic freedom or tenure.

There are of course occasions on which the determination of whether an individual has lost his right to be classed as a scholar is a difficult matter. It is easy if one can prove gross incompetence, immorality, deceit, or disloyalty. But scholarship demands also positive qualities of sincerity, integrity, loyalty, respect for others, good taste. Honest men may often differ in their opinions as to whether or to what degree a colleague has failed to measure up to scholarly requirements. But one thing is clear: the determination of scholarly competence must be made by scholars; the right of a man to continue as a faculty member must be judged by his colleagues and his university, not by any outside group. Each university must make its decision on the basis of its principles and the facts involved in each case; it must not be swayed by public clamor, no matter how loud this may be.

There have been two recent incidents which illustrate extremes of positions in regard to academic freedom.

## Freedom to disagree

Press reports indicate that the governing board of a western university has recently, at the recommendation of the President, dismissed a professor who expressed views on educational matters which were contrary to the views expressed by the President himself. The professor was thus dismissed for "insubordination." This is a shocking violation of all of the principles of academic freedom. Academic freedom means precisely that a professor *is* free to disagree with his colleagues, with his President, or with his governing board. He is particularly entitled to such disagreement on matters of educational policy which affect his university. He even has the duty to give voice to his opinions. By its action (assuming the press reports to be correct) this university has abdicated its right to be listed as one of the centers of scholarship of this country.

## Action at Harvard

A noble and a heartening contrast to this action was the one recently taken by the Corporation of Harvard University. Harvard has been one of the nation's leading universities in guaranteeing academic freedom to its faculty. Three members of the Harvard faculty recently declined to testify before a Congressional committee, invoking the Fifth Amendment to the Constitution. After a thorough examination of each case the Harvard Corporation issued the following statement:

"We would regard with the gravest concern the presence on our teaching staff today of a person who is now under the domination of the Communist Party. We think membership in the Communist Party by a faculty member today, with its usual concomitant of secret domination by the Party, goes beyond the realm of his political beliefs and associations. It cuts to the core of his ability to perform his duties with independence of thought and judgment. By the same token, it is beyond the scope of academic freedom. In the absence of extraordinary circumstances, we would regard present membership in the Communist Party by a member of our faculty as grave misconduct, justifying removal.

"We deplore the use of the Fifth Amendment by a member of our faculty. In the first place we think full and candid testimony by all teachers would disclose that there is little Communist activity today in educational institutions. But more important, the use of the Fifth Amendment is in our view entirely inconsistent with the candor to be expected of one devoted to the pursuit of truth. It is no excuse that the primary purpose of its use is to protect one's friends, or to express one's feeling that Congressional committees are by-passing the Constitutional safeguards of due process of law, or to avert danger of prosecution for perjury in case one's testimony should later be contradicted by the false testimony of others. Furthermore, since we are not conducting a criminal trial, we will not shut our eyes to the inference of guilt which the use of the Fifth Amendment creates as a matter of common sense. Hence, the use of the Fifth Amendment by a member of our teaching staff within the critical field of his possible domination by the Communist Party, makes it necessary in our judgment for us to inquire into the full facts. We regard it as misconduct, though not necessarily grave misconduct."

The Corporation found that the three teachers were not now members of the Communist Party and therefore they were not deprived of their positions. They were, however, reprimanded and one of them was placed on probation for three years. The interesting points about this statement are, first, that the cases were judged on the basis of the teacher's *conduct*, not his opinions, and, second, that misconduct may be punished by a rebuke while dismissal is reserved only for cases of grave misconduct.

You may wonder why I take the time of the alumni on this occasion to discuss this difficult and delicate matter of academic freedom. The reason is very simple. Unless the alumni of the colleges and universities of this country understand and appreciate the purpose and values of academic freedom, there is little chance that this purpose and these values can be retained. However, if alumni do understand and appreciate the essential values of academic freedom, then academic freedom will never die. In my opinion, the death of academic freedom would be a body blow to the progress of learning in this country, and hence a possibly fatal blow to our future freedom and security.

*Shemuel Duvdevani, Caltech Research Fellow, sets up one of his dew gauge stations on the campus*

# DEW RESEARCH

**Work in progress at the Institute's Earhart Plant Research Laboratory may have important applications in arid-zone agriculture**

RECENT RESEARCH in the Institute's Earhart Research Laboratory indicates that dew may be an important factor in the growth of plants in semi-arid regions. Water-hungry plants, supplied with water by dew, were found to carry the water from their leaves and store it in their roots until it was needed.

This research project was started in Israel by Shemuel Duvdevani, head of the Dew Research Station at Karkur. It was sponsored by the Research Council of Israel and the Ministry of Agriculture.

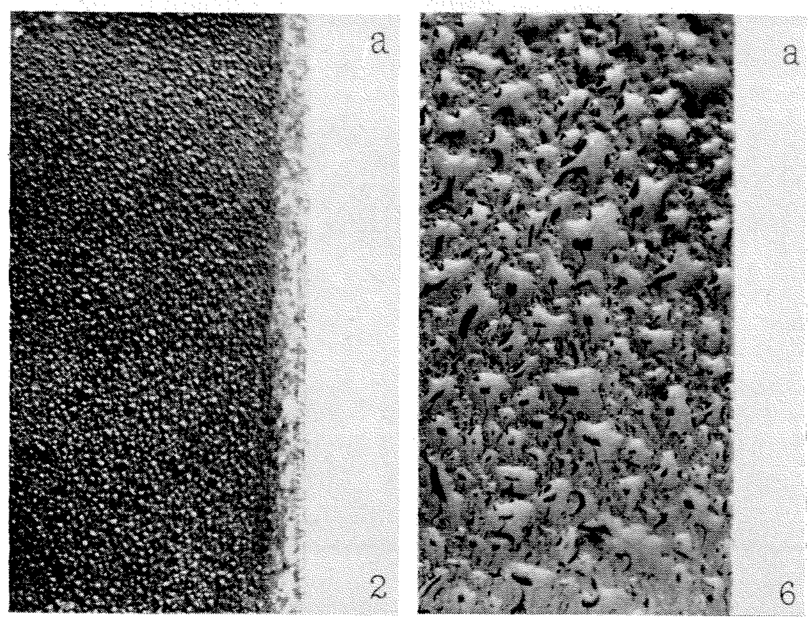
Since last December Duvdevani has continued his research on a fellowship at Caltech, working in the Earhart Plant Research Laboratory with Dr. Frits W. Went, Professor of Plant Physiology. The research is supported here by the Earhart Foundation and the United Nations Education, Scientific and Cultural Organization (UNESCO).

In Israel, Duvdevani observed that, in dry soil, plants that received dew grew better than those that did not. He also found that dew, condensing on the leaves during the cool of the night, could be taken into such summer crops as corn, cucumbers, watermelons, pumpkins and beans to promote their growth.

He came to Caltech to check his field findings under the highly controlled conditions of the Earhart Laboratory, in which the climate of virtually any area of the world can be duplicated.

Here he has been studying the relationship of water intake by leaves to the growth of corn, watermelons, cucumbers, beans, sugar beets, Brussels sprouts and tomatoes. He sealed the roots of partly-wilted plants in glass jars. Then, with temperatures held constant, the plant tops were sprayed eight hours a night with a fine spray of water to simulate dew. The plants recovered

*During the night, dew is deposited on the Duvdevani gauge in certain patterns—each characteristic of the amount of dew. Patterns are identified by comparison with standard dew photographs like the two samples shown at the right.*

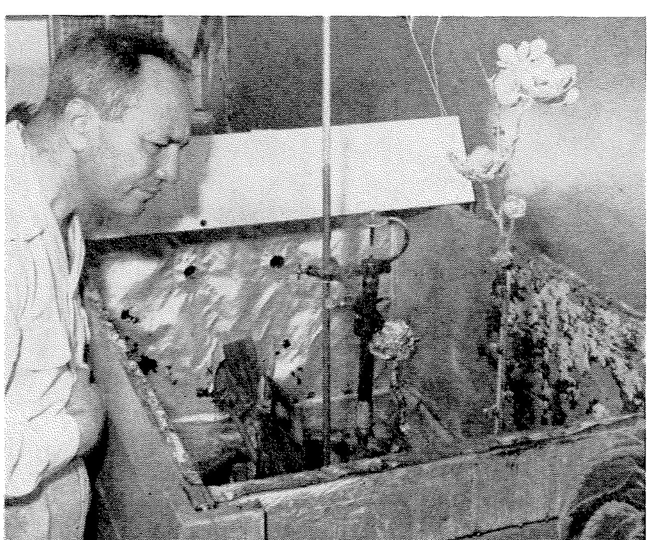



and continued growing under this spray for weeks and months.

Duvdevani also found evidence of a "two-way traffic" for water movement through plants. During the experiments, droplets formed on the roots and root hairs and water accumulated in the jars. During one simulated dew period, some plants excreted many times their own weight in water through their roots.

For centuries it has been known that plants absorb water from the soil through their roots. They use some of it in photosynthesis and in the growth process, and give up most of it to the atmosphere through their leaves.

The experiments in Israel and at Caltech show that the reverse is also possible: Plants can absorb water through their wetted leaves and transport it to the roots—as well as other parts—for night storage in the soil until photosynthesis begins after sunrise.



*In the Earhart Laboratory Duvdevani keeps this Brussels sprout plant growing under a fine spray of water—and with its roots sealed in a glass jar.*

This process occurs in plants developed under fairly dry conditions, according to Duvdevani, who has also found that young plants and leaves show the best effects in the experiments.

The ability of leaves and roots to interchange their water functions under certain conditions provokes revision of basic concepts in the water physiology of plants. How much of the total water needs of plants in near-desert regions is contributed by dew or mist is not known. This phase of the problem is now being studied with the aid of a simple, easily-read dew gauge developed by Duvdevani several years ago and now in use in various countries.

Dew deposits on the gauge during the night in certain patterns, each characteristic of the amount of dew. The patterns are identified by comparison with standard dew photographs.

Systematic dew records have been obtained for a number of years with hundreds of such gauges throughout Israel. Now about 30 of the gauges have been set up on the Caltech campus, at the Los Angeles State and County Arboretum and in other southern California locations. Daily observations over a long period of time will give the distribution of dew in different localities, and this distribution can be correlated with phenomena of growth and vegetation.

Dudevani expects that his investigations will provide information on the types of plants that can use dew and on the plant age and environment in which dew is most effective. This should help arid-zone agriculture, especially if the proper times can be determined for spraying plants with small amounts of water in areas where insufficient water exists for irrigation. Also dew, or water spray, may be a deciding factor under critical drought conditions when a few drops of water may determine whether a plant dries up or survives.

# ENGINEERING MODELS

**Scale models of industrial plants used to be nothing but expensive toys. Now they've been turned into valuable new engineering tools.**

IN THIS PRESENT period of industrial expansion the economics of designing new plants assumes greater and greater importance. Technological changes and the shift to continuous processing have increased the complexity as well as the cost of new plants. And the shrinking dollar has seriously increased the plant investment per pound of production for normal plant expansion. Thus, one of the big problems of today's designer is to cut costs without impairing design quality.

This same period of industrial expansion, unfortunately, has not seen an increase in the number of experienced designers and engineers. The opposite is only too true, as is indicated by the unusual demand for trained engineers and even recent graduates.

Thus caught between demands for lower engineering cost; a good design for new, complex processes; and a shortage of talent, the practical engineer has been in search of a new tool. More and more he is turning to the engineering model.

Scale models of industrial plants used to be expensive toys, justified only for a few purposes. They were built from final drawings and attempted to duplicate every detail of the actual plant. This type of model was, and still is, useful for getting across engineering thinking to non-technical executives, clients and operating personnel. But the cost was high, the timing too late—and, besides, this type of model was not adaptable to the design office.

Only recently have engineers with design, construction and operating experience merged their knowledge with that of the craftsman and produced a valuable new engineering tool. The engineering model has now been developed to the point where it is a valuable aid for all engineering forces on a project—the design office, field construction and operating personnel.

The engineering model is used early in the planning for any new project. One form of it may be a custom-made "Engineer's Tinker Toy" or preliminary model to assist in the early stages of planning equipment arrangement and optimum steel structure. Once these decisions have been made, the basic engineering model is constructed quickly and delivered to the engineering office to coincide with the place in the design schedule where piping study would normally begin on paper. The model-maker then works with the leading pipe designer or the project engineer.

All pipe-line study and layout can be done on the model, working from the process flow sheet. The center-lines of all pipes are represented by 1/16-inch brass rod; the outside diameter clearance (including insulation) at any point along the pipe is indicated by a sliding fiber disc. This method creates a three-dimensional study value, as well as pointing out immediately any physical interferences in design.

Hand valves are soldered in place to indicate operability and accessibility, as well as to point out interferences. Automatic valves, orifices, rotameters, steam traps, relief valves, check valves and funnels are all shown on the design model. Conduit banks, instrument channels, windbracing, ventilation ducts and safety showers are also indicated and their space occupation defined.

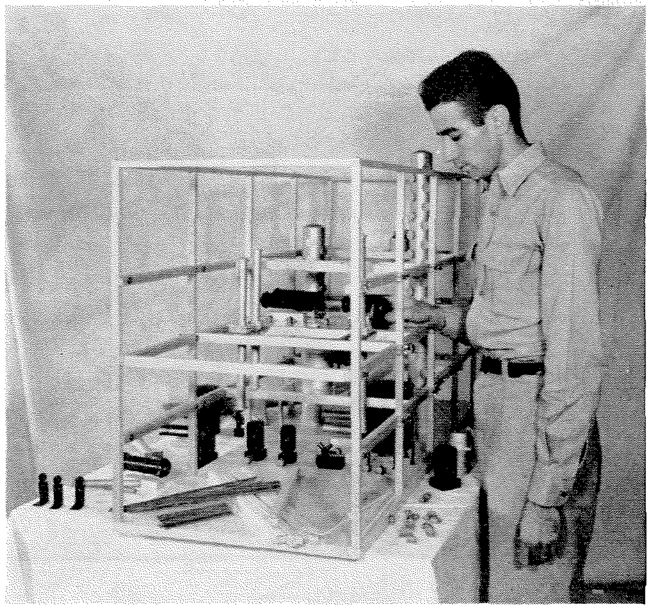
This method of piping study, before making any final piping arrangement drawings, easily lends itself to revisions. Equipment is often relocated during this phase to accomplish better pipe routing.

Normal procedure in model design of chemical, process, oil, or power plants is to put 90 percent of the piping on the model before any final drawings are made. Then a design review is held with the plant operating and maintenance personnel.

This operating review serves two functions:

by

W. A. BUSSARD



*Preliminary model is used by the designer to determine optimum arrangement and steel structure.*

(1) It allows the design group to present a complete picture of the project to the operating forces, showing all the variables affecting the location of any piece of equipment, pipe line, or piece of steel.

(2) It allows operating personnel, specialists in their own fields, to contribute to a better quality design before final drawings are started.

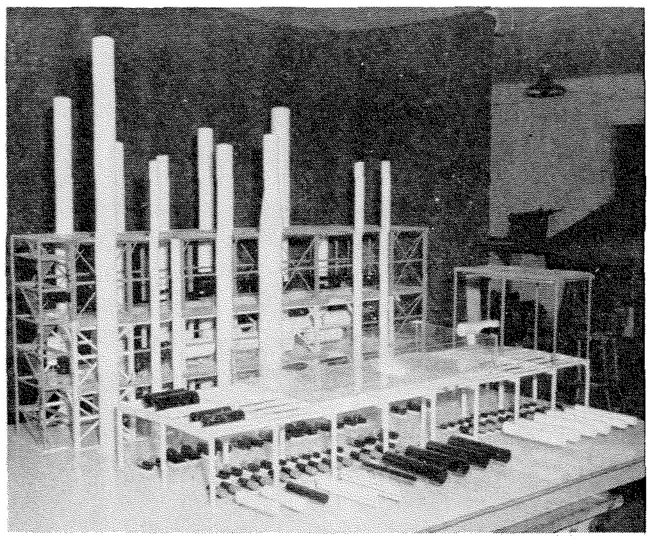
Revisions agreed upon during this review are quickly incorporated in the model, and *then* the final drawings are made. This procedure results in a reduction in the time required to design piping, a better quality of design, and appreciable savings in the cost of piping drawings.

Using a model in the design room offers a visual, three-dimensional tool for all design groups and quickly indicates any interferences between piping, conduit, structural steel, ductwork, and auxiliary equipment. For this reason it stimulates better coordination between design groups and reduces discussion and research time.

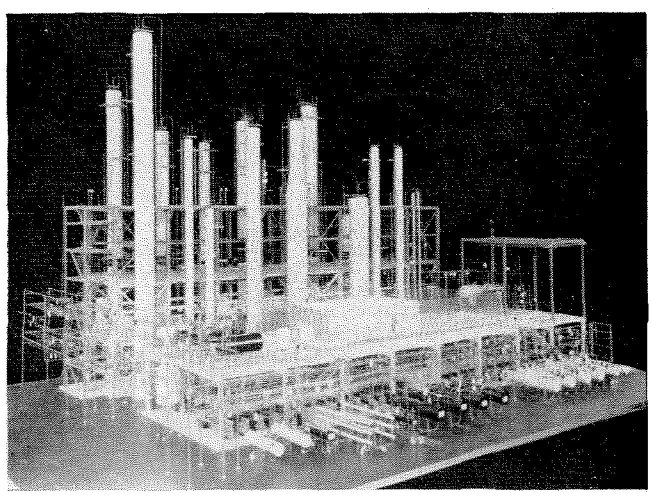
The same model used by the design group is turned over to the construction forces for their own use in scheduling, planning, material take-off and subcontracting bidding.

A construction engineer working on a project which has been modeled during the design stage is erecting a plant with good design insurance. The "hulls" or interferences often found in the field from checked drawings have already been eliminated during the design, and construction delays from this source are minimized. It does not take many wasted man-hours of a gang of pipefitters, riggers, or mill wrights to equal the cost of a model.

Day-to-day scheduling and planning of craftwork are also speeded by use of the model. Color coding on the model quickly points out the items of interest to each



*The engineering model looks like this when it arrives in the design office to serve as a layout tool.*



*The design model with all pipe lines and related equipment installed prior to final review.*

craft, and indicates the location and scope of related work. Electricians recognize the defined path for conduit; insulators quickly spot the vessels and pipes needing their attention; instrument men detect the locations of their work, and each group can see what other crafts will be working in their area.

A recent example of construction use of a plant model was in the erection of new coal-chemical facilities at an old plant site. Because the space restriction was so confining it was necessary to erect the adjoining pump house, distillation structure and distillation towers together from the ground up. To complicate the problem, many of the adjoining towers were from separate vendors, which meant two or three rigs working at the same time. The model here was a natural tool for correlating all the various construction efforts within a small area and with a minimum of delay.

## Saving sub-contracting dollars

Besides saving man-hours the model is also being used to save sub-contracting dollars. Constructors have discovered that a model at the plant site is worth many times its cost in obtaining more realistic bids on piping, painting, insulation, electrical work, sprinkler systems and lighting. It is difficult for any sub-contractor to wade through 800 drawings and give a firm bid on "piping in place." It is not the material cost he finds difficult to estimate, but the many man-hours necessary in scaffolding and erection. In at least one recent case, on competitive lump sum bidding on piping installations, local contractors who thoroughly studied a model were approximately 15 percent lower than their competitors who studied only the blueprints.

When piping represents 20 percent of the plant investment on a typical chemical installation, such a potential saving cannot be disregarded.

Anyone associated with the startup of a new plant, particularly a complex chemical plant, appreciates the many problems involved—economic, process, and personnel. It is a common sense fact that company money is invested in a new plant only if it will return so many dollars. For a ten million dollar plant in the changing chemical field this usually means earnings of $15,000 a day—before taxes. Any delay in putting the new plant "on-stream" only adds this amount to the plant investment.

## The model as a training tool

Early and thorough training of operators will insure a successful and on-time plant startup when construction is complete. To accomplish this means using every training tool available. The model is one of the most important ones.

The modern plant is complex and, for that purpose, it is greatly instrumentized. Instead of reducing the responsibility of the operating group, however, this only increases it. Not only must the operator be trained to control the process through the instruments but he must be trained to operate "by hand" in case of instrument failure. This takes technically competent personnel.

## A package deal

Location of many new plants is away from sources of technically trained personnel; or hiring agreements at old locations may preclude hiring men of this type. In these cases it is essential to present the entire plant concept in a package that the new operator can visualize. The model makes this possible, so that the new operating group can become familiar with the plant and equipment before the building is complete and without getting in the way of the construction people. All the main equipment can be identified and the principal lines traced out so that when the trainees enter a building for the first time they know exactly what to look for and where to find it. It is difficult to see how this could be done in any other way if a large proportion of the trainees cannot read blueprints.

The use of a model in design also insures better operating conditions, once the plant is in "on-stream." Operating and maintenance aids are built into the plant because plant personnel have detected their absence early in design and requested their inclusion before money was invested in costly final drawings. (At present drafting room rates the cost per drawing will vary between $300 for a simple layout and $1,000 for one complex piping drawing.)

Tight operating spots, inaccessible maintenance items, and unsafe operating arrangements are quickly detected on models by the operating group, even though they may not be able to visualize drawings of the same conditions. Correction of these spots before construction begins will result in easier and safer plant operation without delaying the construction schedule.

## Continuously useful

Even after plant startup the model is used for maintenance planning of shutdowns or revisions, and by the training group for quickly orienting new trainees or visitors. The same model is also used for public relations and publicity—for there are very few persons not attracted and fascinated by all types of models.

The full use of scale models in the engineering of industrial plants is a recently accepted concept. Because it is new there are some individuals not acquainted with its many advantages, or with the potential savings to be gained from using models.

The benefits of using a scale model await all groups involved in the design, erection, and startup of any new plant. The larger a project the greater are the potential savings to be realized by using an engineering model—although the advantages of better design, fewer delays during construction, and less time spent in research and discussion during all engineering work exist, no matter how large the project.

# THE CALTECH ALUMNI SURVEY

HERE, AND ON THE FOLLOWING pages, are the initial results of the questionnaire survey mailed out to all Caltech alumni in the summer of 1952.

The questionnaire is based on one sent out in 1947 by *Time* Magazine to college graduates from the class of 1884 to 1947. The replies to that questionnaire, from 9,064 graduates of 1,000 colleges, resulted in a study published in 1952, *They Went to College.*

By using this questionnaire, it has been possible to compare Caltech graduates with the random cross-section of American college graduates studied in *They Went to College.* The column headed "Percent U. S." in the tabulation below gives the percentages for these 9,064 college graduates.

Out of a total of 5,647 questionnaires sent out, 3,800 were completed and returned. Because 130 of these were from members of the Alumni Association who had not received degrees from Caltech, they were discarded—leaving a net total of 3,670 for tabulation.

Since such a large number of questionnaires were returned, a difference of *one percent* in the survey figures is statistically significant—either in a Caltech-U. S. comparison, or between two different Caltech percentages.

The figures below are just the bare bones of the Caltech alumni survey. In future issues of *Engineering and Science*, Dr. John R. Weir, Associate in Psychology at the Institute, and the man responsible for this survey, will clarify, interpret and explain various aspects of these tabulated percentages.

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| | | Percent Caltech | Percent U. S. |
|---|---|---|---|
| **From what high school did you graduate?** | | | |
| Southern California | | 53 | |
| Rest of California | | 7 | |
| Rest of West | | 10 | |
| East | | 8 | |
| South | | 6 | |
| Foreign | | 4 | |
| **Please give us your college record (highest degree earned)** | | | |
| Bachelor's from Caltech | | 45 | |
| Master's—Caltech (2/5 Caltech B.S.) | | 26 | |
| Master's—non-Caltech (all Caltech B.S.) | | 6 | |
| Engineer's—Caltech (1/4 Caltech B.S.) | | 3 | |
| Engineer's—non-Caltech (5/6 Caltech B.S.) | | .3 | |
| Doctorate—Caltech (1/4 Caltech B.S.) | | 14 | |
| Doctorate—non-Caltech (3/4 Caltech B.S.) | | 6 | |
| **Undergraduate major** | | | |
| Biology | 2 | | |
| Chem. & Biochemistry | 9 | | |
| Geology & Geophys. | 5 | | |
| Math. & Astronomy | 3 | | |
| Physics & App. Phys. | 11 | | |
| Chem. Eng. & Applied Chem. | 8 | | |
| Civil Engineering | 12 | | |
| Electrical Engineering | 19 | | |
| Mechanical Engineering | 29 | | |
| Engineering | | 68 | 47 |
| Science | | 30 | 53 |
| Military | | 2 | |

| | Percent Caltech | Percent U. S. |
|---|---|---|
| **Graduate major** | | |
| Aeronautics | 18 | |
| Astronomy & Astrophysics | .3 | |
| Biology | 2 | |
| Chemistry | 10 | |
| Chemical Engineering & Applied Chemistry | 5 | |
| Civil Engineering | 7 | |
| Electrical Engineering | 14 | |
| Geology | 6 | |
| Geophysics | 1 | |
| Mathematics | 2 | |
| Mechanical Engineering | 10 | |
| Meterology | 5 | |
| Physics & Applied Physics | 12 | |
| Business Administration | 2 | |
| Law | 2 | |
| Medicine | 1 | |
| Humanities | .2 | |
| Other, such as social sciences | 3 | |
| **Year of bachelor's degree** | | |
| '96 to '19 | 1.6 | 14.4 |
| '20 to '29 | 14.1 | 20.0 |
| '30 to '39 | 27 | 34.4 |
| '40 to '47 | 35.6 | 31.2 |
| '48 to '52 | 21.7 | — |
| **Year of highest degree** | | |
| '96 to '24 | 5 | |
| '25 to '29 | 6.4 | |
| '30 to '34 | 10.4 | |
| '35 to '39 | 12.8 | |
| '40 to '44 | 15.6 | |
| '45 to '49 | 26.5 | |
| '50 to '52 | 23.3 | |

| | Percent Caltech | Percent U. S. |
|---|---|---|
| **In the light of your post-college experience, and if you had it to do over again, would you attend the same college?** | | |
| Yes | 88 | 81 |
| No | 12 | 19 |
| **Do you now feel satisfied with your selection of a major subject when in college?** | | |
| Yes | 85 | 75 |
| Wish you had chosen another major? | 15 | 25 |
| **Did you have a job while attending college?** | | |
| No | 4 | 29 |
| Yes, both summers and school term | 59 | |
| Yes, summers only | 28 | |
| Yes, school term only | 5 | |
| In military service at time of college | 4 | |
| **What proportion of your total expenses did you earn yourself?** | | |
| Less than 25% | 39 | 42 |
| 25 to 50% | 26 | 20 |
| 50 to 75% | 14 | 14 |
| 75 to 100% | 4 | |
| In military service at time of college | 4 | |
| **Did you have a scholarship at any time while in college?** | | |
| No | 58 | |
| Under $100 | 2 | |
| $100 to $300 | 15 | |
| $300 to $500 | 8 | |
| Over $500 | 11 | |
| In military service at time of college, or G. I. bill | 6 | |
| **Number of extra-curricular activities** | | |
| None | 13 | |
| One | 26 | |
| Two | 27 | |
| Three | 18 | |
| Four or more | 16 | |
| **Were these activities of value after college?** | | |
| Of those who participated, | | |
| Yes | 68 | |
| No | 32 | |
| Of those who did not participate, | | |
| Would, if went again | 50 | |
| Would not, if went again | 50 | |
| **What specific occupation did you when in college plan to follow; have followed during most of adult life; might follow in future?** | | |
| All same field | 84 | 80 |
| Adult life same as college, future different | 3 | |
| Adult life different, future same | 1 | |
| Adult life and future different from college | 12 | |
| **In your present job, do you consider yourself** | | |
| More successful than the average | 69 | |
| As successful as the average | 29 | |
| Less successful than the average | 2 | |



| | Percent Caltech | Percent U. S. |
|---|---|---|
| **Did your parents attend college?** | | |
| Both yes | 25 | 11 |
| Both no | 49 | 68 |
| Father yes, mother no | 18 | 15 |
| Mother yes, father no | 8 | 6 |
| **Does (or did) your father vote mostly** | | |
| Republican | 56 | 56 |
| Democratic | 27 | 44 |
| Don't know | 17 | |
| **Do you consider yourself** | | |
| Republican | 56 | 37 |
| Democrat | 12 | 23 |
| Other party | .1 | .4 |
| Independent | 32 | 38 |
| **As you feel now, how will you most likely vote in the 1952 election?** | | |
| Democratic | 13 | |
| Republican | 76 | |
| Other party | .2 | |
| Depends | 11 | |
| **Number of civic activities** | | |
| None | 2 | |
| One | 6 | |
| Two | 17 | |
| Three | 22 | |
| Four | 16 | |
| Five | 11 | |
| Six | 8 | |
| Seven or more | 18 | 30 |
| **What one does with his life is not very important, except to oneself.** | | |
| Agree | 7 | |
| Disagree | 91 | |
| No opinion | 2 | |
| **Religion has *little* to offer *intelligent, scientific* people today.** | | |
| Agree | 21 | |
| Disagree | 65 | |
| No opinion | 14 | |
| **When the public is really concerned about an issue, its *judgment is usually correct and unassailable, no* matter how complex the issue.** | | |
| Agree | 17 | |
| Disagree | 77 | |
| No opinion | 6 | |
| **The best government is one which governs least.** | | |
| Agree | 60 | 52 |
| Disagree | 32 | 35 |
| No opinion | 8 | 13 |
| **Democracy depends fundamentally on the existence of free business enterprise.** | | |
| Agree | 71 | 72 |
| Disagree | 23 | 18 |
| No opinion | 6 | 10 |
| **Government *planning* should be *strictly limited, for it* almost *inevitably* results in the loss of essential liberties and freedom.** | | |
| Agree | 65 | 51 |
| Disagree | 28 | 36 |
| No opinion | 7 | 13 |

**Individual liberty and justice under law are not possible in Socialist countries.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 36 | 46 |
| Disagree | 50 | 33 |
| No opinion | 14 | 21 |

**We are not likely to have lasting peace until the U. S. and its allies are stronger than all the other countries.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 47 | 40 |
| Disagree | 41 | 48 |
| No opinion | 12 | 12 |

**If we lower our tariffs to permit more foreign goods in this country, we will lower our standard of living.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 9 | 20 |
| Disagree | 82 | 65 |
| No opinion | 9 | 15 |

**Deep idealogical differences between countries are irreconcilable.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 19 | 26 |
| Disagree | 71 | 58 |
| No opinion | 10 | 16 |

**If we allow more immigrants into this country, we will lower our standard of culture.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 7 | 19 |
| Disagree | 84 | 69 |
| No opinion | 9 | 12 |

**The United Nations should have the right to make conclusions which would bind members to a course of action.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 66 | 78 |
| Disagree | 22 | 10 |
| No opinion | 12 | 12 |

**Over the next decade, we must try to make the standard of living in the rest of the world rise more rapidly than in our own country.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 56 | 58 |
| Disagree | 29 | 27 |
| No opinion | 15 | 15 |

**All Americans—Negroes, Jews, the foreign born, and others—should have equal opportunity in social, economic and political affairs.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 92 | 80 |
| Disagree | 5 | 13 |
| No opinion | 3 | 7 |

**Foreigners usually have peculiar and annoying habits.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 10 | 18 |
| Disagree | 80 | 68 |
| No opinion | 10 | 14 |

**Children of minority groups or other races should play among themselves.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 4 | 7 |
| Disagree | 91 | 86 |
| No opinion | 5 | 7 |

**Agitators and trouble-makers are more likely to be foreign born citizens than native Americans.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 15 | 32 |
| Disagree | 68 | 53 |
| No opinion | 17 | 15 |

**There are many worthwhile and important concepts which cannot be proved scientifically.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 79 | |
| Disagree | 11 | |
| No opinion | 10 | |

**The harnessing of atomic energy will bring about fundamental changes in our economic and social order.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 61 | |
| Disagree | 30 | |
| No opinion | 9 | |

**The government should promote and subsidize research in the social sciences.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 42 | |
| Disagree | 43 | |
| No opinion | 15 | |

**There will be as many or more scientific discoveries, inventions and technological changes in the world during the next fifty years as there were during the past fifty years.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 91 | |
| Disagree | 4 | |
| No opinion | 5 | |

**We now have enough scientific and technical knowledge to substantially eliminate poverty, disease and ignorance in the world, if we would apply our knowledge.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 62 | |
| Disagree | 29 | |
| No opinion | 9 | |

**The government should promote and subsidize research in the physical and biological sciences.**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Agree | 50 | |
| Disagree | 39 | |
| No opinion | 11 | |

**Do you now go to church**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Every week | 13 | |
| Pretty regularly, but not every week | 16 | |
| A few times a year | 21 | |
| Rarely | 26 | |
| Not at all | 24 | |

**Were you brought up as a**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Protestant | 84 | |
| Catholic | 7 | |
| Jew | 5 | |
| Other | 4 | |

**Is your age**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| Under 30 years | 32) | |
| 30 to 39 years | 40) | 60 |
| 40 to 49 years | 20 | 21 |
| 50 and over | 8 | 19 |

**Is the place where you were born**

| | Percent Caltech | Percent U. S. |
|---|---|---|
| A farm | 9 | |
| A small town (2,500 pop.) | 15 | |
| A small city (25,000 pop.) | 19 | |
| A medium city (100,000 pop.) | 19 | |
| A big city (500,000 pop.) | 14 | |
| A metropolis (over 500,000 pop.) | 24 | |

| | Percent Caltech | Percent U. S. |
|---|---|---|
| **Is the place where you spent most of your pre-college years** | | |
| A farm | 6 | 10 |
| A small town | 11 | 20 |
| A small city | 22 | 24 |
| A medium city | 22 | 17 |
| A big city | 14 | 12 |
| A metropolis | 25 | 17 |
| **Is the place where you spent most of your post-college years** | | |
| A farm | .5 | |
| A small town | 3 | |
| A small city | 15 | |
| A medium city | 24 | |
| A big city | 18 | |
| A metropolis | 39 | |
| **Is the place where you are living now** | | |
| A farm | 1 | 3 |
| A small town | 4 | 14 |
| A small city | 18 | 22 |
| A medium city | 21 | 18 |
| A big city | 18 | 16 |
| A metropolis | 38 | 27 |
| **Is the place where you were born** | | |
| In California | 35 | |
| In the West | 13 | |
| In the Midwest | 23 | |
| In the East | 13 | |
| In the South | 8 | |
| Foreign | 7 | |
| Possessions | 1 | |
| **Is the place where you spent most of your pre-college years** | | |
| In California | 56) | |
| In the West | 10) | 10 |
| In the Midwest | 14 | 34 |
| In the East | 9 | 36 |
| In the South | 6 | 20 |
| Foreign | 4 | |
| Possessions | 1 | |
| **Is the place where you have spent most of your post-college years** | | |
| In California | 70 | |
| In the West | 4 | |
| In the Midwest | 6 | |
| In the East | 11 | |
| In the South | 6 | |
| Foreign | 2 | |
| Possessions | .4 | |
| **Is the place where you are living now** | | |
| In California | 64 | |
| In the West | 6 | |
| In the Midwest | 7 | |
| In the East | 11 | |
| In the South | 9 | |
| Foreign | 2 | |
| Possessions | 1 | |

| | Percent Caltech | Percent U. S. |
|---|---|---|
| **Were your college undergraduate grades** | | |
| Mostly As | 22 | |
| Mostly Bs | 50 | |
| Mostly Cs | 28 | |
| Mostly Ds (1 individual) | 0 | |
| **Income from occupation** | | |
| Less than $1,000 | 4.2 | |
| $1,000 to $5,000 | 13.6 | |
| $5,000 to $7,000 | 27.7 | |
| $7,000 to $9,000 | 25.4 | |
| $9,000 to $19,000 | 26.2 | |
| $19,000 and over | 2.9 | |
| **Income from consulting fees** | | |
| None | 88.7 | |
| $100 to $500 | .6 | |
| $500 to $900 | 1.8 | |
| $1,000 to $5,000 | 5.0 | |
| $5,000 to $100,000 | 1.9 | |
| **Income from other sources** | | |
| Under $1,000 | 87.1 | |
| $1,000 to $2,000 | 9.3 | |
| $2,000 to $6,000 | 9.4 | |
| $6,000 to $50,000 | 3.2 | |
| **Total income** | | |
| Under $5,000 | 12.4 | |
| $5,000 to $8,000 | 37.2 | |
| $8,000 to $11,000 | 29.1 | |
| $11,000 to over $100,000 | 21.3 | |

| | Percent Caltech | Percent '37 Survey* |
|---|---|---|
| **Occupational fields** | | |
| Research & development | 29.6 | 15 |
| Administration | 14.8 | 2 |
| Design | 10.9 | 14 |
| Teaching | 8.8 | 6 |
| Production & operation | 5.1 | 6 |
| Military | 5.1 | ** |
| Construction & maintenance | 4.9 | 6 |
| Student | 3.3 | ** |
| Selling & advertising | 3.0 | 3.5 |
| Field Work | 2.2 | 13 |
| Consulting | 2.0 | ** |
| Laboratory | 1.7 | 14 |
| Law | .7 | .5 |
| Insurance | .6 | 1 |
| Medicine | .4 | ** |
| Statistics | .4 | 1 |
| Accounting | .3 | 1 |
| Finance | .1 | 1 |
| Other | 6.1 | 16 |
| **How many people directly or indirectly are responsible to you** | | |
| None | 20 | |
| 1 through 5 | 28 | |
| 6 through 19 | 22 | |
| 20 through 199 | 23 | |
| 200 and over | 7 | |

* 1937 survey of Caltech alumni
** Not tabulated

# A CARICATURE OF SIR JOHN LESLIE

by E. C. WATSON

DEMONSTRATION OR CAUSE & EFFECT.

Sir John Leslie (1766-1832), Professor of Natural Philosophy in the University of Edinburgh, is remembered nowadays primarily for his invention and application of the differential thermometer and his discoveries in the field of heat radiation. Physics teachers should think of him, however, whenever they repeat the experiment of freezing water with a vacuum pump using sulfuric acid to remove the water vapor—for it is to him that this well-known experiment is due.

The amusing caricature of Leslie above was sketched by John Kay (1742-1826), the self-taught Scottish etcher, who from 1785 until his death produced nearly 900 plates of the oddities and celebrities of Edinburgh. Almost every notable Scotsman of the period, with the exception of Burns, was represented, and the etchings, while not entitled to high rank as works of art, possess a certain quaint originality as well as considerable fidelity as likenesses.

Kay's work was collected and published in two volumes after his death. The curious biographical notes that accompany the etchings were started by Kay, but were completed after his death by James Paterson, author of *The History of the County of Ayr,* aided by David Laing, Alexander Smellie, and other antiquarians.

"The character of Sir John," according to the biographical notes on Leslie, "has been subject to some little stricture. All have admired the inventive fertility of his genius—his extensive knowledge and vigorous mind. As a writer, however, his style has been criticised; and he has been accused as somewhat illiberal in his estimate of kindred merit, while he is represented to have been credulous in matters of common life, and sceptical in science. 'His faults,' says his biographer, 'were far more than compensated by his many good qualities—by his constant equanimity, his cheerfulness, his simplicity of character, almost infantine, his straight-forwardness, his perfect freedom from affectation and, above all, his unconquerable good nature. He was, indeed, one of the most placable of human beings; and if, as has been thought, he generally had a steady eye, in his worldly course, to his own interest, it cannot be denied that he was, notwithstanding, a warm and good friend, and a relation on whose affectionate assistance a firm reliance could ever be placed.' In this character we are disposed to concur. One slight blemish, however, has been overlooked—personal vanity; for, strange to say, although in the eyes of others the worthy knight was very far from an Adonis, yet in his own estimation he was a perfect model of male beauty.

"The general appearance of Sir John is well represented in the print which precedes this notice. He was short and corpulent—of a florid complexion—and his front teeth projected considerably. What the natural color of his hair may have been we cannot say; but in consequence of the use of some tincture—Tyrian dye it is said—it generally appeared somewhat of a purple hue. In later life, his corpulence increased;* he walked with difficulty; and he became rather slovenly in his mode of dress—a circumstance the more surprising, as his anxiety to be thought young and engaging continued undiminished."

* "When unbending his mind from severer labours, the knight resorted to Apicius; and to his success in reducing to practice the gastronomical propositions of that interesting writer has been ascribed his somewhat remarkable exuberance of abdomen. A legal friend, now, alas! no more, once witnessed an amicable contest between Sir John and an eminent individual, celebrated for his taste in *re culinaria.* The latter was invincible in the turtle soup and cold punch, but the former carried all before him when the 'sweets' were placed on the table. To show how easily the victory was won, besides other fruits produced with dessert, the knight, without any effort, devoured nearly a couple of pounds of almonds and raisins."

# HOW PLANTS TELL TIME

**Caltech biologists develop a new concept of the roles played by light and darkness in plant growth**

TWO CALTECH BIOLOGISTS have developed a new concept of the roles played by light and darkness in plant growth which explains how plants tell time.

Drs. James Liverman, Research Fellow in Biology, and James Bonner, Professor of Biology, reported on their work, supported by the National Science Foundation and the Lederle Laboratories Division of the American Cyanamid Company, at a meeting of the American Institute of Biological Sciences at the University of Wisconsin last month.

They found that red light activates a particular protein in plant tissue, enabling it to combine with the essential plant hormone, auxin, to produce growth. It was already an established fact that both the protein (whose chemical composition is now being studied) and auxin are needed for growth; but it had never been clear before which of these was affected by light.

The researchers also found that the effect of red light can be reversed quickly by exposure to infra-red light or, less quickly, by darkness. Infra-red light and darkness, they believe, inhibit growth by breaking apart the auxin-protein combination and de-activating the protein.

These findings suggest the following "growth cycle": Inactive protein is activated by the red component of sunlight and combines with auxin to form a growth-producing compound. In darkness this combination slowly splits apart and the protein must again be activated by red light before the growth compound can be formed.

Further experiments have indicated that this same cycle applies to seed germination, leaf expansion and the initiation of flowering, as well as to growth. Thus, one simple mechanism forms the basis for an understanding of four previously unrelated processes.

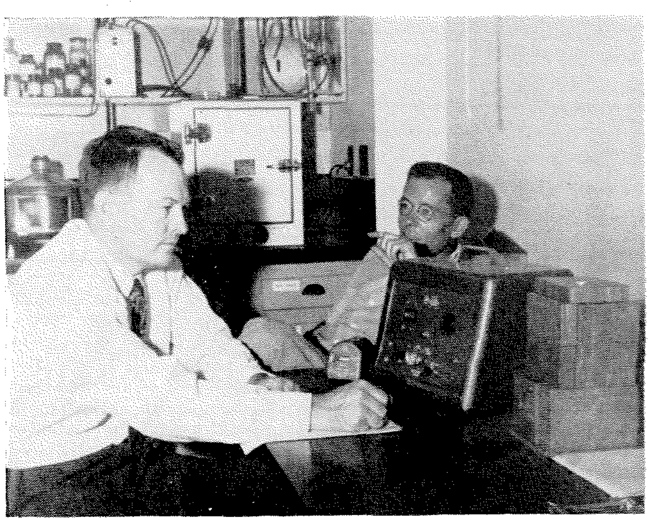
The relation of this mechanism to the "time-telling" activities of plants may be illustrated by flowering, one of many phenomena influenced by light and darkness. Relative day and night length controls the flowering of many plants. Cocklebur, ragweed and poinsettia, for example, grow vegetatively during summer when nights are short, and flower only after one or more long nights in fall.

During the day—on the basis of the proposed growth cycle—the plants accumulate a large store of the auxin-protein growth compound. Some of this compound is destroyed at night, but after a short night enough remains unaffected so that growth continues.

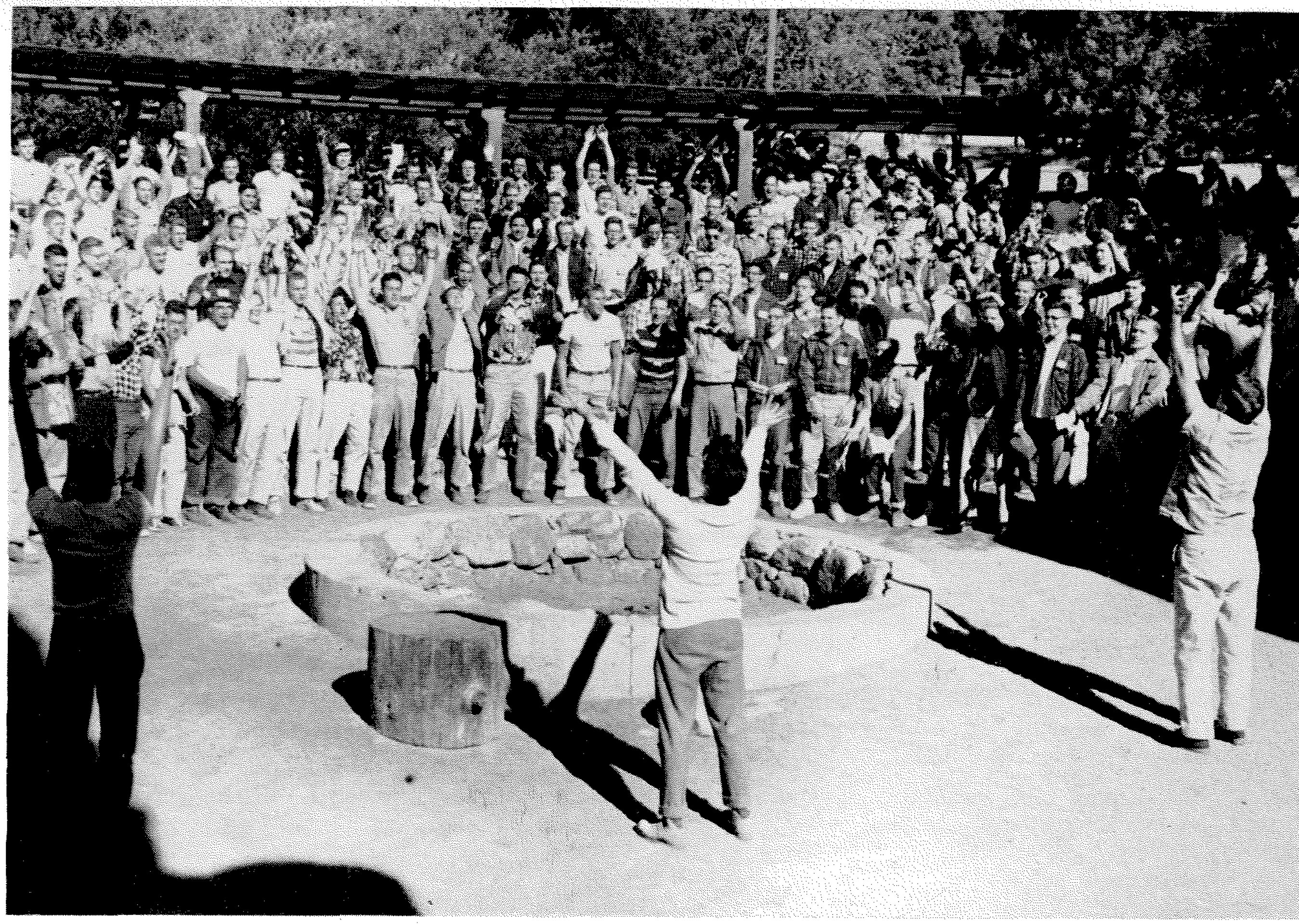
As the nights get longer, more of the compound decays. Eventually a night length is reached during which the amount drops below a critical level. One such night is enough to stop vegetative growth of the cocklebur and to start the plant producing a hormone that causes flower buds to appear. Other plants require two or more long nights before such reactions occur.

In their growth experiments the Caltech scientists used auxin-free sections of oat leaf-sheaths cut from below the tips, which produce the growth hormone. Some of the sections were given auxin and left in darkness, without exposure to red light. These grew very slowly. Others were given auxin before being exposed to red light and some after. All these sections grew rapidly. The scientists concluded that the light acted on the protein, because growth was subsequently stimulated even if the exposure occurred before the sections got auxin.

In similar experiments they found that infra-red light and darkness influenced neither the auxin alone nor the protein alone, but rather inhibited growth by acting on the auxin-protein combination.



*Drs. James Liverman and James Bonner counting a radioactive sample of auxin-protein complex.*



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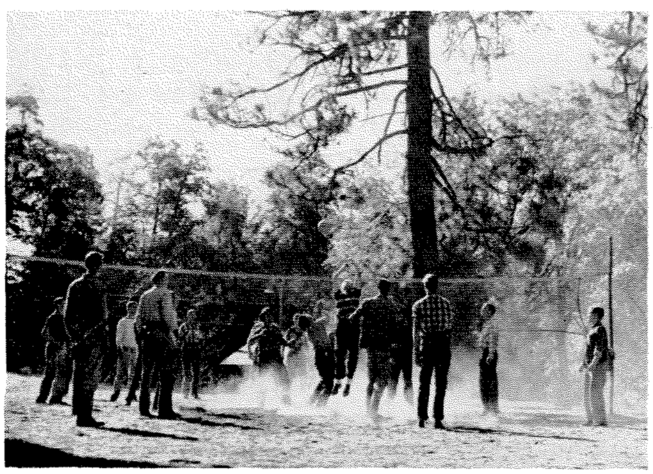
# FRESHMAN CAMP, 1953

## The class of 1957 signs in

THE ACADEMIC YEAR at Caltech always gets under way in the unacademic atmosphere of Camp Radford in the San Bernardino Mountains. There, for three days last month, the 159 new members of the class of 1957 got acquainted with Caltech's student body leaders, faculty, and each other. They played volleyball, football, baseball, ping-pong, and mountain golf. They sang. They cheered. And on top of all this they did their best to absorb a spate of speeches ranging all the way from "How to Study" to "Student Health—the Professors Ruin It, the Students Disregard It, the Health Center Salvages It." Some of this year's camp activities are pictured on the following pages.



*Above—Frozen action in a touch football game that had absolutely no frozen action.*

*Left—Volleyball games were continuous.*

*Below—But swimming in the mountain pool was strictly for the warm-blooded element.*

*Right — The class of '57 tries its pipes on the Caltech songs.*

*Below—Some campers get acquainted with President DuBridge.*

# THE SUMMER AT CALTECH

## Edwin P. Hubble 1889-1953

Dr. Edwin P. Hubble, 63, one of the world's leading astronomers, died of a stroke at his home in San Marino on September 28. His wife, the former Grace Burke, whom he married in 1924, survives.

Dr. Hubble joined the Mount Wilson Observatory in 1919 and at the time of his death was a staff member of the Mount Wilson and Palomar Observatories. He was recognized as a foremost authority on spiral nebulae and was noted for his determination of the nature and distance of these stellar systems beyond our Milky Way and for developing the law of red-shifts. That law has been taken to indicate that outlying stellar systems are receding at speeds increasing with their distance from the observer. It has generally been interpreted as meaning that the universe is expanding.

"Dr. Hubble's . . . observations with the 100-inch telescope during his first ten years at the Observatory completely revolutionized our ideas as to the extent of the universe," says Dr. Ira S. Bowen, Director of the Mount Wilson and Palomar Observatories.

"Before 1920 the universe was thought to consist of one great stellar system, the Milky Way. Hubble's studies, however, showed that our Milky Way system is but one of some hundreds of millions of such stellar systems which extend out to the extreme limit of observation of our largest telescopes.

"These discoveries emphasized the need of even greater telescopes and provided one of the chief reasons for the construction of the 200-inch telescope. Hubble assisted greatly in the design of this larger instrument and carried out the first observations with it. He has served on the Observatory Committee since the start of the joint operation of the Mt. Wilson and Palomar Observatories. His sound and effective advice concerning the operation of the Observatories will be greatly missed."

Born on November 20, 1889, in Marshfield, Missouri, Hubble was awarded the bachelor of science degree in 1910 at the University of Chicago, where he became interested in astronomy. He then studied law at Oxford University in England for two years as a Rhodes Scholar, receiving the degree of bachelor of arts in jurisprudence, and spent another year there as Rhodes Memorial Lecturer.

He was admitted to the bar in Louisville, Kentucky, in 1913 and practiced law for a year. However, his interest in astronomy was too strong to resist and he returned to the University of Chicago, where he received his Ph.D. in astronomy in 1917.

By then, however, he was already serving in the U. S. Army, where he completed his Ph.D. thesis as time permitted. He had enlisted in the first Officer Training Corps and during World War I rose from line officer to Major of Infantry with the A.E.F. in France.

After the war he joined the Mount Wilson Observatory, where he remained except for his service, from 1942 to 1945, as Chief of the Exterior Ballistics Branch of the Army Ordnance Ballistic Research Laboratory at Aberdeen Proving Ground, Maryland. He was awarded the Medal for Merit for his outstanding contributions to the war effort in 1946. In that year he also became consultant to the Ballistic Research Laboratory.

Dr. Hubble was active in the community as a trustee for the Huntington Library and as a member and past chairman of the Los Angeles Committee on Foreign Relations. He was an ardent dry fly fisherman and collector of original works important in the history of science.

He was the author of two books—"The Realm of the Nebulae," published in 1936, and "The Observational Approach to Cosmology," published in 1937—as well as numerous scientific papers.

His scientific contributions were recognized by many American and foreign universities and professional societies. He received honorary degrees from Oxford, Princeton and Brussels Universities, Occidental College and the University of California. His gold medals included the Barnard Medal, Bruce Medal, Franklin Medal and the Medal of the Royal Astronomical Society.

Said President DuBridge: "In the passing of Edwin Hubble the world has lost one of its greatest astronomers, and Pasadena has lost one of its greatest citizens. He will be missed by scientists the world over—most of all by his colleagues at Caltech, at the Mount Wilson and Palomar Observatories and the Huntington Library. To them he was not only a great scientist but also an irreplaceable friend."

*Sir Lawrence Bragg, Visiting Professor of Chemistry*

## Sir Lawrence Bragg

SIR LAWRENCE BRAGG, Nobel Laureate and co-founder of X-ray crystallography, and a dozen other British scientists participated in an informal conference on the structure of proteins at the Institute last month with leading American scientists in the field.

The conference of the select group of invited participants ran from September 21-25. It was made possible through support from the Rockefeller Foundation, the National Foundation for Infantile Paralysis, and the Office of Naval Research through the American Institute of Biological Sciences.

The conferees discussed informally all aspects of the application of X-ray techniques to the problem of protein structures. No formal papers were presented.

Arrangements for the meeting were made by Drs. Linus Pauling, Robert B. Corey and Edward W. Hughes of the Caltech Division of Chemistry and Chemical Engineering, one of the world centers of protein structure research. They and several of their colleagues have been engaged for some 15 years in intensive efforts to learn the molecular configuration of various proteins, essential constitutents of all living things. The research has resulted in the past two years in proposed structures for a number of proteins, among them those found in muscle, hair and fingernails.

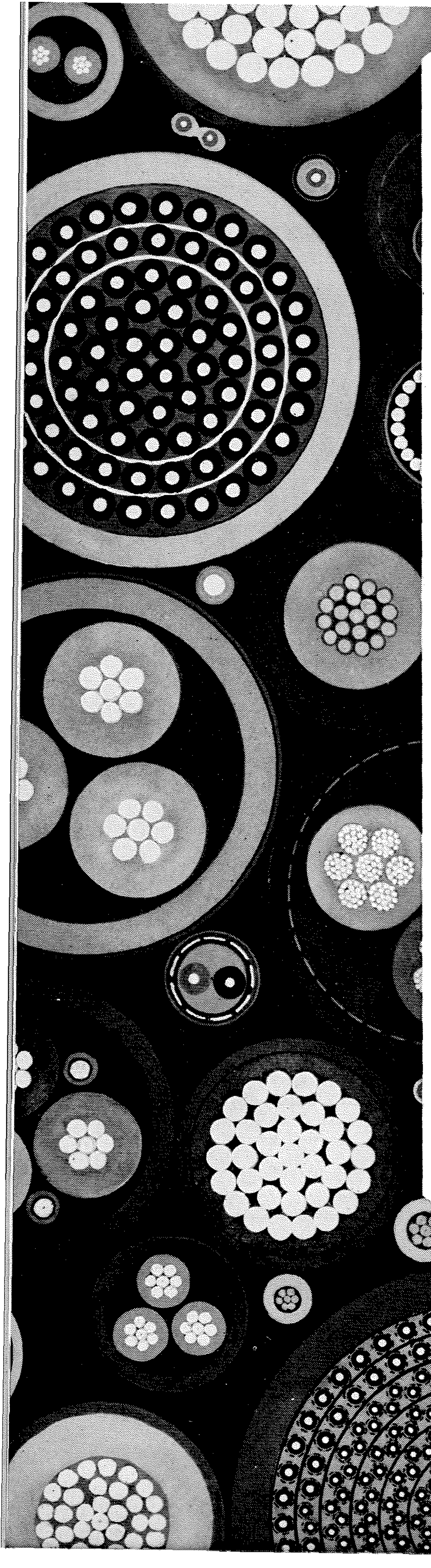
They have primarily been using modified methods of X-ray crystallography, a technique originally developed about 40 years ago by Sir Lawrence Bragg and his late father, Sir William Bragg, as a means of determining the position of atoms in crystals by the use of X-rays.

Sir Lawrence, Cavendish Professor of Experimental Physics at Cambridge University since 1938, recently was appointed Fullerian Professor at the British Royal Institution and will take up these duties January 1. He is acompanied on his visit to Pasadena by Lady Bragg.

After the conference, Sir Lawrence stayed on at Caltech as Visiting Professor of Chemistry to give a series of scientific lectures during the first two weeks of the first term.

A native of Adelaide, South Australia, he entered the University of Adelaide at the age of 15. Seven years later, in 1912, he was graduated from Cambridge University with first class honors in physics and began analyzing the patterns which Max von Laue of Germany reported were produced when X-rays struck crystalline materials. This work and parallel research by his father led to their development of a technique by which X-rays are used to determine the geometrical structure of crystals and to their election to share the 1915 Nobel Prize in physics when the younger Bragg was 25 years old.

By 1919 he was a full professor at the University of Manchester and two years later, at the age of 31, was elected to the Royal Society. He became director of the Cavendish Laboratory at Cambridge University



NO. 3 IN A SERIES

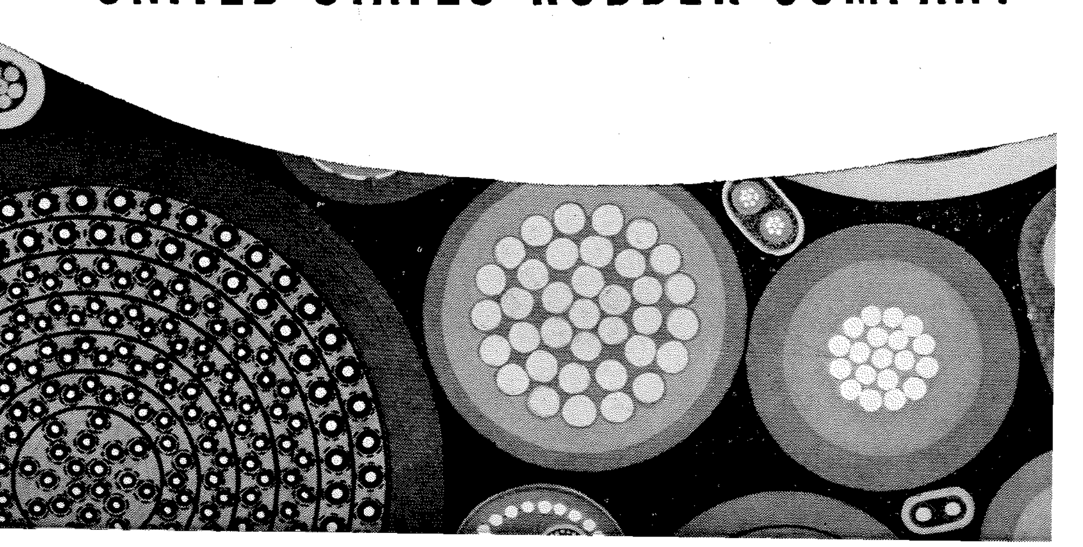
# The importance of insulations for

THE PURPOSE of electrical insulation is to offer resistance to the flow of electricity and thus to confine electrical potential to the conductor material throughout its length. An ideal insulating material would have infinite insulation resistance and voltage breakdown, a specific inductive capacity of 1 and zero power factor. In addition it would be flexible, physically strong and unaffected by abrading, cutting and impact forces, oxygen, ozone, acids, alkalies and water throughout a temperature range from minus 80 C. to the maximum operating temperature of copper. A conductor insulated with a thin wall of such a material would occupy minimum space and would operate indefinitely even at high voltages in the presence of any or all of the above destructive materials with no energy loss within the insulation. All available insulating materials fail to comply with the above ideal in practically every respect.

Insulations for use on electrical wires and cables which are subject to bending during manufacture, installation or use must have adequate flexibility. Flexible insulations for such uses are of two general classes, depending chiefly on the extent that they absorb or are affected by moisture. In one group are included the homogeneous rubber and rubber-like insulations, made from natural rubber or the synthetic rubbers, GR-S, butyl and silicone and thermoplastic insulations such as polyvinyl chloride compounds and polyethylene. Most of these are highly resistant to moisture. The other group consists of insulations built up of one or more layers of fibrous materials such as asbestos, cotton, varnished cambric, various synthetic fibers and paper. Even though these fibrous materials are impregnated with moisture-proofing materials such as paraffin, asphalts and oils, they readily absorb sufficient moisture in wet locations to completely lose their insulating properties. Such insulations must therefore be protected by a moisture-proof sheath such as lead when used in moist locations.

The insulations made from materials appearing in the first group fall into two general classes depending on whether or not they are vulcanized after application to the conductor, namely, (1) thermosetting insulations, those which are vulcanized and, (2) thermoplastic, those that are not vulcanized. Thermosetting insulations are those made from natural rubber, GR-S, butyl and silicone synthetic rubbers. Such insulations are applied to the conductor in a soft plastic condition and attain their ultimate physical properties as a result of a heat treatment (vulcanization) during which the sulfur or vulcanizing agents combine with the rubber. Thermoplastic insulations become plastic enough for application to the conductor simply by raising their temperature. They acquire their toughness again on cooling. From this it follows that thermosetting insulations are less subject to softening at elevated temperatures than thermoplastic insulations.

## UNITED STATES RUBBER COMPANY



# electrical wires and cables

Natural rubber, including Laytex®, GR-S synthetic rubber and thermoplastic insulations are available in two classes, depending on whether they are designed for use in dry or wet locations. Standard insulations, Type R and Laytex Type RU (made from rubber) and Type T (made from thermoplastic) are for use in dry locations while moisture-resistant insulations Types RW, RUW, and TW are for use in wet locations. There are many installations, particularly in buildings, where the less costly standard compounds give entirely satisfactory service.

Natural rubber and GR-S synthetic rubber insulations are also available in two classes depending on the operating temperature for which they are designed, namely, Type R and RW for 60 C. operation and Type RH and RUH for 75 C. operation. Conductors insulated with RH insulation carry more current, that is, use the conductor more efficiently than those insulated with Type R insulation. There is also available a combination insulation capable of operating at 60 C. in wet locations and 75 C. in dry locations. Butyl rubber insulation is suitable for operation at 80 C. and silicone rubber for even higher temperatures.

The thermoplastic insulations described above are limited to 600 volts for general power distribution. The rubber and rubber-like insulations are limited to a maximum operating voltage of 5000. For operation at higher voltages where ozone is produced in quantity, resistance to ozone in the insulation must be provided.

Acceptable ozone resistance in rubber and GR-S synthetic rubber insulations is provided by incorporating in them relatively high percentages of an inert or chemically saturated compound such as vulcanized vegetable oil. These are the so-called oil base compounds. Compounds made from butyl rubber are inherently ozone resistant. Oil base and butyl compounds are suitable for operation at a maximum voltage of about 28 KV, grounded neutral, when properly shielded.

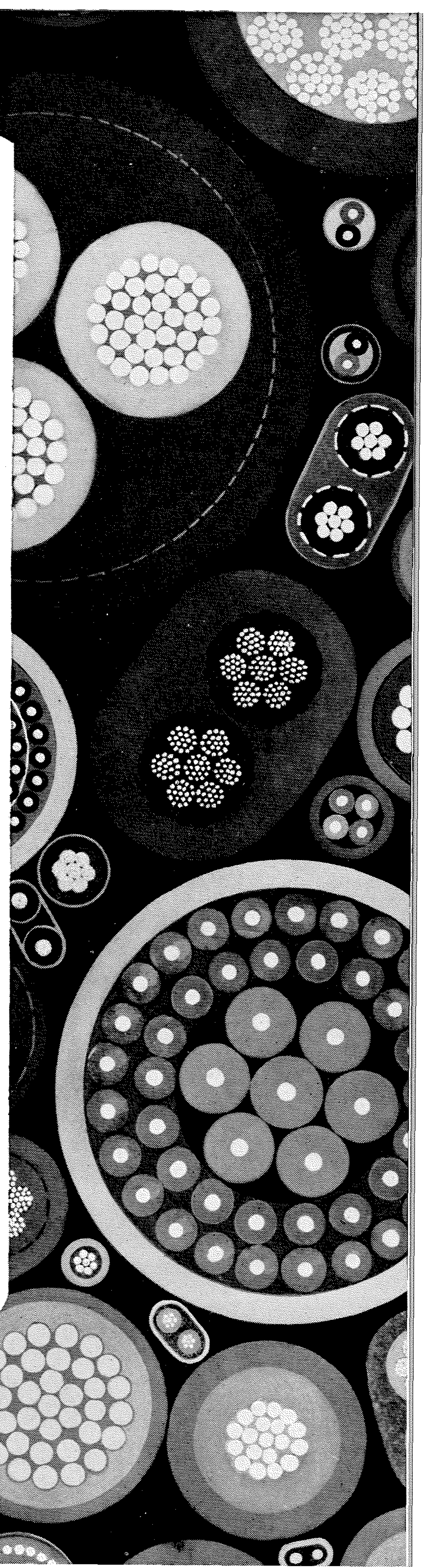
Varnished cambric insulated cables are generally used in the same voltage range as ozone resistant rubber, that is, at a maximum of 28 KV, grounded neutral, and at a maximum conductor temperature of 85 C. For use in wet locations varnished cambric cables must be covered with a lead sheath.

Impregnated paper-insulated, lead-covered cables are suitable for operation at voltages up to 69 KV at a maximum temperature of 85 C. Gas or oil filled paper insulated cables are suitable for higher voltage services at somewhat reduced temperatures.

Insulation thicknesses for all insulations depend on the rated voltage, the conductor size and type of insulation. Minimum insulation resistance and test voltages have been established for all classifications.

**For reprints of these pages write to address below.**

**Electrical Wire and Cable Department**
Rockefeller Center • New York 20, N. Y.



in 1938 and in 1941 was knighted in recognition for his scientific achievements. He has been awarded the Hughes and Royal medals of the Royal Society and the Roebling Medal of the Mineralogical Society of America in addition to receiving honorary degrees from ten leading universities.

## William N. Birchby 1877-1953

William N. Birchby, 76, who retired in 1952 as Assistant Professor of Mathematics after 34 years on the Caltech faculty, died on September 13 at his Altadena home. Survivors include his wife, Marjorie, and daughter, Mary Clare Birchby.

Born near Manchester, England, he came to the United States as a small boy. He was awarded the A.B. degree at Hope College, Holland, Michigan, in 1899, and the M.A. at Colorado College in 1905.

Before coming to Caltech in 1918 he was an instructor at Colorado College and a summer instructor at the University of Southern California. At Caltech he served as assistant registrar and on the committees on freshman registration and admission to upper classes.

Professor Birchby was an expert designer of mathematics examinations, and his programs for testing the knowledge of students were famous throughout the Institute. He has done research and written a number of papers in his field of mathematical analysis. At Colorado College he collaborated in work on the theory of equations.

## Faculty Changes

Additions to the Caltech faculty for the academic year 1953-54 include:

*John D. Roberts, Professor of Organic Chemistry (E&S*—March, 1953).

Lester Lees, Associate Professor of Aeronautics and Applied Mechanics (*E&S*—June, 1953).

James C. Davies, Assistant Professor of Political Science. Dr. Davies received his Ph.D. from the University of California at Berkeley in 1952, and has spent the last two years at the Survey Research Center at the University of Michigan, on a Carnegie Corporation fellowship. A specialist in public opinion research, he will teach a course in Political Behavior at Caltech as well as one in American History and Government.

Thomas M. Smith, Assistant Professor of the History of Science. Dr. Smith comes from the History of Science Department at the University of Wisconsin, where he has been completing his work for the Ph.D. He is a 1946 graduate of U.C.L.A.

L. G. Berry, Visiting Professor of Chemistry. Dr. Berry has a fellowship from the John Simon Guggenheim Memorial Foundation. He comes from Queen's University, Kingston, Ontario, Canada, where he is an Associate Professor.

Sir Lawrence Bragg, Visiting Professor of Chemistry. Sir Lawrence will be at Caltech only for one month, at the beginning of the first term (see p. 27).

Richard L. Greene, Visiting Professor of English. Dr. Greene is former President of Wells College in Aurora, New York.

George E. Hall, Visiting Professor of Chemistry. Dr. Hall holds a faculty fellowship from the Fund for the Advancement of Education. He is from Mt. Holyoke College in Massachusetts where he is an Associate Professor of Chemistry.

Terminations:

Albert G. Wilson, Staff Member of the Mount Wilson and Palomar Observatories, now Associate Director of the Lowell Observatory in Flagstaff, Arizona.

Howard J. Teas, Senior Research Fellow in Biology, now at the Federal Experiment Station of the U. S. Department of Agriculture in Mayaguez, Puerto Rico, working on the biochemistry of rubber formation.

John A. Schutz, Assistant Professor of History, now *a lecturer in history and political science at Whittier* College, Whittier, Calif.

Wilbur A. Varney, Assistant Professor of Mechanical Engineering.

On Leave of Absence, 1953-54:

Henry A. Dye, Instructor in Mathematics, to do research at the Institute for Advanced Study, Princeton, New Jersey.

Heinz Ellersieck, Instructor in History, to study in Scandinavia and Germany, on a fellowship from the *Fund for the Advancement of Education.*

Howard J. Lucas, Professor of Organic Chemistry, to be Visiting Professor of Organic Chemistry at the University of Hawaii for the first semester.

Henry Dan Piper, Assistant Professor of English, to teach American Literature at the University of Lille, France.

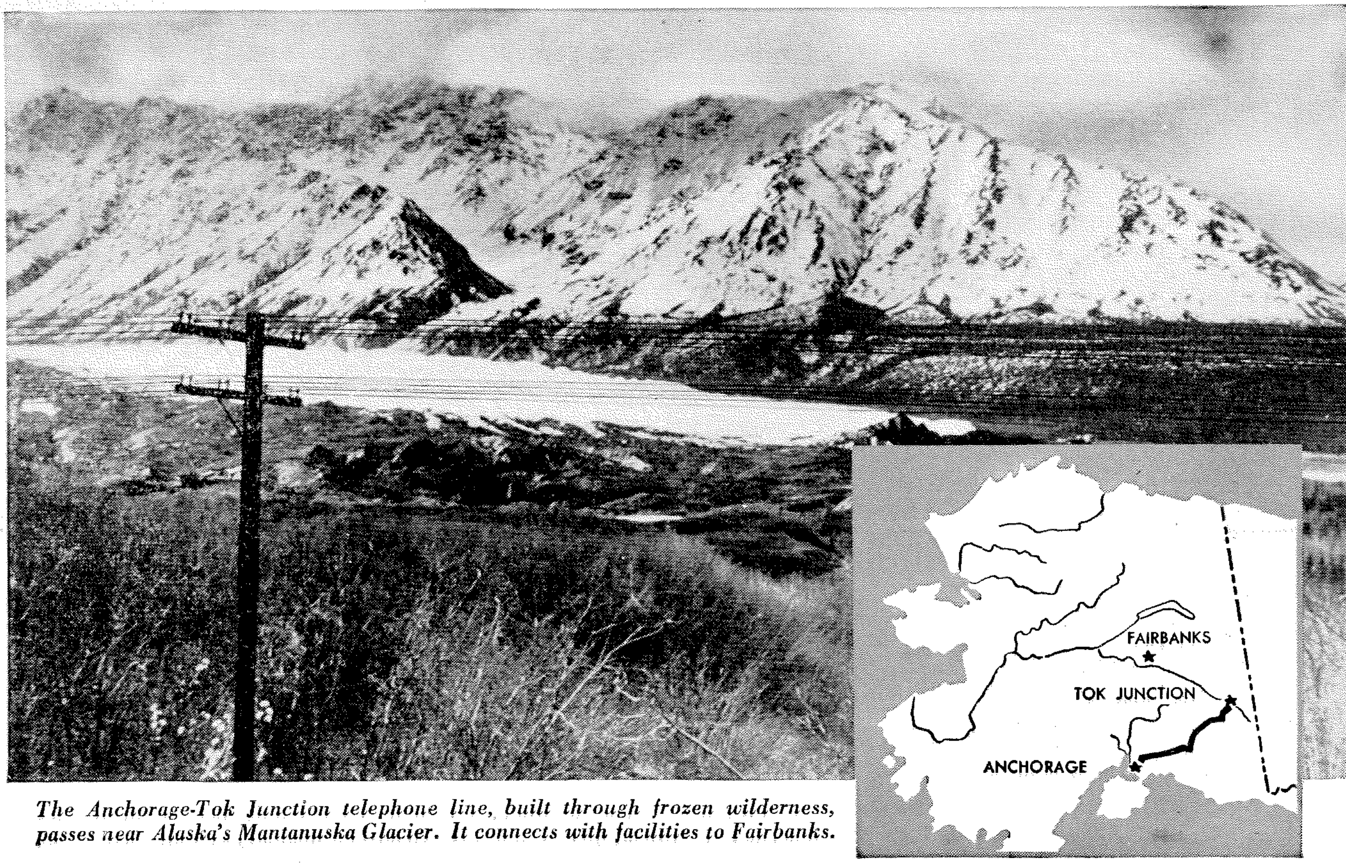
Harold Wayland, Associate Professor of Applied Mechanics, to study at the University of Strasbourg, France, on a Guggenheim Fellowship.

Returned from Leave of Absence:

J. B. Koepfli, Research Associate in Chemistry, after serving for two and a half years as Science Advisor to the Secretary of State.

Thomas Lauritsen, Associate Professor of Physics, from a year's study, on a Fulbright Award, at the Copenhagen Institute for Theoretical Physics.

Matthew Sands, Associate Professor of Physics, after




*The Anchorage-Tok Junction telephone line, built through frozen wilderness, passes near Alaska's Mantanuska Glacier. It connects with facilities to Fairbanks.*

# The line is through to Tok Junction, Alaska

**Ever hear of permafrost? It's sub-surface earth, permanently frozen hard as rock. But it was only one small problem in pushing through Alaska's newest telephone line**

As the nation's defense perimeter was pushed northward, it became plain that high-speed communications were needed for Alaska. The Army Signal Corps asked the Bell System to help build a modern telephone line for our strategic northern outpost. Today the line is a fact.

But the 330-mile route between Anchorage and Tok Junction on the Alcan Highway called for all the resourcefulness and skill of Bell System and Army engineers.

**What type of line?** Engineering studies and surveys proved that weather, expense and maintenance problems made it impractical for the new line to be aerial or buried cable or radio relay. The answer was open-wire pole line plus carrier equipment. But stringing this line through frozen wilderness was rough business.

The line had to cross two high mountain ranges. Average spacing between poles was 155 feet, but to bridge rivers, ravines and steep mountainside descents called for long-span crossings, ranging from 400 to 1800 feet.

Getting the right vehicles, tools, and materials to the right places when needed was a major feat of planning in this wilderness. The line called for 15,000 poles of varying lengths, 2500 crossarms, 1,325,000 pounds of copper-steel wire and 2400 tons of hardware.

**Dynamite licks permafrost.** Bulldozers, pole-hole diggers and big trucks battled their way over tortuous mountain roads. The simple process of setting poles proved almost impossible in some areas because of a volcanic silt hardened by permafrost. No drill was tough enough to withstand its pumice-like action. The problem was licked by punching holes and using small dynamite charges.

But now the work is done. Engineers have turned their talents to other parts of the vital communication system—building a long distance dial switching system between Anchorage and Fairbanks.

And so it is with the fast-growing telephone company. There always is a new frontier to conquer—in research, at the Bell Laboratories, in manufacturing at Western Electric, or in one of the operating companies serving the changing requirements of a constantly shifting population. Check now with your Placement Officer on the opportunities which await college engineers in the Bell System.

**BELL TELEPHONE SYSTEM**

# THE SUMMER . . . CONTINUED

ten months as a Research Scholar under the Fulbright program at the Institute of Physics of the University of Rome.

George K. Tanham, Assistant Professor of History, after a year's reading at Oxford, on a fellowship from the Fund for the Advancement of Education.

## Pure Chemistry Award

Dr. John D. Roberts, Professor of Organic Chemistry, has been named recipient of the 1954 American Chemical Society Award in pure chemistry. The $1,000 award, given annually to an outstanding young chemist in recognition of his contributions in fundamental research, will be presented at the spring meeting of the society in Kansas City.

Professor Roberts is the third member of the Caltech faculty to win the award in the past five years. Dr. Verner F. H. Schomaker, Professor of Chemistry, received it in 1950 and Dr. Harrison S. Brown, Professor of Geochemistry, in 1952. Professor Linus Pauling, Chairman of the Division of Chemistry and Chemical Engineering, received the first award in 1931.

Professor Roberts has conducted research in the field of physical organic chemistry since 1940. His chief investigations have dealt with theoretical organic chemistry, and he has conducted radioactive tracer research and studies on small-ring organic compounds and rearrangement reactions of organic compounds.

Dr. Roberts, who joined the Caltech faculty on July 1, was a John Simon Guggenheim Memorial Fellow last year, carrying on research at Caltech and in Europe on the theory of the structure of organic compounds.

## Lilly Award

Dr. Harvey A. Itano, Senior Research Fellow in Chemistry, was named recipient of the 1954 Eli Lilly and Company Award in biological chemistry at the annual meeting of the American Chemical Society in Chicago last month.

The $1,000 award is made in recognition of contributions to fundamental research in biological chemistry and is presented annually to an outstanding young American chemist.

Dr. Itano, who is a senior assistant surgeon of the National Cancer Institute of the National Institutes of Health, is assigned to the Gates and Crellin Laboratories of Chemistry at Caltech by the U. S. Public Health Service. He is engaged in research on the physical chemistry and inheritance of abnormal human hemoglobins, and has pursued studies on the problems and diagnosis of sickle cell anemia.

A graduate of the University of California, Dr. Itano received the M.D. degree from St. Louis University in 1945 and the Ph.D. degree from Caltech in 1950.

# ALUMNI NEWS

## Placement

During the year 1952-53, there were 326 jobs filled through the Caltech Placement Office. This figure includes 131 students in part-time work, 109 students in summer jobs, 61 seniors and graduate students in permanent employment, and 25 alumni in new positions.

Of the total number of men who received the B.S. degree, 53.4 percent went on to graduate work (slightly higher than last year's 43.6 percent). A larger proportion of the B.S. men went into military duty this year also—5.2 percent as against 1.6 percent last year.

Of the 50 men who received the B.S. degree and accepted employment, 78 percent went to work for industrial organizations, while 12 percent went with research organizations, and 10 percent with government agencies.

Of the 39 employed men who received the M.S. degree, 72 percent went into industry this year (as against 59 percent last year), 18 percent went into research, 10 percent into government agencies, and none into teaching. Last year 15 percent went into teaching.

Of the 52 employed Ph.D men, 38 percent went into research, another 38 percent into industry (23 percent last year), 12 percent into government (3 percent last year), 12 percent into teaching.

Salaries are still going up. The median salary accepted by B.S. men this year was $355 a month; $419 for M.S. men; $479 for the Engineer's degree men; $505 for Ph.D.'s.

The maximum salary for a man with a B.S. degree was in the field of mechanical engineering—about $645 a month; maximum for the M.S. degree was in aeronautical engineering—$755; maximum for the Engineer's degree was in mechanical engineering—$575; and for Ph.D.'s it was in physics—$805.

## Chapter Notes

The Northern California Chapter enjoyed its annual swimming party and picnic at Bob Bowman's ranch in Concord on September 5. About forty attended—including such old timers as Walter Jones and Eugene (Tule) Smith, who were among the organizers of the chapter. We were all pleased to see again the Fred Groats from the Sacramento Chapter and their guests, the Bob Sorensens. The weather was fine for swimming in the afternoon and cooled off to just the right temperature for poker playing and group singing in the evening.

*—Robert Heitz*

Thirteen members of the Chicago Chapter met for dinner at the Bismarck Hotel on September 9.

Much of the evening was devoted to planning a sparkling program for the chapter's fall meeting. All Chicago area alumni will be urged at that time to make every effort to attend what promises to be an outstanding affair.

*—Harrison C. Lingle*

# PERSONALS

## 1922

*John E. Shield*, consulting structural engineer, died on June 1, 1953 in Los Angeles. He was a past president of the Structural Engineers Association of Los Angeles and was formerly in charge of the Earthquake Strength Program for Tanks and Towers of the Board of Fire Underwriters of the Pacific. John served on active duty in the Corps of Engineers of the U. S. Army from January, 1941 to January, 1946 and was an honorary reserve officer in the Corps of Engineers with the rank of Lieutenant Colonel. He was also a director of the Caltech Alumni Association in 1939-40.

*Capt. Frederic A. Brossy*, Ex., is commander of naval air bases for the Eighth Naval District.

## 1926

*William A. Lewis*, Ph.D. '29, was recently elected to the Executive Committee of the Chicago section of the AIEE. He is also serving on the following national AIEE committees: power division, standards, research, protective devices and rotating machinery. The Lewises have a son, Alan Carver, born November 19, 1950; and a daughter, Ellen Elizabeth, born February 17, 1953.

## 1927

*Gustaf W. Hammar*, Ph.D., was recently honored for his research in physics with fellowship in the American Physical Society. He joined the Eastman Kodak Company in 1946, and is at present head of a research, development and engineering department of the Company's Navy Ordnance Division.

## 1930

*Truman H. Kuhn* took over the position of Graduate Dean at the Colorado School of Mines in Golden in September. He has been Professor of Geology and head of the mining geology option there since 1947.

## 1931

*Carl F. J. Overhage*, M.S. '34, Ph.D. '37, assistant director of Eastman Kodak's color technology division, was recently honored with fellowship in the American Physical Society. In 1948, Carl was awarded a presidential Certificate of Merit in recognition of his services at M.I.T.'s Radiation Laboratory. In 1951 he was appointed a member of the scientific advisory board of the Chief of Staff, U. S. Air Force.

*Glenn M. Webb* was appointed an assistant division director in the Whiting, Indiana, research laboratories of the Standard Oil Co. Glenn served as a research associate with Standard, starting in 1948, and earlier this year was promoted to section leader.

## 1933

*William W. Moore*, M.S. '34, addressed a dinner meeting of the Los Angeles Section of the American Society of Civil Engineers on September 9. Bill reported on his recent four-month trip to Pakistan, Iraq and India.

## 1934

*Nick Van Wingen* has gone to Turkey, where he will make an engineering evaluation of two oil fields for the Turkish government. He recently resigned as vice-president of Petroleum Technologists, Inc. and is now a consultant petroleum engineer with offices in South Pasadena.

*Garford G. Gordon* received his Ph.D. in applied physics from the University of Southern California in June.

*Carsten C. Steffens* has returned to the Stanford Research Institute as technical coordinator of the research division. He was assistant director of the Institute from 1947 to 1949, and for the past four years has been associate professor of chemistry at the University of New Mexico. In 1947 he helped initiate the SRI's study of smog in Los Angeles, and during the time he spent at the University of New Mexico he continued to serve as technical consultant to the Institute's air research laboratories. In his new position he will follow progress of all research groups and act as technical advisor on certain industrial projects.

## 1935

*James J. Halloran* is a partner in Electro Engineering Works in Oakland, Calif. He has been associated with the company since 1945.

*Bruce B. Gravitt* was named manager of General Electric's meter and time-switch sales in the company's meter and instrument department. Bruce was formerly a sales engineer in G.E.'s Los Angeles and San Diego offices. He moved to West Lynn, Mass., in 1951 as manager of instrument transformer sales.

## 1937

*Robert P. Bryson*, M.S., is still with the U. S. Geological Survey, Washington, D.C. He is currently chairman of the geologist staffing committee, charged with coordinating, selecting, and assigning geologists in the Survey. Bob is also secretary of the Geologist Society of Washington through 1954, and published "The Coalwood Coal Field, Powder River County, Montana" in the U. S. Geological Survey Bulletin 973-B last year. He and his family—wife and two children, Rob (4) and Belinda (6 months)—live in Arlington, Virginia.

## 1938

*John G. MacLean* has been teaching at the Harvard Business School and develop-

ing a new second-year course dealing with the management policies of industrial companies. He has also been doing research and writing in the field of business administration, and consulting work for industrial companies (primarily Continental Oil Co.) and various government organizations, such as the Naval Ordnance Test Station at Inyokern.

*John R. Woolson*, M.S. '41, has been working for the United Geophysical Company in Fairbanks, Alaska, for the past four years. He says—"We have been working for the Navy on the arctic slope of Alaska, attempting to help them find oil. This has involved many trips across the Arctic Circle, following easily the routes laid out with such difficulty by the explorers of 50 to 75 years ago. One flies almost any place one wishes to go in Alaska, so all of these trips have been by airplane." John has been married since 1942, and has three boys whose ages are five, seven, and nine.

*Sidney Bertram* joined the Rand Corporation in 1951, shortly after he completed work for a Ph.D. in physics at Ohio State University. Although his home is in Los Angeles, Sid has been on special assignment for Rand with the Lincoln Lab in Massachusetts. His wife and three boys (Irving, 7, Henry, 4, and Robert, 3) are enjoying the East.

*Carl Friend* is aerodynamics engineer at the Lockheed Aircraft Corporation in Marietta, Georgia. The facility is known as the U. S. Government Aircraft Plant No. 6 and is the largest airplane plant under one roof in the world. They are currently building B-47 medium bombers and tooling up for the C-130 medium transport. Carl is in charge of preliminary design, aerodynamics and related work.

*Carlton L. Horine* is at present in charge of the China Lake Pilot Plant Division and working on propellant and testing problems associated with such rockets as the 2.75-inch FFAR (Mighty Mouse). Although the Horines have been living in China Lake since 1945, they've been able to take several trips. Navy business takes Carlton to Washington several times a year; the whole family took a trip to Carlton's home town—Cristobal, in the Canal Zone—in 1946 by freighter via New Orleans; and he and his wife had a three-week trip to Belgium with a weekend in Paris and Amsterdam in August of 1951. The Horines have three children—a son 10, and two daughters 8 and 6.

***Harrison M. Lavender, Jr.*** is Assistant Chief Engineer at the California Research Corporation in Richmond, Calif. The report of his death, published last year in *E&S*, was, we are glad to say, highly exaggerated. Harrison's father died at that time.

## 1939

*Walter H. Munk*, M.S. '40, has been awarded a Guggenheim Fellowship in recognition of his work involving the effect of winds on ocean currents. He is currently an associate professor of geophysics at the Scripps Institution of Oceanography at La Jolla, where he received his doctor's degree in 1947.

## 1941

*John M. Richardson* is now a member of the technical staff of the Radar Laboratories of the Hughes Research and Development Laboratories in Culver City, Calif. He was formerly a research physicist at the U. S. Bureau of Mines.

*Col. John K. Arnold, Jr.*, M.S., was the command pilot of a B-29 type aircraft which was reported missing on January 12, 1953 on a combat mission over North Korea. No further information has been received as yet regarding his exact fate.

## 1942

*John R. Allan* is Hull Section Head at Todd Shipyards Corp. in San Pedro, Calif. The Allans have another son, Richard Bruce, one year old.

*S. Kendall Gold* writes that his second child, Virginia Ann, was born on April 15 in Rye, New York. Kendall is employed at the California-Texas Oil Co. in New York and is Secretary-Treasurer of the New York Alumni Chapter.

## 1943

*Fred H. Tenney* received his Ph.D. in physics from the University of Rochester and has a position as Instructor at Princeton for the coming year. The Tenneys have one son, Steven, now ten months old, and expect another child at Christmas time.

*William C. Thompson, Jr.* married Caroline Cralle on August 15. Caroline is a graduate of Stanford and also attended U.C.L.A. Bill is now employed as an electronics engineer at the Naval Ordnance Test Station in Pasadena.

*Arthur O. McCoubrey* received his Ph.D. in June from the University of Pittsburgh.

*Richard M. Sutton*, Ph.D. '47, taught a course in basic concepts in physics at the University of Delaware's summer session this year. He's Professor of Physics at Haverford College, Pa., and a visiting lecturer at the Case Institute of Technology.

### 1944

*Bob Freeman* has been working in the magnetic materials development group of the Digital Computer Laboratory at M.I.T. for the past year. The Freemans now have three sons—Jeff (5), Jim (3), and a recent arrival, John.

*Bert Golding*, M.S. '47, is still working in the research laboratory of the United Gas Corporation in Shreveport, Louisiana. He is now supervisor of the reservoir engineering section. He also teaches general chemistry and physical chemistry in night school at Centenary College. The Goldings have two boys, Bruce and Martin. Bert and his wife still spend much of their time trying to assist the spread of Unitarianism, and Bert is chairman of the Shreveport Fellowship.

*Fred W. Morris, Jr.* returned to California this summer after spending the past few years in New Jersey, where he was Chief of the Research Studies Section, Countermeasures Branch, of the Signal Corps Engineering Laboratories in Fort Monmouth. His new position is in the same field, this time participating with a contractor (Sylvania Electric Products) in the establishment of a wholly new laboratory—the Electronic Defense Laboratory in Mountain View, Calif. He represents the Chief Signal Officer in the technical direction of this activity.

*Thomas A. Carter* received an M.S. in mechanical engineering from the University of Southern California last June.

### 1946

*Cassius Richard McEwen* and his wife anounced the birth of a son, Todd Wells, on August 2, 1953.

*Lt. Col. John W. Barnes*, M.S., graduated from the Command and General Staff College at Fort Leavenworth, Kansas, and went to Korea in June. His wife, Mary, and three children are waiting for him in Washington, D.C.

*Willard A. Ross* was recently promoted to Lieutenant and given the new title of Shops Engineer for the Public Works Department at the Naval Station in Great Lakes, Illinois.

*Lt. Milton G. Webb* received a B.S. degree in engineering electronics from the U. S. Naval Postgraduate School in Monterey in June.

*Frederick C. Essig* received his Master of Science degree from U.S.C. in June.

### 1947

*John D. Holmgren* is now a member of the technical staff of the Radar Laboratory at the Hughes Research and Development Laboratories in Culver City, Calif.

*Lt. Cdr. Quentin R. Whitmore* reports that the Whitmore family now includes two boys and one girl—Bob, 7; Bev, 4; and Greg, 1.

*Capt. Spencer R. Baen*, M.S., Ph.D. '50, was assigned to Army Field Forces Board No. 2 at Fort Knox, Kentucky, after graduation from Tech. This is part of the Army's Development system. The Baen's third child, Peter Roe, was born in December, 1952. Spencer left Kentucky this summer to attend the Artillery Officers' Advanced Course at Fort Sill, Oklahoma until the spring of 1954.

*Richard L. Felberg* is now a registered electrical engineer and working at CWT. He has two daughters, and a third child is expected this month.

### 1948

*Byron L. Youtz* completed work for a Ph.D. in physics at the University of California at Berkeley in August, and left immediately for Beirut, Lebanon, where he is an assistant professor in the Physics Department at the American University of Beirut. His wife, Bernice, accompanied him.

*Julius Bendat* received his Ph.D. in mathematics last July from U.S.C., and is now engaged on special applied mathematical problems at Northrup Aircraft. The Bendats now have a year-old daughter to supplement the son born when Julius left Caltech in 1948.

*Colonel Harvey R. Fraser*, M.S., graduated from Command and General Staff College in Fort Leavenworth, Kansas, in June and is now Professor of Mechanics at the U. S. Military Academy.

*Lt. Col. Roy S. Kelley*, M.S., was assigned to the Far East Command after graduation from Command and General Staff College last June.

*Thomas G. Lang* received an M.S. in mechanical engineering from U.S.C. last June.

*Lothrop Mittenthal* received his M.S. from U.S.C. in June.

*Paul MacCready*, M.S., Ph.D. '52 won the national soaring championship on July 15 in a 104-mile hop from Elmira to Utica, New York.

### 1949

*Roy W. Gould* was awarded a Hughes Fellowship for study toward a Ph.D. in physics at Caltech, and will at the same time be associated with the microwave lab at the Hughes Research and Development Laboratories in Culver City, Calif.

*Lt. Col. Albert E. Saari*, M.S., has been serving with the Korean Military Advisory Group, comprised of U. S. person-

nel to advise the South Korean Army in training and in the field. Al is a veteran of 13 years Army service and holds the European-African-Middle Eastern Theater Ribbon with five campaign stars.

## 1950

*Roger A. Picciotto* received a Master's degree in industrial chemistry from M.I.T. in June, and has started work with Procter and Gamble in Cincinnati, Ohio.

*David B. MacKenzie,* who has been doing graduate work at Princeton for the past three years, completed his doctorate thesis last spring and expects to take his final oral examination in October. He has been working as a geologist with American Overseas Petroleum Ltd., a subsidiary of the California-Texas Oil Company in New York. Following a short training period in geophysics in California he will soon be sent overseas, destination unknown. He lists the following Tech graduates who will be returning to Princeton in the fall: *Don Baker* '50, *Manny Bass* '48, *Gene Shoemaker* '47, M.S. '48, *Tom Slodowski* '53, *Fred Eisen* '51 and *Jim Gerhart* '50.

*Albert Eschner, Jr.* received his M.S. degree in electrical engineering from U.S.C. last June.

## 1951

*E. B. Crichton* has accepted a job as instructor at Anatocia College in Thessaloniki, Greece. He took off for a stopover in Paris at the end of August.

*Charles Bates* married Nancy Lindheck at Jamestown, New York on June 27. *Phil Bates* '53 was best man. Charlie is still working at M.I.T., on an AEC contract, on cold sterilization of foods.

*Frank Hooper,* after two years in the Union Oil Company's sales training program, has been sent to their sales department headquarters in Balboa, Canal Zone. His wife, Claire, accompanied him.

*Nathan H. Koenig* wrote that he was busy putting in a California-style patio in a new home he bought in Denver this summer. He is now working in the Shell Development Company's Agricultural Research Division.

*Richard M. Libbey* received his commission in July at the U. S. Naval Officer Candidate School in Newport, Rhode Island.

*Reuben Kachadoorian* is an engineering geologist with the U. S. Geological Survey, working in cooperation with the Alaskan Road Commission, putting in a road from Paxton to Cantwell, Alaska.

## 1952

*Harry C. Hoyt,* Ph.D., is now on the staff of the Scientific Laboratory at Los Alamos, New Mexico.

*David L. Hanna* was one of a hand-picked group from Korean Communication Zone headquarters supervising prisoner of war exchange this summer in "Operation Big Switch" at Munsan.

*Peter Verdier* was married on May 29, and he and his wife are living in Cambridge while he continues his studies in chemistry at Harvard.

## 1953

*J. Morgan Ogilvie* is Deck Officer on the U. S. Coast and Geodetic Survey Ship *Cowie* out of Norfolk, Virginia.

*Arthur E. Britt* is now a member of the technical staff of the Hughes Research and Development Laboratories in Culver City.

*John D. Gee* is taking the Bethlehem Steel Corporation's Loop Course. This is an intensive indoctrination and training program for selected college graduates conducted from the company's headquarters in Bethlehem, Pa., preparatory to assignment in one of the firm's various operations on the West Coast.

# "Allis-Chalmers Graduate Training Course Was Just What I Needed,"

**says LOWELL E. ACKMANN**

*University of Illinois—B.S., E.E.—1944*
*and now manager, Peoria, Ill., Branch Office*

"MY EXPERIENCE with machinery in the Navy during the war convinced me I needed a training course. There was so much equipment on board that was a complete mystery to me that I became very 'training-course minded'.

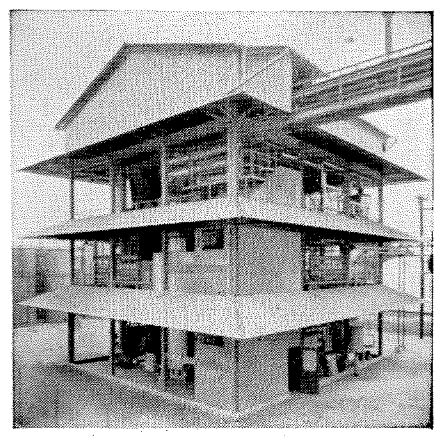
"After investigating many training courses, the one at Allis-Chalmers looked best to me then—and still does.

"In my opinion, the variety of equipment is what makes Allis-Chalmers such a good training spot.

"No matter what industry you may be interested in, Allis-Chalmers makes important, specialized equipment for that industry. Electric power, steel, cement, paper, rock products, and flour milling industries—to name a few, are big users of A-C equipment.

"Before starting on the Allis-Chalmers Graduate Training Course, I thought I would like selling, preferably technical selling but, as is often the case, I didn't know for sure. This course, together with some personal guidance, helped me make up my mind. That, too, is an important advantage of the GTC program.

"But whether you want to be a salesman or designer, production engineer, or research engineer, Allis-Chalmers, with its wide variety of equipment and jobs, is an ideal place to get off to a good start—without wasting time."



PROCESSING—Allis-Chalmers built solvent extraction plant processes one hundred tons of rice bran per day at oil processing plant in Texas.

## Facts You Should Know About the Allis-Chalmers Graduate Training Course

**1.** It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

**2.** The course offers a maximum of 24 months' training. Length and type of training is individually planned.

**3.** The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

**4.** He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control, pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

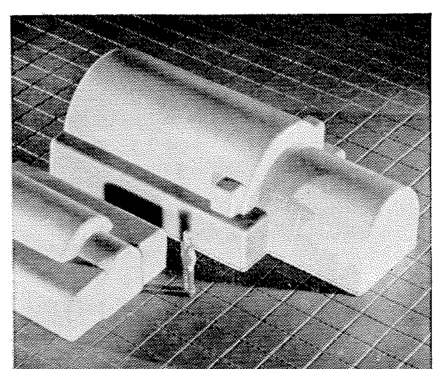
**5.** He will have individual attention and guidance in working out his training program.

**6.** The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

**7.** For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS** A-C

C-5676



POWER—Models show comparative size of generators having the same rating with and without super-charged hydrogen cooling. Allis-Chalmers is first to supply super-charged hydrogen cooling.

# ALUMNI FUND

## Report of the Sixth Year — 1952 - 1953

YOUR CALTECH ALUMNI Fund reached $167,455.28 on June 30, 1953. Of this, $38,727.17 was the result of the sixth year's efforts. A total of 1,172 alumni contributed $27,238.54 during this year. Special contributions and interest brought the fund to the above figure.

The alumni can well be proud of their achievement in creating this fund. It will be used by the Institute to build a swimming pool in Tournament Park. The pool will adjoin the gymnasium to be constructed as a result of the previously announced Scott Brown bequest. A ground-breaking ceremony for the alumni pool was held during the seminar on Saturday, April 11. Plans for the integrated athletic facilities are being prepared and construction is expected to start before the first of 1954.

The Alumni Association directors believe that the accomplishment of the first goal, a swimming pool, has shown the true potential of the Fund. We believe the Fund has strikingly demonstrated its ability to be a significant aid to the Institute, and to be an opportunity for all Tech men to make a lasting contribution to their Alma Mater.

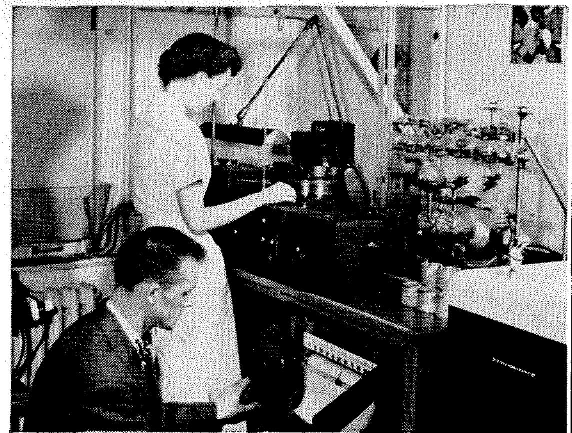
It has been decided that the next objective of the Alumni Fund will be the establishment of undergraduate scholarships on an endowment basis. We look forward to the time when each undergraduate class will have at least one member whose tuition is provided by a permanent Alumni Scholarship.

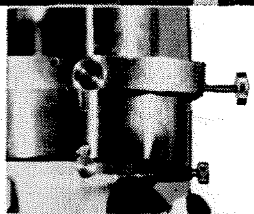
Undergraduate contributions received by the Fund during the last year are tabulated below. Class rankings are also shown. In the last two columns of the table shown below, the 40 classes are ranked according to the size of their average gifts and according to the percentage of each class that contributed. The names of all the 1952-53 contributors are listed on the following pages.

*—K. E. Kingman*
*Director in charge of the Alumni Fund*

**SIXTH YEAR—1952-53**
**(As of June 30th, 1953)**
**Alumni Who Took Undergraduate Work at C.I.T.**

| | | | | | | | Class Ranking | |
|---|---|---|---|---|---|---|---|---|
| Class | Amount | Number Giving | Number Eligible | Per Cent of Eligibles Giving | Average Gift | Median Gift | Average Gift | Per Cent of Eligibles Giving |
| Prior 1915 | $ 46.00 | 6 | 25 | 24.0 | $ 7.67 | $ 10.00 | 10 | 13 |
| 1915 | 20.00 | 2 | 8 | 25.0 | 10.00 | 10.00 | 14 | 5 |
| 1916 | 20.00 | 2 | 7 | 28.6 | 10.00 | 10.00 | 25 | 17 |
| 1917 | 50.00 | 2 | 9 | 22.2 | 25.00 | 25.00 | 15 | 7 |
| 1918 | 230.37 | 6 | 30 | 20.0 | 38.40 | 30.00 | 6 | 39 |
| 1919 | 0 | 0 | 3 | 0 | 0 | 0 | 38 | 38 |
| 1920 | 75.00 | 6 | 30 | 20.0 | 12.50 | 10.00 | 17 | 8 |
| 1921 | 1,140.00 | 14 | 34 | 41.2 | 81.43 | 22.50 | 4 | 11 |
| 1922 | 2,555.00 | 23 | 61 | 37.7 | 111.09 | 20.00 | 2 | 10 |
| 1923 | 202.50 | 14 | 49 | 28.6 | 14.46 | 10.00 | 1 | 12 |
| 1924 | 1,650.00 | 10 | 73 | 13.7 | 165.00 | 10.00 | 5 | 33 |
| 1925 | 833.00 | 24 | 78 | 30.8 | 34.71 | 15.00 | 7 | 14 |
| 1926 | 1,218.00 | 16 | 100 | 16.0 | 76.13 | 10.00 | 11 | 37 |
| 1927 | 248.00 | 20 | 89 | 22.5 | 12.40 | 10.00 | 23 | 25 |
| 1928 | 255.50 | 20 | 60 | 33.3 | 12.78 | 10.00 | 16 | 8 |
| 1929 | 302.00 | 17 | 84 | 20.2 | 17.76 | 10.00 | 12 | 27 |
| 1930 | 348.37 | 21 | 102 | 20.6 | 16.59 | 10.00 | 13 | 35 |
| 1931 | 4,887.50 | 23 | 97 | 23.7 | 212.50 | 10.00 | 3 | 31 |
| 1932 | 1,427.00 | 28 | 94 | 29.8 | 50.96 | 10.00 | 8 | 23 |
| 1933 | 258.00 | 16 | 93 | 17.2 | 16.13 | 10.00 | 20 | 32 |
| 1934 | 426.00 | 33 | 103 | 32.0 | 12.91 | 10.00 | 18 | 16 |
| 1935 | 414.00 | 27 | 110 | 24.5 | 15.33 | 10.00 | 19 | 28 |
| 1936 | 1,403.00 | 26 | 115 | 22.6 | 53.96 | 10.00 | 9 | 29 |
| 1937 | 200.00 | 15 | 112 | 13.4 | 13.33 | 10.00 | 29 | 33 |
| 1938 | 385.00 | 31 | 125 | 24.8 | 12.42 | 10.00 | 22 | 36 |
| 1939 | 312.50 | 29 | 112 | 25.9 | 10.78 | 10.00 | 30 | 19 |
| 1940 | 419.00 | 45 | 140 | 32.1 | 9.31 | 10.00 | 26 | 17 |
| 1941 | 295.00 | 31 | 128 | 24.2 | 9.52 | 10.00 | 21 | 24 |
| 1942 | 445.50 | 48 | 149 | 32.2 | 9.28 | 7.00 | 28 | 15 |
| 1943 | 473.00 | 48 | 124 | 38.7 | 9.85 | 10.00 | 24 | 6 |
| 1944 | 570.40 | 50 | 208 | 24.0 | 11.41 | 10.00 | 27 | 21 |
| 1945 | 458.51 | 34 | 190 | 17.9 | 13.49 | 10.00 | 31 | 26 |
| 1946 | 227.00 | 28 | 163 | 17.2 | 8.11 | 5.00 | 33 | 30 |
| 1947 | 291.00 | 33 | 144 | 22.9 | 8.82 | 5.00 | 32 | 22 |
| 1948 | 338.50 | 49 | 193 | 25.4 | 6.91 | 5.00 | 34 | 20 |
| 1949 | 402.00 | 64 | 212 | 30.2 | 6.28 | 5.00 | 35 | 1 |
| 1950 | 327.00 | 42 | 183 | 22.9 | 7.79 | 5.00 | 36 | 1 |
| 1951 | 309.41 | 47 | 159 | 29.6 | 6.58 | 5.00 | 37 | 1 |
| 1952 | 188.48 | 25 | 126 | 19.8 | 7.54 | 5.00 | 39 | 1 |
| TOTAL | $23,651.54 | 975 | 3922 | 24.9 | $ 24.26 | $ 10.00 | .... | .... |





Making an analysis with the infra-red Spectrophotometer.

Testing action of Perchlorethylene on various metals.

# COLUMBIA-SOUTHERN

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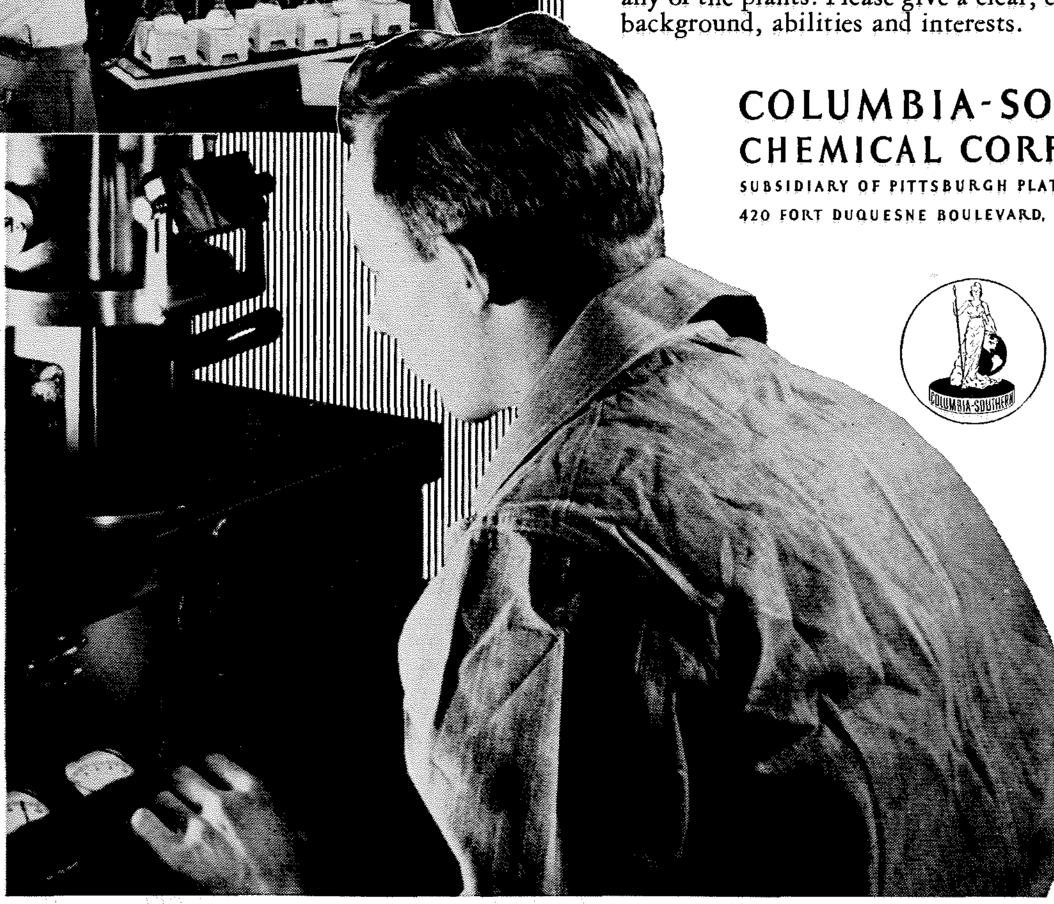

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Focusing the Electron Microscope on a chemical sample to be photographed.

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# CONTRIBUTORS TO THE ALUMNI FUND 1952 - 1953

**1896**
Haynes, Miss Diantha M.

**1900**
Harris, Irving C.

**1906**
Canterbury, H. H.

**1912**
Ferguson, Benjamin

**1913**
Parkinson, Ralph W.

**1914**
Morse, Virgil F.

**1915**
Holmes, William M.
Wilcox, Charles H.

**1916**
Allen, Robert N.
Chamberlain, Bernard

**1917**
Kensey, Alexander
Richards, Roy T.

**1918**
Andrews, Clark F.
Essick, L. F.
Hainsworth, Wm. R., M.S.
Heywood, Gene B.
Hoge, E. R.
Karge, Fritz W.
McDonald, G. R.

**1920**
Barton, Paul D.
Ehrenfeld, Day, M.S.
Hounsell, Victor E.
Hounsell, Theron C.
Linhoff, Harold R.
Smith, R. Carson
St. Clair, Harry P.
Swift, Ernest H., M.S.

**1921**
Badger, Richard M.
Boggs, Chester A.
Case, Henry R.
Champion, Edward L.
Clarke, Philip S.
Craig, Robert W.
Hambrook, Richard E.
Honsaker, Horton H.
Mullin, Wynne B.
Quirmbach, Chas. F.
Raymond, Albert L.
Simpson, Charles F.
Sinclair Smith Memorial
Stenzel, R. W., Ph.D.

**1922**
Ager, Raymond W.
Alles, Gordon A.
Bear, Ralston E.
Bozorth, R. M., Ph.D.
Clever, George H.
Crissman, Robert J.
Darnell, Donald W.
DeVoe, Jay J.
Erb, Louis H.
Fleming, Thomas J.
Groat, Edmund T.
Hall, Albert D.
Hathaway, Edward A.
Henny, George C., M.S.
Honsaker, John, Jr.
Hopper, Francis L.
Jasper, Walter
Keith, Clyde R.
Knight, Alfred W.
Learned, Kenneth A.
Marsh, Hallan N.
Ogden, Harold S.
Reynolds, Maynard S.
Smith, George K.
Steffes, A. P. G.

**1923**
Alcock, Joseph R.
Baier, Willard E.
Barnett, Harold A.
Blakeley, Loren E.
Evans, Bernard G.
Fowler, L. Dean
Heimberger, William L.
Lewis, Howard B.
Loughbridge, Donald H.
North, John R.
Reeves, Hubert A.
Schonborn, Robert
Stromsoe, Douglas A.
Walter, John P.
Woods, Robert E.

**1924**
Anderson, Kenneth B.
Forbes, C. Leonard
Gandy, E. Harold
Goodhue, Howard W.
Henderson, William G.
Irwin, Emmett M.
Losey, Theodore C.
Squiers, Willis L.
Wilson, Edward A.
Winegarden, Howard M.

**1925**
Alderman, Raymond E.
Atherton, Tracy L.
Burmister, LCdr. C. A.
Byrne, Hugh J. P.
Chapman, Albert
Clayton, Frank C. A.
Dalton, Robert H.
Erickson, Alfred L.
Ferkel, Albert J.
Freeman, Henry R.
Hart, Edward W.
Heilbron, Carl H., Jr.
Henderson, Lawrence P.
Hertenstein, W.
Jones, Herbert J.
Jones, Walter B.
Karelitz, Michael B.
Maxstadt, F. W., Ph.D.
Miller, Leo M.
Newcomb, Leroy
Pauling, Linus C., Ph.D.
Prentice, Leland B.
Rivinius, Paul C.
Sellers, W. D.
Stanton, Robert J.
Thompson, Wilfred G.

**1926**
Anderson, Arthur B.
Austin, H. Carter
Ball, Alpheus
Dinsmore, Daniel G.
Edwards, Manley W.
Friauf, James B.
Kirkeby, Eugene
Krech, Clarence F.
Kroneberg, Alex A.
Lewis, William A., Jr.
Maechtlen, L. G.
Michelmore, John E.
Moodie, R. W.
Pompeo, Domenick J.
Schott, Hermann F.
Serrurier, Mark
Sokoloff, Vadim M.
Wulf, Oliver R., Ph.D.

**1927**
Anderson, Carl D.
Baldwin, Marshall A.
Baxter, Ellery R.
Bower, Maxwell M.
Boyd, James
Capon, Alan E.
Diamos, G. K. S., M.S.
Farrar, Harry K.
Forster, John B.
Gardner, David Z., Jr.
Gottier, Thomas L.
Hale, Frank S.
Hoover, Vaino A.
Jaeger, Col. Vernon P.
Mendenhall, Hallam E.
Peterson, Fred H.
Peterson, T. S., Ph.D.
Rodgers, V. Wayne
Southwick, Thomas S.
Stanton, W. Layton
Starke, Howard R.
Thompson, Russell E.

**1928**
Armstrong, Richard C.
Beckman, A. O., Ph.D.
Berman, Jack Y.
Brighton, Thomas H.
Chilberg, Guy L.
Coulter, Robert I.
Duval, Richard H.
Evans, Robley D., Ph.D.
Gewertz, Moe W.
Kaneko, George S.
Kuhn, Jackson G.
Lash, Charles, Ph.D.
Lindvall, F. C.
Lombard, A. E., Ph.D.
McFaddin, Don E.
McMillan, Edwin M.
Millikan, Clark, Ph.D.
Minkler, C. Gordon
Noel, Francis
Righter, Walter H.
Shaffer, Carmun C.
Suzuki, Tomizo
Templin, Edwin W.

**1929**
Atwater, Eugene
Birge, Knowlton R.
Clark, D. S.
Cline, Frederick R.
Cravitz, Philip
Dunham, James W.
Exley, Sidney T.
Fredendall, Beverly F.
Grimes, Walter B.
Haeff, Andrew, Ph.D.
Hugg, Ernest B.
Kingman, Kenneth E.
Kircher, Reymond J.
Lau, Kam Hu
Myers, Albert E.
Roberts, Bolivar
Sperling, Milton H.
Wheeler, Fred A.

**1930**
Alderman, Frank E.
Atkinson, R. B., Ph.D.
Barnes, D. P., M.S.
Blohm, Clyde L.
Bode, F. D., Ph.D.
Boyle, J. R. Lester
Bungay, Robert H.
Butler, Albert
Giebler, Clyde
Johnson, Josef J.
Johnston, Norris, Ph.D.
Kinney, Edward E.
Levine, Ernest
Mauzy, Harris K.
Pleasants, J. G., M.S.
Pritchett, J. D.
Ross, George A.
Sawyer, H. G.
Sheffet, David
Stirton, R. I., Ph.D.
Strong, Austin W.
Thayer, Eugene M.
Towler, J. W.
Waite, Howard W.
Zipser, Sidney

**1931**
Amann, Jack H.
Arndt, Wm. Frederick
Arnold, William A.
Biddle, R. L., Ph.D.
Boothe, Cdr. Perry M.
Bovee, John L., Jr.
Cogen, Wm. M., Ph.D.
Detweiler, John S.
Green, E. F.
Gunderson, Norman R.
Harker, Joseph C.
Hill, Earl S., M.S.
Kinney, Edward S.
Kircher, Chas. E., Jr.
Kuykendall, Chas. E.
Leeper, Laverne D.
Lehman, Robert M.
Lewis, George E.
McMillan, John R.
Murdock, DeWolfe
Neher, H. Victor, Ph.D.
Peer, Edward S.
Peterson, Raymond A.
Pratt, Leland D.
Smith, H. G.
Wilmot, Charles A.

**1932**
Arnerich, Paul F.
Atwood, Albert W., Jr.
Behlow, Lewis B.
Bowden, Frederick W.
Bradburn, James R.
Chambers, John V.
Claussen, William H.
Coryell, C. D., Ph.D.
Freeman, Robert B.
Hamlin, Charles F.
Harsh, Charles M.
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**1933**
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Binder, R. C., Ph.D.
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Craig, Cdr. Phillip H.
Edwards, E. C., Ph.D.
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Russell, Richard L.
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**1934**
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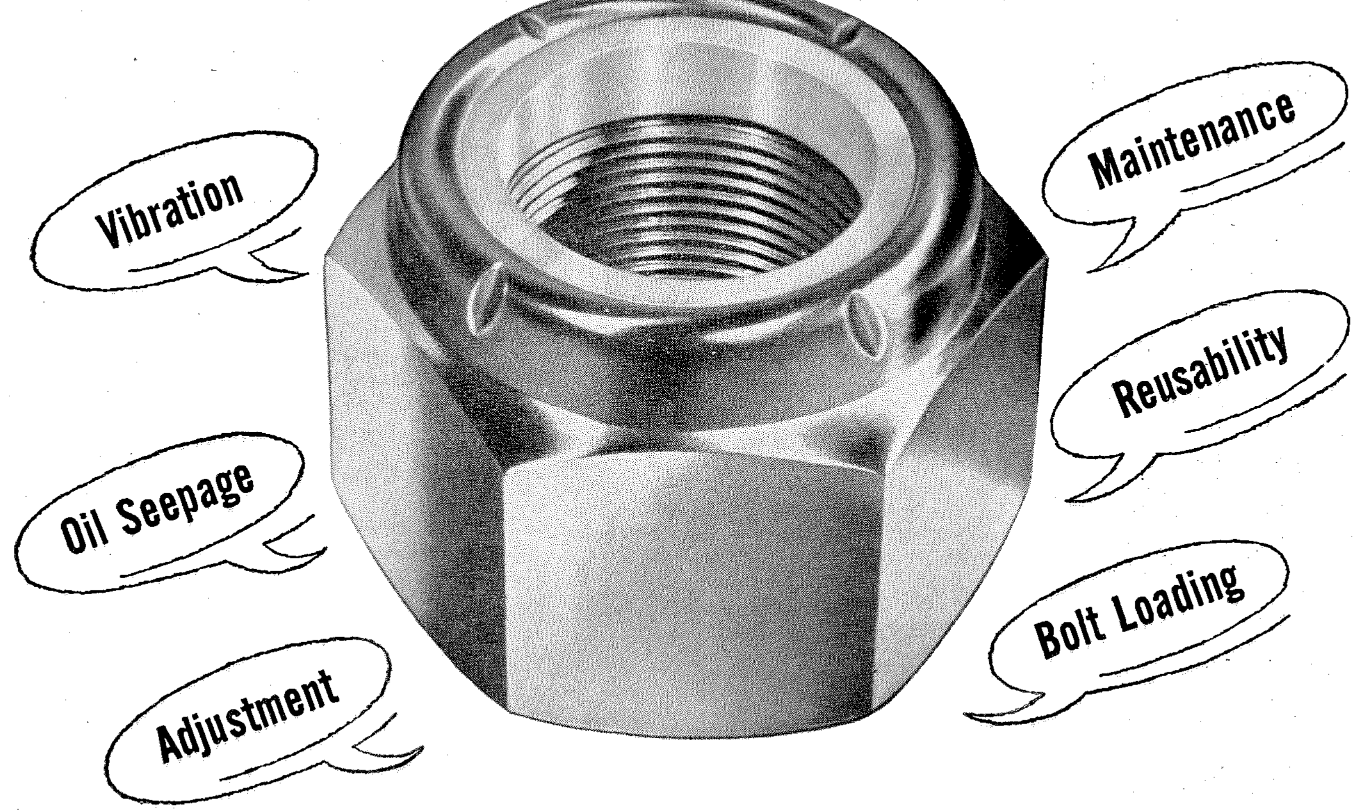


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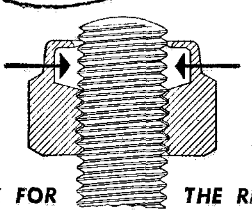

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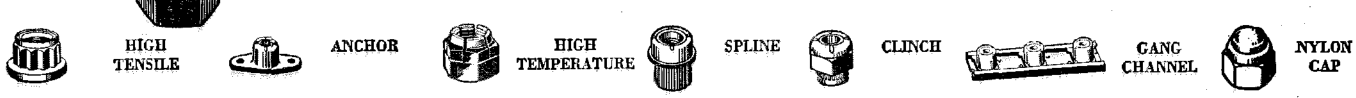


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**1935**

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**1939**

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1942

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Webster, Paul W.
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Widenmann, John A.
Woods, Gordon K.

1943

Allrud, Ralph G.
Alpert, Leonard S.
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Brown, Edward I.
Buchanan, John W.
Buettell, Theodore D.
Carter, Claude L.
Christianson, Warren L.
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**1944**

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Andrews, Tway W.
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Barnes, Frank A.
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**1945**

Austin, Dale H.
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Davis, Charles M.
Duncan, Donal B.
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**1946**

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Sefton, Wayne E.
Skogstad, Leif, M.S.
Steenson, Bernard, Ph.D.
Stix, Thomas H.
Susskind, Charles
Tracy, Tom
Waters, Alfred E. II
Wilkinson, Donald P.
Williams, LCol. D., M.S.
Williamson, William J.
Worcester, Bruce A.
Zacharias, Robert

**1949**

Albert, LCol. J., M.S.
Andres, John M.
Atkins, Douglas C., M.S.
Barnes, Stanley M.

# What's Happening at CRUCIBLE

## about Alnico Permanent Magnets

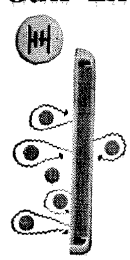
You will find Crucible Alnico Permanent Magnets in products ranging all the way from cuff links to magnatrons. Here are just a few unusual applications in which these magnets were used to simplify or improve a product.

*This is Warren, age 4, a cerebral palsied youngster, using magnetic toys in therapy-play.*

**Magnetic Toys** Cerebral palsied youngsters at the Children's Rehabilitation Institute, Cockeysville, Maryland, are unable to play with normal toys. Their lack of muscular coordination and control, causes ordinary blocks or toys to slip through their grasp and fall to the floor. Crucible helped overcome this problem by imbedding small permanent magnets in the toys. By using these magnet-equipped toys on metal topped tables, the children are able to control them much more easily.

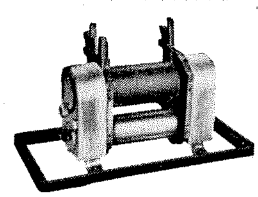
The Children's Rehabilitation Institute has pioneered techniques to help these handicapped children gain maximum muscular control and coordination. Experience at the Institute has shown that the use of magnetized toys helps develop coordination in hand and arm use, and in grasping and releasing.

**Cuff Links** One manufacturer of cuff links had a happy idea. He replaced the stem with a magnet assembly designed by Crucible magnet engineers. The tiny, powerful aspirin-sized magnets used, gave the finished product a holding force at the pole plate as high as 80 ounces troy.



*Enlarged cross section view of one cuff link.*

**Telescriber-Recorder** In one application, for this instrument that transmits written messages over wire, two permanent magnets were being used to match the electromagnetic fields. Assembly time and unit costs were high. Crucible magnet specialists designed one permanent Alnico magnet to replace the two. Magnet costs were cut 50% ... and efficiency of the unit was increased.



*Top bar Crucible Alnico; lower bar (replacing former 2nd magnet) provides return path.*

## Engineering Service Available

Perhaps your magnet problems are entirely different from these. Whatever they may be, our staff of magnet and electronic engineers will be glad to tackle them, and to work with you in meeting your magnet requirements. Don't hesitate to call us when you have an application for permanent magnets.

**CRUCIBLE** first name in special purpose steels

53 *years of* Fine *steelmaking*

**CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.**

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

Batson, Maj. R. T., M.S.
Berry, V. J., Jr., M.S.
Beveridge, John H., M.S.
Bornstein, M. S., M.S.
Browne, Davenport, Jr.
Bruington, Arthur E.
Carter, Hugh C.
Curtis, F. A., Jr., M.S.
Danielson, W. E., Ph.D.
Doherty, Patrick D.
Dolan, Edwin J.
Doolin, William A.
Dufort, Edward C.
Englar, Clayton
Fasola, Henry, Jr.
Fisk, Edward P.
Flam, Frederick H.
Fletcher, Aaron N.
Forester, Charles F.
Funk, Robert B.
Gardiner, Kenneth W.
Gift, Myrven F., Jr.
Gould, Roy W., Jr.
Green, Joseph M.
Guthrie, G., Jr., Ph.D.
Harmon, Cdr. L. E., A.E.
Harris, Paul B.
Harris, William N.
Hayward, Philip, Ph.D.
Herzig, Wayne M.
Hibbard, Don E.
Hubay, Paul W.
Iura, Toru, M.S.
Karzas, Byron C.
Kashiwabara, Naomi
Katz, Eli
Keinonen, Frank W.
Kenney, James T., Jr.
Kermeen, Robert W.
Knight, Charles H., Jr.
Kohnen, Keith D.
Kostelac, John F.
Krumholz, Irving L.
Lawford, Victor N., M.S.
Levonian, Edward P.
Liberman, David A.
Love, John R.
McIntosh, James A.
McKay, Richard A.
Maun, Eugene, Ph.D.
Mitchell, Orson L.
Monroe, Emmett P., M.S.
Morgan, G. Richard
Morrison, Ralph
Myers, Ridley
Nobles, Laurence H.
Palmer, William E.
Patterson, Richard L.
Peterson, Donald W.
Pilling, Robert R.
Powell, David O.
Prevost, Walter G.
Pyle, William D.
Roesch, Wm. C., Ph.D.
Rosicky, Fred G., M.S.
Saltman, Paul D.
Satre, Leland H.
Schneider, Fred C.
Sheriffs, Leigh
Shibata, Harry H., M.S.
Simons, William H.
Six, Don E.
Six, Gene D.
Stewart, Robert M., Jr.
Terriere, Robert T.
Vaughan, P. A., Ph.D.
Vogel, Milton C.
Walquist, Robert L.
Ward, Wm. W., Ph.D.
Waters, Warren P.
Wilts, James R., Ph.D.

### 1950

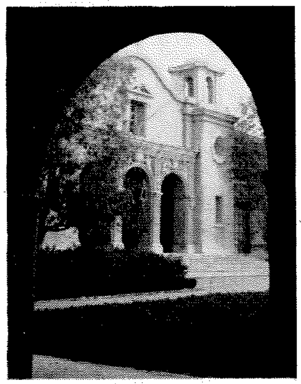
Barrie, Donald S.
Bowen, Theodore M.
Cockel, Lowell C., Jr.
Connolly, T. J., Ph.D.
Coons, Thomas P.
Corbato, Fernando J.
Cox, William P.
Crossley, Harry E., M.E.
Culbertson, William C.
Fabula, Andrew G., M.S.
Fink, Norman S.
Freed, William A.
Frick, Cdr. Leo F., A.E.
Friswold, Carroll L.
Gage, Boyd M.
Greene, John M.
Grinstead, R. R., Ph.D.
Haefliger, William W.
Hakala, Palmer E., M.S.
Hall, Michael A., M.S.
Hickey, Malcolm
Howell, Peter A.
Humphrey, Floyd B.
Irwin, William P.
Itano, Harvey A., Ph.D.
Jackson, P. H., Jr., M.S.
Jacobs, Jerome E.
Kam, Merle T.
Katz, Louis
Kendall, Donald V.
Knipe, Richard H.
Lansdown, William D.
McCaldin, James O.
McIntyre, Richard M.
McLellan, William H.
McMillan, Robert E., M.S.
MacAllister, R. V., Ph.D.
MacKenzie, David B.
Markoff, Daniel
Marks, Craig
Martin, Harold C., Ph.D.
Mosich, John T.
Oakes, Gibson
Pastan, Harvey L.
Petzold, Robert F., M.S.
Proud, William H.
Riesenfeld, Werner B.
Robertson, G., Jr., M.S.
Rutherford, John, M.S.
Schofield, James E.
Schuyler, Arent H., Jr.
Sims, Virgil J., Jr.
Solomon, George, Ph.D.
Spencer, Eugene
Staats, William T.
Stowe, Bruce B.
Weeks, LeRoy W.
Wong, Kam L.
Wright, Richard Bruce

### 1951

Adler, Robert G.
Armstrong, Paul L., Jr.
Baily, Frederick G.
Bates, Charles J.
Bemis, Richard C.
Bible, Robert E.
Bieler, Barrie H.
Bunker, Rodney S.
Caldwell, Ronald T.
Clark, Bert H.
Cleland, G. H., Ph.D.
Connelly, Robert F.
Crichton, Edward B.
Daily, Dean C. II
Dervishyan, A. O., M.S.
Dyer, John W.
Edwards, Walter G.
Elder, John K.
Gardner, Oliver H.
Goerke, Rudolph J. III
Hallstrom, John V.
Hawk, Riddell L., M.S.
Hefner, Earl C.
Hermann, Julius, M.S.
Hooper, Frank L.
Houser, Bradford C.
Hull, Herbert M., Ph.D.
Ito, Henry
Jackson, Albert S.
Jaskowsky, W. F., M.S.
Johnson, Roland W.
Kamei, Hiroshi
Kendrick, J. B., A.E.
Klarfeld, Marshall L.
LeMay, Dan B.
Li, Cheng-Wu, Ph.D.
Madden, Robert W.
Malanoski, Anthony J.
Merkel, George
Merritt, Richard, M.S.
Merten, Ulrich
Morrison, John W.
Narud, Jan A.
Nuno, Richard K.
Paulson, Charles T.
Pfeiffer, Capt. W. F.
Ragon, Capt. Rex B.
Rathje, David S.
Sato, Kazuhiko
Sereno, Alfred W.
Sharp, Richard S.
Smith, George L., M.S.
Staples, William, M.S.
Steese, Charles M., Jr.
Stern, Edward A.
Stratton, Kent
Walp, Robert M.
Wood, Frederick E., Jr.

### 1952

Bader, Michel
Baier, Rodger
Blount, George H., M.S.
Brown, Oswin N., M.S.
Butler, Sherman E.
Cassidy, Mell D.
Cook, Samuel P.
Cooke, George B.
Ghauri, Waheed K.
Gnutti, Etalo G., M.S.
Greene, Malbone
Hanna, David L.
Herscovici, Bruno
Irwin, William W.
Israelsen, Boyd
Keswick, Henry F.
Koons, David
Larson, Carl V.
Lew, Clinton
McCool, John M.
McEwing, Archie J.
Miller, Charles R.
Moore, Randolph
Munson, Capt. H., M.S.
Peck, Norman
Perpall, Robert C.
Perrault, Ralph E.
Schlipf, Logan H., M.S.
Serdengecti, Sedat, M.S.
Stegall, Gilbert, M.S.
Suzuki, Henry E., M.S.
Wise, William L.
Wong, Edgar
Yakel, H. L., Jr., Ph.D.



## ALUMNI CALENDAR

| | |
|---|---|
| October 28 | Dinner Meeting Athenaeum |
| November 12 | Oxy-Caltech Pre-Game Luncheon Athenaeum |
| November 13 | Open House Dabney Hall of Humanities |
| January 13 | Dinner Meeting |
| February 6 | Dinner Dance Oakmont Country Club |
| March 17 | Dinner Meeting |
| April 10 or 17 | Alumni Seminar Day |
| June 9 | Annual Meeting |
| June 26 | Annual Picnic |

## CALTECH ATHLETIC SCHEDULE

### VARSITY FOOTBALL

Oct. 9, 8 p.m.
Pomona at the Rose Bowl

Oct. 17, 8 p.m.
Redlands at the Rose Bowl

Oct. 24, 8 p.m.
Whittier at the Rose Bowl

Oct. 31, 2:15 p.m.
Pomona at Pomona

### FROSH FOOTBALL

Oct. 17, 2:15 p.m.
Redlands at Caltech

Oct. 24, 2:15 p.m.
Occidental at Occidental

Oct. 30, 2:15 p.m.
Pomona at Pomona

# ALUMNI ASSOCIATION

# CALIFORNIA INSTITUTE OF TECHNOLOGY

## BALANCE SHEET

### As of June 30, 1953

**ASSETS**

| | | |
|---|---|---|
| Cash in bank | | $ 3,989.50 |
| Accounts receivable (Funds held by C.I.T.) | | 1,869.50 |
| Postage deposit | | 192.09 |
| Investments: | | |
| Share in Consolidated Portfolio of C.I.T. 6-30-53, prior to current year capital gain | $30,382.65 | |
| Shares in Savings and Loan | 5,058.33 | |
| U. S. Savings Bonds cost | 222.00 | |
| Total Investments | | $35,662.98 |
| Furniture & fixtures at nominal amount | | 1.00 |
| TOTAL ASSETS | | $41,715.07 |

**LIABILITIES**

| | | |
|---|---|---|
| Accounts payable | $ 1,462.73 | |
| 1953-54 membership dues paid in advance | 4,947.00 | |
| Total Liabilities | | $ 6,409.73 |

**RESERVES**

| | | |
|---|---|---|
| Life membership reserve: | | |
| Fully-paid life memberships | $29,275.00 | |
| Payments on life memberships under the installment plan | 694.50 | |
| Total Reserves | | $29,969.50 |

**SURPLUS**

| | | |
|---|---|---|
| Balance June 30, 1953 | $ 3,467.45 | |
| Provisions for Directory | 1,800.00 | |
| Excess of income over expense for year ended June 30, 1953 | 68.39 | |
| Total Surplus | | $ 5,335.84 |
| TOTAL LIABILITIES, LIFE MEMBERSHIP, RESERVES AND SURPLUS | | $41,715.07 |

## STATEMENT OF INCOME

### For the year ended June 30, 1953

**INCOME**

| | | |
|---|---|---|
| Dues | | $ 9,224.09 |
| Less: Subscriptions to Engineering and Science Monthly for Association Members | | 7,077.50 |
| Net Income from Dues | | $ 2,146.59 |
| Income from Investments | | |
| Investment Income and Interest Income | | 1,635.67 |
| Program and Social Functions: | | |
| Income | $ 5,151.90 | |
| Less Expense | 5,003.03 | 148.87 |
| Annual Seminar: | | |
| Income | 2,268.50 | |
| Less Expense | 1,828.27 | 440.23 |
| Sundry Income | | 41.65 |
| NET RECEIPTS | | $ 4,413.01 |

**EXPENSES**

| | | |
|---|---|---|
| ADMINISTRATION: | | |
| Directors' expenses | $ 200.13 | |
| Postage | 879.21 | |
| Printing & supplies | 1,002.72 | |
| Total Administration | 2,082.06 | |
| Alumni Membership Solicitation | 429.09 | |
| Fund Solicitation | 933.47 | |
| Student Relations expense | 100.00 | |
| Total Expense | | $ 3,544.62 |
| NET INCOME | | $ 868.39 |
| Less: Directory appropriation | | 800.00 |
| NET INCOME TO SURPLUS | | $ 68.39 |

**AUDITOR'S REPORT**

Alumni Association,
California Institute of Technology,
Pasadena, California.

I have examined the balance sheet of the Alumni Association, California Institute of Technology as of June 30, 1953 and the related statement of income for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as I considered necessary in the circumstances.

In my opinion, the accompanying balance sheet and statement of income present fairly the financial position of the Alumni Association, California Institute of Technology at June 30, 1953, and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

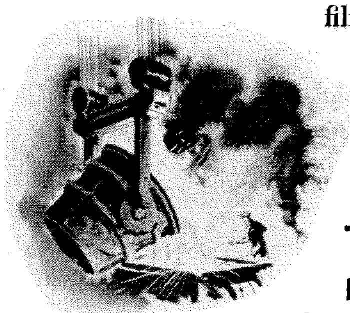
September 11, 1953.

DALE J. STEPHENS,
Public Accountant.

PHOTOGRAPHY AT WORK    No. 4 in a Kodak series

# Photography helps a New Steel Mill roll into action

**Fairless Works, U. S. Steel's new Eastern Seaboard mill, is now starting operations—and growing—at the same time. And camera and film play their parts in both.**



**. . . to help locate ore, plot transportation, lay out plants, control quality, improve production, U. S. Steel puts Photography to work.**

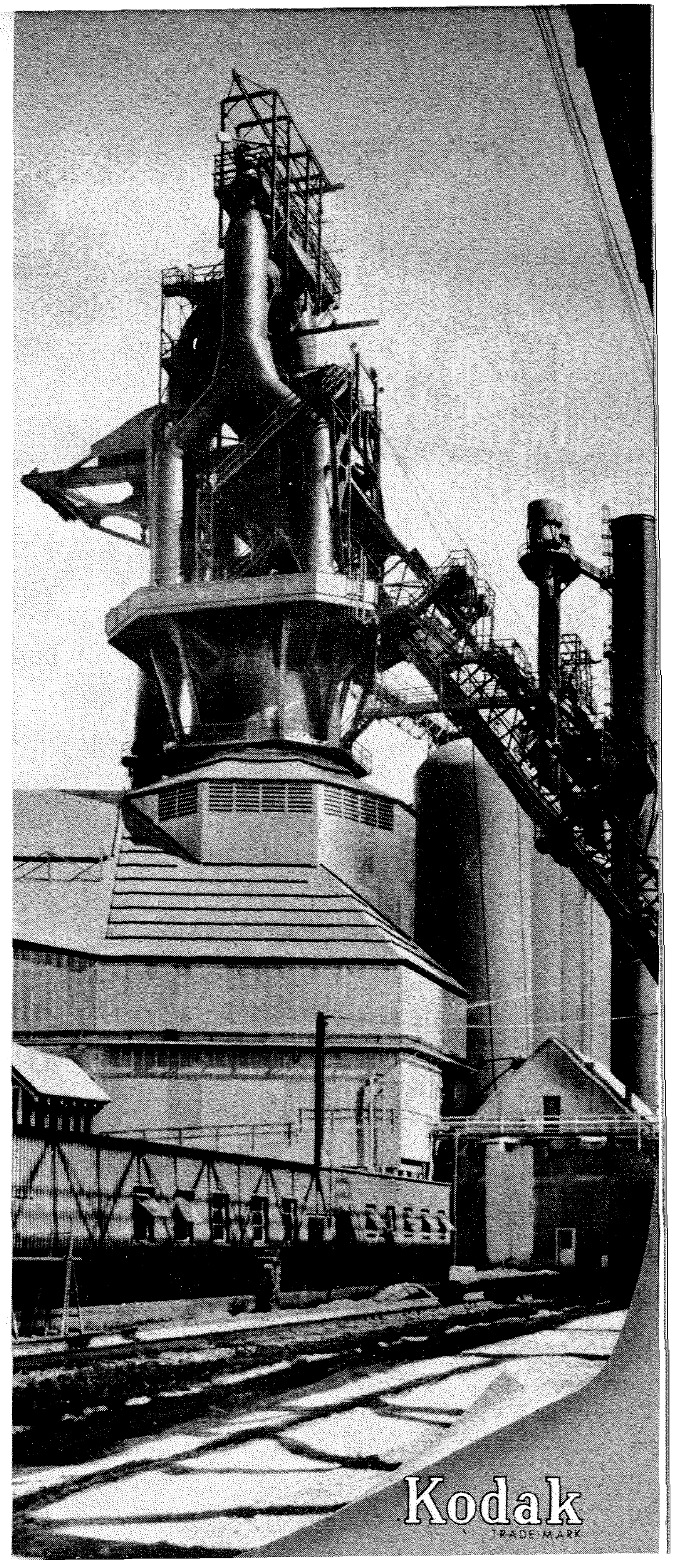
From ore through research and production, Photography is one of Steel's important operation tools. It helped locate and appraise the new Venezuelan Cerro Bolivar deposits which sparked this great new seaboard mill. It helped chart the ore's course to the sea—helped plan the plant and keeps a running record of its growth. And day after day it's at work in the research lab improving steel metallurgy, and on the production line controlling quality.

Countless numbers of America's varied industries, large and small, use photography in many ways to save time, speed accomplishment, increase production, and cut costs.

In fact, so many new applications of photography are being found, that many well-qualified graduates in the physical sciences and in engineering have been led to find positions with the Eastman Kodak Company. Returning servicemen, too, have found new opportunity here.

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

**Eastman Kodak Company**
**Rochester 4, New York**



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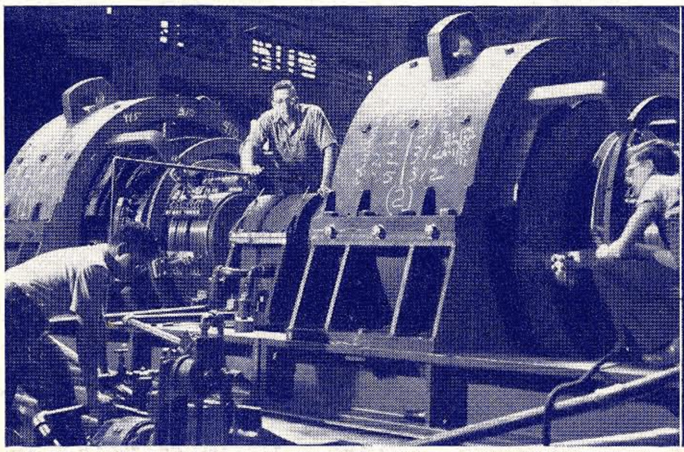
Engineering & Science
Calif. Inst. of Technology
Pasadena, Calif.



CHARLES SNYDER, R.P.I., (center) adjusting 5250 triple-unit d-c mill motor for use in a steel mill.

Engineers RICHARD RENK, IOWA STATE, (left) and ALLEN FRINK, CATHOLIC UNIV., make last-minute check on 1600-hp diesel-electric switcher before it is moved to test track.

# THEY'RE "GOING PLACES" AT GENERAL ELECTRIC

Like these young men pictured here, hundreds of scientists, engineers, chemists, physicists and other college graduates are "getting ahead" fast at General Electric . . . . and they are working on projects with the assurance that their contributions are meaningful and important.

They are moving up rapidly because at General Electric a world of opportunity awaits the college man of today—a world limited only by his own ability and interest. The variety of General Electric products and the diversity of the Company's operations provide virtually unlimited fields of opportunity and corresponding rewards, both materially and in terms of personal satisfaction to young men who begin a G-E career.

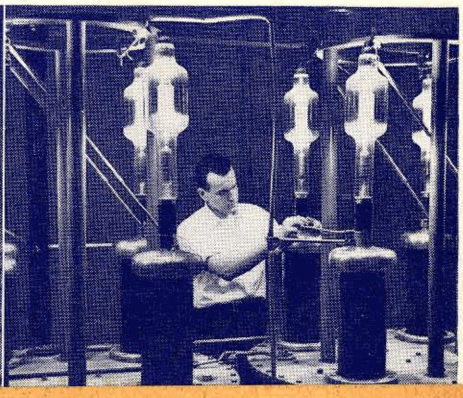
New developments—in silicones, electronics, semi-conductors, gas turbines, atomic power, and others—springing from G-E research and engineering, are creating exciting new opportunities, and are giving college graduates the chance of finding satisfying, rewarding work.

And by placing prime importance on the development of talent and skill, developed through G-E training programs and broadened through rotational job programs, and by providing incentives for creative minds, General Electric is hurrying young men into success in an industry that is devoted to serving all men through the ever-increasing and ever-widening uses for electricity, man's greatest servant.

*If you are interested in building a career with General Electric see your college placement director for the date of the next visit of the General Electric representative on your campus. Meanwhile, for further information on opportunities with General Electric write to College Editor, Dept. 2-123, General Electric Company, Schenectady 5, New York.*

Test engineers E. K. VON FANGE, U. OF NEB., (left) and R. E. LOVE, U. OF TEXAS, work on stacker and stapler built by them for homework project.

Physicist ROGER DEWES, BROOK working with scintillation count Engineering Laboratory.



GENERAL E