ENGINEERING | AND | SCIENCE

MARCH / 1952

Compton and Millikan . . . page 26

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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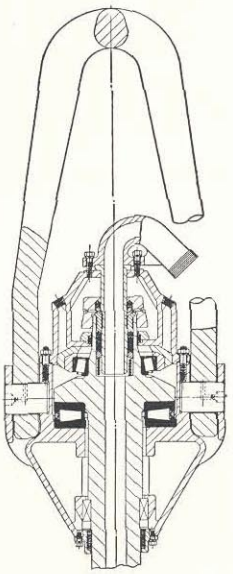

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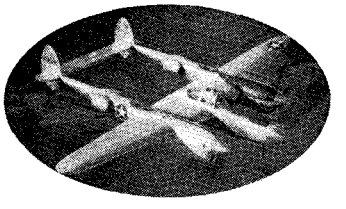

The P-38 Lightning – first 400 mile per hour fighter-interceptor, the "fork-tailed Devil" that helped win World War II.

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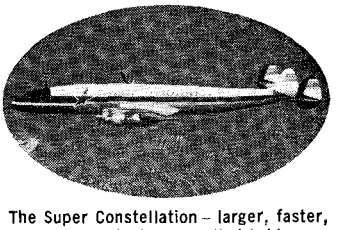

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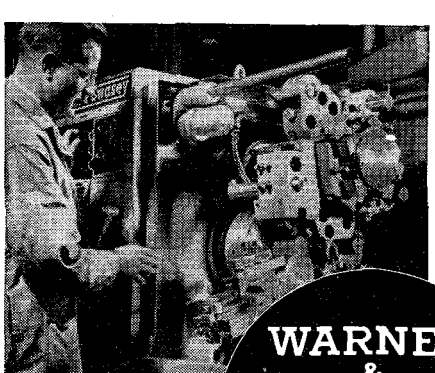
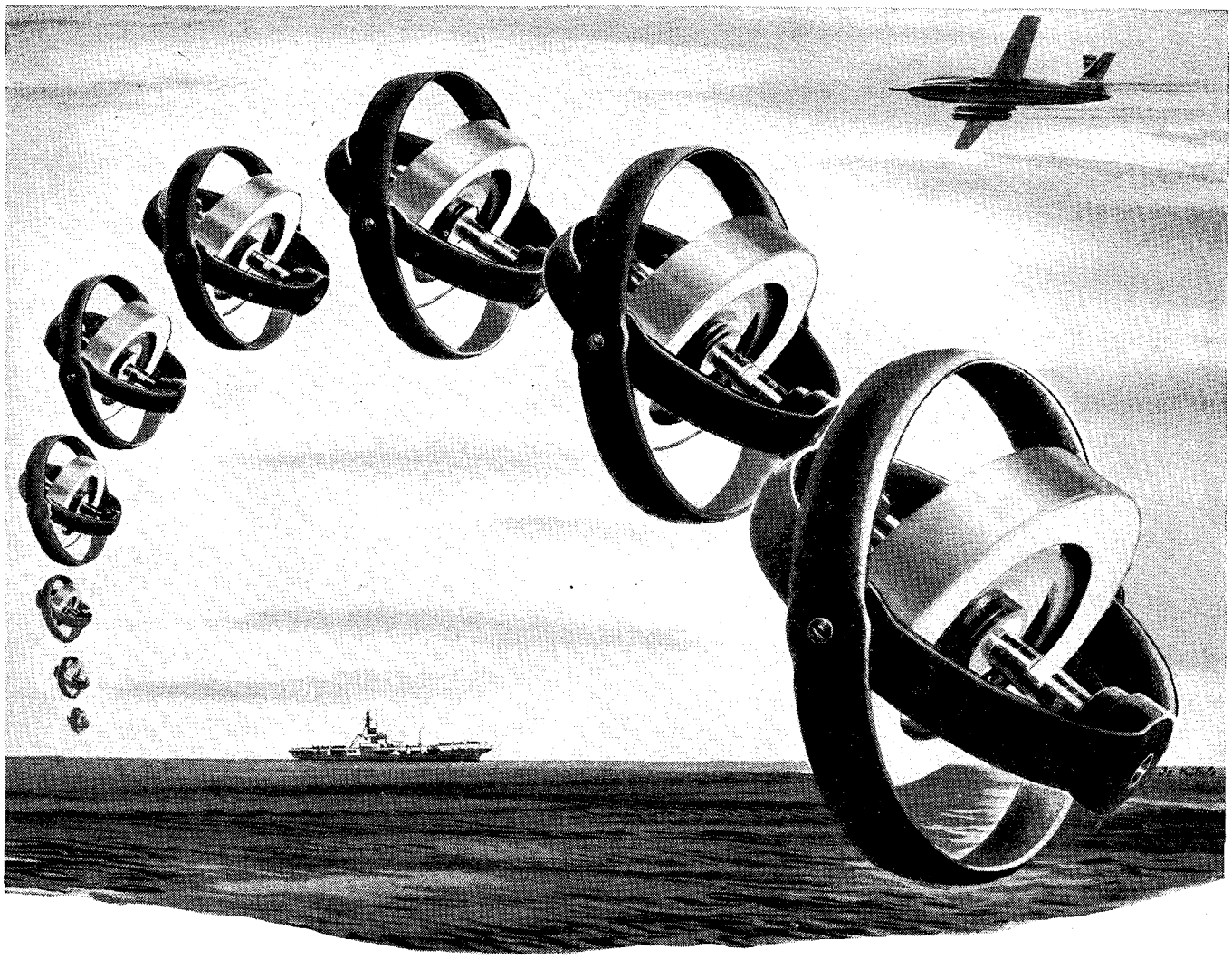
Their sons and grandsons started grocery stores, became mechanics, saved their money and started factories. American machines bought by American thrift made the factories grow.

And that's America. Made by people willing to walk 2,000 miles beside a wagon—to find opportunity. If such people are gone, if all we've got left are soft weaklings who want to be taken care of, then in truth American manliness is dead, that 2,000 mile walk was wasted, and there is nothing left of America but a hollow shell.





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BOOKS

PALOMAR
The World's Largest Telescope
By Helen Wright
The Macmillan Co., New York $3.75

HELEN WRIGHT'S book is a popular history of the origin and development of the 200-inch Hale telescope —and a good one. Though it's a small book (188 pages) it covers a lot of ground, starting with Galileo and the first astronomical telescope, and working up to George Ellery Hale and the greatest of all telescopes.

After a historical introduction on telescopes, Miss Wright settles down to the story of the 200-inch from the time when Hale first conceived it in 1928, through the negotiations with the Rockefeller Foundation which resulted in a $6,000,000 grant to build it, the selection of Palomar Mountain as the site for it, the construction of the observatory, the casting of the mirror at the Corning Glass Works, the building of the mounting at the Westinghouse Electric and Manufacturing Company, and the dedication of the telescope on June 3, 1948.

Helen Wright is an astronomer herself (she's been associated with the Vassar College Astronomy Department, the U. S. Naval Observatory, Mount Wilson Observatory and the Maria Mitchell Observatory) and she is author of a biography of Maria Mitchell, *America's first woman astronomer*. For the past three years she has been working, under a Carnegie Foundation grant, on what is to be the official biography of George Ellery Hale. *Palomar* is a detour from this long-range project.

Naturally, then, this book is strong on detail from the years when Hale was alive (he died in 1938). Material on the final construction, tests and recent observations made with the 200-inch telescope is confined to a few pages in the book—though that doesn't keep it from being a first-rate introduction to the Palomar Observatory.

Recent Faculty Publications

THOMAS POWNALL
By John A. Schutz, Assistant Professor of History
The Arthur H. Clark Co., Glendale, Calif. $10.00

A BIOGRAPHY of the British defender of American liberties who served as Governor of Massachusetts from 1757 to 1760—and an incisive study of Anglo-American relations in the eighteenth century.

PRINCIPLES OF PLANT PHYSIOLOGY
By James Bonner, Professor of Biology, and Arthur W. Galston, Associate Professor of Biology
W. H. Freeman & Company, San Francisco $5.50

A TEXTBOOK for undergraduate students, at the second or third year level, who have had a course in general chemistry and general biology or botany.

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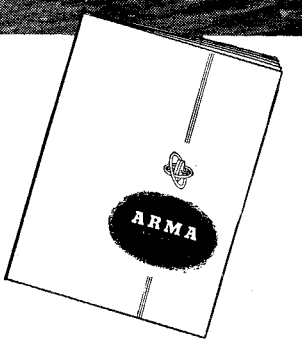

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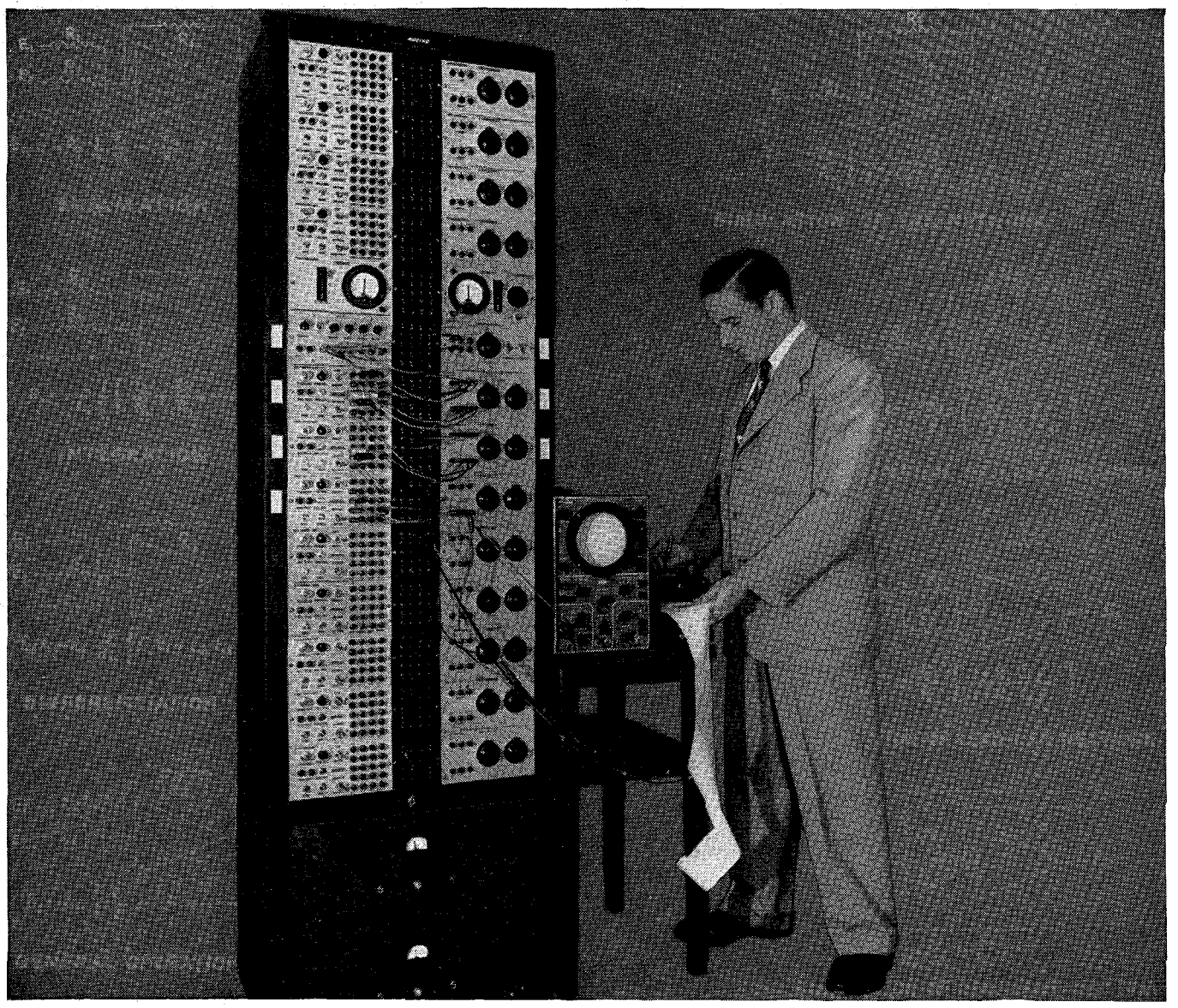

Solving a dynamics problem with the Boeing Computer; oscilloscope at right shows result.

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ENGINEERING AND SCIENCE

IN THIS ISSUE

This month's cover shows Dr. R. A. Millikan greeting Dr. Arthur H. Compton on the latter's recent visit to Pasadena. Dr. Compton, Chancellor of Washington University in St. Louis, came here to deliver a public lecture on "Science and Religion Shaping Man's Future" on February 18th. You'll find some extracts from the talk on page 26 of this issue.

Dr. Compton's speech was sponsored here by Pasadena City College, Caltech, Redlands, Pomona, Whittier and Occidental colleges, under the auspices of the Religion in Education Foundation. Dr. Compton was introduced at the meeting by R. A. Millikan, fittingly enough. Both men are eminent physicists and Nobel prize winners. Both, recently, have embarked on extensive lecture tours to advocate the principle that scientific truth and religious values are consonant and that an applied harmony of the two is essential to human welfare. The cover photograph was taken in Dr. Millikan's office at Caltech.

Dr. Frits Went's article on page 14 describes some recent results of experiments conducted in Caltech's unique Earhart Plant Research Laboratory, the only place in the world where scientists can get exact knowledge of the effect of climate on plants. Work has been going on in the Laboratory

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PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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

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

for nearly two years now and has already produced some significant results.

Scientists in the Laboratory are now looking for new experimental objects with which they can study particular processes in a more efficient way. In principle, a corn plant or a small grass may react similarly; yet, with the same amount of space researchers may be able to carry out five times as many experiments on the small grass plants. They are already switching over partially from tomatoes—the plant physiologist's standby—to peas, because where one tomato plant can be grown per square foot, nine peas can be grown in the same area. In a more extreme way they are screening dozens of desert and alpine annuals in the hope that they will find a plant which will be as useful as the fruit fly has become for genetical investigation.

Dr. Frits Went and assistant at work in the Earhart Lab (p. 14).

In November of 1951, *E&S* ran an article on the great new earthquake recording station being built on Palomar Mountain by the Caltech Seismological Laboratory. What the article failed to mention—and it was merely the most important fact of all—is that the new station, and in fact all the research we reported on, has been made possible through the support and sponsorship extended by the Geophysics Research Division of the Air Force Cambridge Research Center.

After you have read the wry remarks on student elections written by Al Haber '53 on page 30 of this issue, please note that Mr. Haber himself, in spite of these cynical comments, has managed to get himself elected president of Fleming House.

THE PRESIDENT'S REPORT

Highlights from the report, on activities and research at the Institute in 1950-51

by L. A. DuBRIDGE

As was forseen in the President's Report for 1949-1950, the Institute has been called upon during the current year to assist the Federal government in many aspects of its program directed toward national security. The Institute has responded generously to these calls though they have frequently meant serious sacrifices to our normal program of education and research.

Though such sacrifices are gladly made, we must remain cognizant of the fact that our normal program of education and research is also essential to national security. The education of first-quality scientists and engineers is of more critical importance today than ever before. It would also be disastrous to the nation for basic research programs to be abandoned in institutions such as this.

On the other hand, the military services also need immediate help. Fortunately, there is no central agency to tell us how we should balance our effort between these "normal" and "emergency" activities. We must make such decisions ourselves, using our own best judgment of the relative value of the Institute contributions in these two areas, basing our judgment on our own knowledge of the national and international situation. This is a grave responsibility, indeed, and must be approached with farsighted and patriotic unselfishness.

Fortunately, many members of the faculty, the administration and the Board of Trustees are in close touch with military and other national problems and can assist greatly in reaching wise decisions. And if your President seems rather frequently absent from his desk on trips to Washington, it can at least be hoped that his activities there will also help cast light on important Institute decisions.

The largest Institute activity directly related to national defense is the operation of the government-owned Jet Propulsion Laboratory. The increasing tempo of mobilization has naturally meant a substantial increase in activity there, with increased emphasis on the more immediate as against the long-range developments.

Similarly, the Cooperative Wind Tunnel operated by the Institute for a group of aircraft companies, has been exceptionally busy. Plans for enlarging the tunnel to make supersonic tests possible are well along.

Project Vista

Of more immediate concern to the campus was the initiation of a special project known as Project Vista. The name derived from the fact that quarters to house this project were provided by the Army in what was once the Vista del Arroyo Hotel, later the Army McCornack Hospital, in Pasadena. The name of the project is about the only feature of it which can be made public. A large fraction of the senior faculty members of the Institute have participated and also a number from

Caltech's President L. A. DuBridge. His services to various government agencies are typical of those of other Caltech faculty members. He is on the Naval Research Advisory Committee and the General Advisory Committee of the AEC, the Advisory Committee on Scientific Manpower of the National Securities Resources Board, the Scientific Advisory Committee of the Office of Defense Mobilization, and the National Science Foundation Board.

other universities. The project is sponsored jointly by the Army, Navy and Air Force, and the work is of far-reaching importance. The program will be completed on January 1, 1952. Professor W. A. Fowler is performing a superb job as research director of the project.

Members of the faculty continued to be called upon to serve on military advisory committees in many fields. Professor H. P. Robertson was persuaded to extend his year's leave of absence to two years to serve as Scientific Director of the Weapons System Evaluation Group of the U. S. Joint Chiefs of Staff.

Your President's services to various government agencies are typical of those of other faculty members. In addition to his regular service on the Naval Research Advisory Committee and the General Advisory Committee of the Atomic Energy Commission, he has also been appointed by the President of the United States to serve on the Advisory Committee on Scientific Manpower of the National Securities Resources Board (a short term committee), the Scientific Advisory Committee of the Office of Defense Mobilization, and the National Science Foundation Board.

These are mentioned only to illustrate that practically no major national scientific group is any longer established without at least one—sometimes several—representatives of Caltech. The Institute's high achievements in science and engineering have made it a critical national asset, but have also brought attendant obligations.

Finances

The total net assets of the Institute, including plant assets, stood at $47,580,131 on June 30, 1951, a rise of $2,434,094 for the fiscal year. This figure includes endowment funds of nearly $24,000,000, a plant investment of over $17,000,000, trust funds of just under $3,000,000 and surplus and unexpended income of $2,600,000.

The expenditures for the year amounted to $11,363,984 and this amount was slightly less (by $95,647) than the total income. Of the income about $7,200,000 was received as reimbursement for research carried out under government contracts, the Jet Propulsion Laboratory being the major item. Endowment income amounted to $1,547,936, and current gifts totaled $855,111. The Institute's investments in marketable securities (excluding real estate, trust funds, etc.) yielded an income of 5.3 per cent of the average book value, or 4.6 per cent of the current (June 30) market value. The Institute portfolio now consists of about 27 per cent preferred stocks, 51 per cent common stocks and 3 per cent real estate.

It is gratifying to note that during the past five years the total capital assets of the Institute have increased by about $10,000,000—an average increase of $2,000,000 per year. Assets will probably pass the $50,000,000 mark during this coming year.

Fifty million dollars seems like a lot of money—in nongovernment circles. But measured by Caltech's needs and opportunities it is distressingly inadequate. Faculty salary scales are in urgent need of revision; facilities for education, research and for student life are desperately needed. The thoughtful donor will find here many fine opportunities for a gift that will pay dividends forever.

Research at the Institute

It is impossible, of course, in the space of a very brief report to convey any adequate idea of the nature and extent of the many important research activities being carried on at the California Institute. As an ex-

ample of the great magnitude of the research effort, it might be mentioned that the Division of Biology for special reasons prepared during the year a complete catalogue of all the research enterprises in progress within that division, with one or two descriptive paragraphs relating to each project. When completed, this report turned out to be a volume of 140 pages.

As in previous years, therefore, it is necessary to confine our attention in this report to a few random samples of research projects of general interest in various fields of current activity at the Institute.

Astronomy

Regularly scheduled observations with the 200-inch Hale Telescope have continued throughout the year. Most of the observations on moonless nights have been devoted to the cosmological program. This is a systematic step-by-step program planned to extend our knowledge of the distances, dimensions and structural features of the extragalactic nebulae. These are vast stellar systems similar to our own Milky Way, each nebula being made up of millions or even billions of stars.

As a first step in this program, hundreds of photographs have been taken of the Andromeda and other nearby nebulae. Studies of these plates have already indicated that the increased resolution of the 200-inch telescope will make possible the elimination of most of the uncertainties in the earlier determinations of the distance and size of these objects. Another group of plates of more distant nebulae has shown that this same type of direct distance measurement can be extended to several times as many nebulae as could be reached with the 100-inch telescope.

The accurate determination of the absolute sizes and luminosities of a large sample of nebulae will in turn permit a survey with greatly increased accuracy of the distribution of these objects out to the extreme range of the 200-inch telescope, that is, throughout a sphere some 2,000,000,000 light years in diameter.

Another important part of this program has been the study of the spectra of the nebulae which are so distant as to be beyond the range of the 100-inch telescope. An examination of these spectra enables one to determine the velocity at which these nebulae are receding into space. Previous observations have shown that the more distant a nebula is from the observer the greater is its velocity of recession. Recent observations have extended this relation out to new limits. For example, one nebula estimated to be at a distance of 360,000,000 light years from the earth shows a velocity of recession of approximately 38,000 miles per second. This is a speed exceeding 1/5 the velocity of light. New techniques for improving the precision of the measurements of distance and recession velocities will enable astronomers to make far more accurate determinations of the relation between two quantities, and the precise nature of this relation is an important method of testing various cosmological theories.

On the campus, work in astrophysics was continuing its development. Further light on the nature of nuclear reactions in the stars emerged from the joint efforts of physicists and astronomers.

Biology

During the year 1950-1951 a number of important advances were made in the research and teaching activities of the Division of Biology. An extensive project on radiation genetics, supported largely by the Atomic Energy Commission and the Office of Naval Research, added significantly to our knowledge of the effects of higher energy radiation on living systems.

Another of the noteworthy research activities of the division is that having to do with viruses. One group with Professor James Bonner has investigated higher plant viruses. Others working in Professor Max Delbrück's laboratory have continued study of bacterial viruses. Doctor André Lwoff of the Pasteur Institute of Paris spent two weeks working with this group and was to a large extent responsible for stimulating research on the interesting and important phenomenon of "lysogenesis." This term is used to describe the condition in which bacterial cells carry viruses in a latent condition without harm to the host cells. The special contribution of Lwoff to an understanding of this relation was the discovery that treatment of lysogenic strains of bacteria with ultraviolet radiation under suitable conditions brings about liberation of active viruses capable of infecting sensitive bacterial cells.

With the assistance from the Boswell Foundation for Virus Research, Doctor Renato Dulbecco and associates are attempting to develop a new type of animal virus assay fashioned after the now classical "plaque count" technique widely used in bacterial virology. If this is successful, a serious bottleneck in animal virus research will have been opened up. In order to obtain desired background and the best available advice on this project, Dulbecco spent two months during the early part of 1951 on a trip to various animal virus and tissue culture laboratories. Since his return, active work has been under way with the virus of equine encephalomyelitis in a newly equipped and modernized virus-tissue culture laboratory suite.

As in the past several years, many activities of the division have been performed in close collaboration with members of the Division of Chemistry and Chemical Engineering as a part of the joint Chemistry-Biology Research Program. This program is generously supported by a special seven-year grant from the Rockefeller Foundation.

An example of an area of research in which the activities of the two divisions come close together is found in the various investigations on proteins and protein structure. Professor Linus Pauling and Professor Robert Corey have recently increased our understanding of the molecular structure of proteins in a truly remarkable way. Since proteins are the key molecules of all living

Chemistry: Research in progress on the problem of determining the structure of protein molecules.

systems, the impact of this work on the biological sciences is indeed very great.

Geology

The Division of the Geological Sciences has continued to advance in many fields in spite of the severe shock caused by the death of Professor Chester Stock. For example, there was progress in the improvement of its earthquake recording instruments and the multiplication of its Southern California seismic stations, in fundamental studies on the nature of the earth's core, in studies of past glaciations in California and of the dynamics of desert dunes, and in the development of a fundamental and comprehensive hypothesis on the origin of pegmatites. In addition to many continuing investigations of important industrial minerals, significant studies were completed during the year on mica deposits in the southeastern United States, talc deposits in southeastern California, and gypsum deposits in the Palen Mountains, California.

Much thought and planning on the part of the division staff have been given throughout the year to the relatively new field of geochemistry in anticipation of the arrival of Professor Harrison Brown, under whose leadership an important and far-reaching program in this field will be initiated.

Chemistry

Many important advances in a number of chemical research programs were made during the year. For example, a penetrating investigation of the nature of enzymes has been under way for some time by Professor Carl Niemann and his associates. This study has involved especially the enzymes that are responsible for the breakdown of proteins and amino acids in the animal body. Important progress has been made toward determining the mechanism of the action of these enzymes and its relation to their structure.

Fifteen years of work by Professor Linus Pauling and Robert B. Corey and their many colleagues on the problem of determining the structure of protein molecules culminated in important and new results. Protein molecules are known to consist of chains of amino acids, but a chain may contain several hundred amino acid residues, and at least 24 different kinds of amino acids are known to occur. The problem of finding the precise way in which these amino acids are arranged in a protein molecule is thus a formidable one. However, new X-ray studies have enabled Pauling and Corey to propose a detailed structure of several important protein molecules and to show that these proposed structures are apparently consistent with all known X-ray data and also to show that previous models of protein structure are inconsistent with the new X-ray data. If further work confirms these findings, this will be an advance of great importance in a field which has occupied the attention of chemists and biologists for many years.

During World War II, Drs. Dan H. Campbell, Linus Pauling and J. B. Koepfli conducted a search for a substance which could be used as a satisfactory substitute for human blood plasma and which could be manufactured in large quantities and stored for long periods and be adaptable to use on the battlefield. A material was developed by chemical treatment of gelatin with glyoxal and hydrogen peroxide and was given the name oxypolygelatin. Clinical tests indicated that the material might be an exceedingly satisfactory plasma substitute. Because of the recently renewed interest in this field, additional investigations have been undertaken and extensive clinical tests are under way in the various medical centers of the U. S. Armed Forces. All the results so far are exceedingly promising.

Work on the problem of the crystal structure of metals has attracted the attention of physicists, chemists and metallurgists for many years. Recently Dr. David P. Shoemaker and Dr. B. Gunnar Bergman have been able to work out the structure of the important so-called sigma phase which occurs in certain alloys such as stainless steel. Many previous attempts to determine the structure of this phase have been unsuccessful but these workers have now succeeded. The structure turns out to be a most unusual one and the success of this work will cast light on many of the problems of the structure of metals and alloys.

Physics and Mathematics

A major effort during the year was devoted to the construction of the new synchrotron. Preliminary opera-

tion was achieved at very low power levels, showing that no serious problems existed in ejecting electrons into the proper orbits. The new power supply for high power operation was installed and tested and construction was fairly well complete by the fall of 1951. Operation at the initial level of one-half billion volts may be expected by the middle of 1952.

A new cosmic-ray laboratory, built as a wing to the Norman Bridge Laboratory, was completed and Professor Carl D. Anderson and his colleagues are installing new equipment which will make possible a major addition to the Institute's important cosmic-ray program. Professor Anderson's group has added important new information to the nature and behavior of the most puzzling new neutral particle—the "V-particle," which apparently disintegrates into a proton and a negative meson.

Professor Victor Neher and his colleagues made cosmic-ray studies during the summer at Thule, Greenland —the nearest accessible point to the north magnetic pole.

Professor J. W. M. DuMond has continued his astonishingly precise measurements of the wave lengths of gamma-ray lines from various radioactive isotopes. He has also put into operation a new type of instrument, a point-focusing X-ray monochromator for low-angle X-ray diffraction studies of small particles.

Work in the Kellogg Radiation Laboratory on the properties of light nuclei continued to yield a stream of new information, in spite of the disruption during the spring and summer of 1951 caused by participation of many staff members in the Vista Project.

Engineering

The past year was the first full year of occupancy of the new engineering building. This has given greatly improved facilities for instruction and research in civil and mechanical engineering. A similar building for chemical and electrical engineering is badly needed to relieve overcrowding in those areas.

In civil engineering a new study of water purity problems was initiated by Professor J. E. McKee. Professor F. J. Converse reported important progress on a new vibrational method of compacting soil. Further studies of resistance of structures to shocks and earthquakes have been reported by Professor George Housner. A study of the wind-induced vibration problem in long pipe lines has been initiated.

In electrical engineering Professor G. D. McCann and his colleagues have obtained new data on the characteristics of high-power arcs in air, which are of interest to the three electrical companies sponsoring the work. Applications of the electric analogue computer to many types of engineering problems have rapidly expanded to the point where the Institute Analysis Laboratory can no longer handle the load which industry would like to place on it. Hence the Institute is assisting a number of companies in building their own computers and in training computer personnel. Aircraft vibration problems can be handled in such an effective manner that most major aircraft companies are finding computers of this type to be essential equipment. The Institute will continue the basic research on computer design and application to new types of problems.

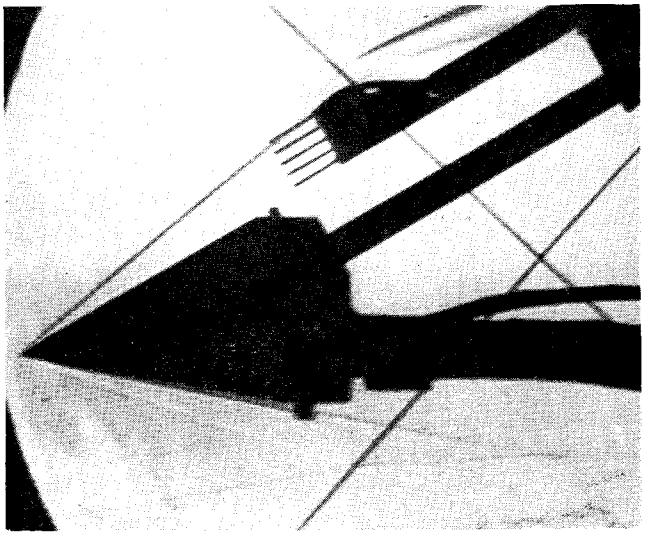
Basic studies in hydrodynamics continued to yield information of value to the Navy, to designers of pumps and turbines. In mechanical engineering new metallurgical studies by Professor Pol Duwez of titanium alloys provided new data of value in developing additional applications of this important metal, whose usefulness has only recently come to be recognized.

In the Guggenheim Aeronautical Laboratory basic research continued on many problems in fluid mechanics, the properties of air flow at hypersonic speeds (5 to 10 times the speed of sound) and in elastic and vibration problems encountered in aircraft structures. In the hypersonic wind tunnels the expansion of the air stream necessary to attain these extremely high speeds is accompanied by extremely low temperatures. Thus, rather surprisingly, new information on the liquefaction of air under these conditions is being obtained.

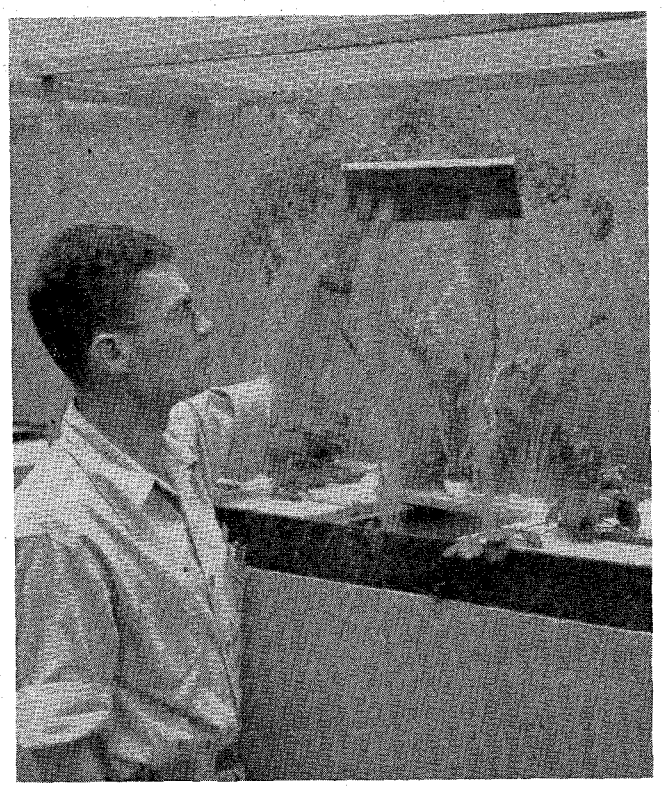
The very large Cooperative Wind Tunnel was built before supersonic speeds were of such importance—or could be attained. A $6,000,000 modification program now under way will bring this tunnel to the supersonic range, thus vastly increasing its value.

Acknowledgment

In conclusion, I should like to express appreciation to all members of the Board of Trustees for the active interest which they have taken in the Institute and for their generous contribution of time and energy to Institute affairs. This group of outstanding public-spirited men who assume responsibility for the continued success and financial stability of this great institution are performing a difficult and often thankless task—but one whose value to the community and to the nation can hardly be overestimated.



Aeronautics: Schlieren picture of model used in investigation of condensation of air in Army Ordnance Galcit Hypersonic Wind Tunnel.



Pret Keyes, Superintendent of the Earhart Lab, checks root development in carrots grown in an atmosphere kept continuously moist with a fog nutrient solution.

THE EARHART PLANT RESEARCH LABORATORY

A Progress Report

by FRITS W. WENT

SCIENTISTS WORKING in Caltech's Earhart Plant Research Laboratory (E&S—June, 1949) are still in an early and very simple part of their investigations on the effects of climate on plant growth. But they have already obtained a number of interesting results from their experiments.

The Earhart Laboratory offers complete weather control. It can simulate sun, rain, shade, heat, cold, humidity, dryness, wind or calm. If each one of these had an important influence on plant growth, it would be exceedingly difficult to come to any general conclusions. Fortunately, most plants are affected more by one of these variables than by the others.

In the Laboratory, for instance, we have studied the effect of day and night temperatures on tuber formation in the potato plant. In different day temperatures, we find that tuber formation does not vary if the plants have the same night temperature. But, if we vary night temperatures, and keep day temperatures constant for a group of plants, then we find that tuber formation is strongly influenced. At a 20 degree Centigrade night temperature, there is no tuber formation at all. At low night temperatures there will be a few tubers, but the total growth of these plants is very small. Optimal tuber formation occurs at about 12 degrees C.

Fruit formation in tomato plants is also dependent on night temperature, and shows an optimum around 17 degrees C. So there are definite differences in requirement from plant to plant, even in plants which react to the same single factor.

Neither light intensity nor photoperiod (the period of daily illumination) is very important in the case of the tomato and the potato. No matter how we vary these other climatic factors we get the same general response.

Another investigation is under way in the Laboratory on *Veratrum* or corn lily. This plant is of special interest because it contains alkaloids which lower hypertension. These alkaloids are extremely complex and, at the moment, cannot be synthesized. Since *Veratrum* is collected in the field only, and is now used in fairly large quantities, the possibility exists that it may some day become extinct.

Before *Veratrum* could be grown commercially, a large number of field plots were laid out to test its growth in different climatic zones. But it doesn't grow easily, and in practically none of the field plots was the growth even remotely normal.

At the same time, we did work on the climatic requirements of the plant in the Earhart Laboratory. We found that *Veratrum* has two or three main conditions which have to be met before it will grow. In the first place it needs a very long rest period—about six months—at approximately 0 degrees C. If the temperature gets higher or lower, this dormancy will not be broken. So far, it

has been impossible to break it with any of the chemicals which have been effective on other plants.

In the second place, it needs a cold temperature during its growing period. It must not be *too* cold; 17 degrees C. during the day is about optimum, and the night temperatures should be around 10 degrees C. The third requirement, which is absolutely essential, is that the plant have a good root system. This is a difficulty, because the root system develops very slowly. The plants have to be removed with roots and very carefully transplanted if they are to grow again afterwards.

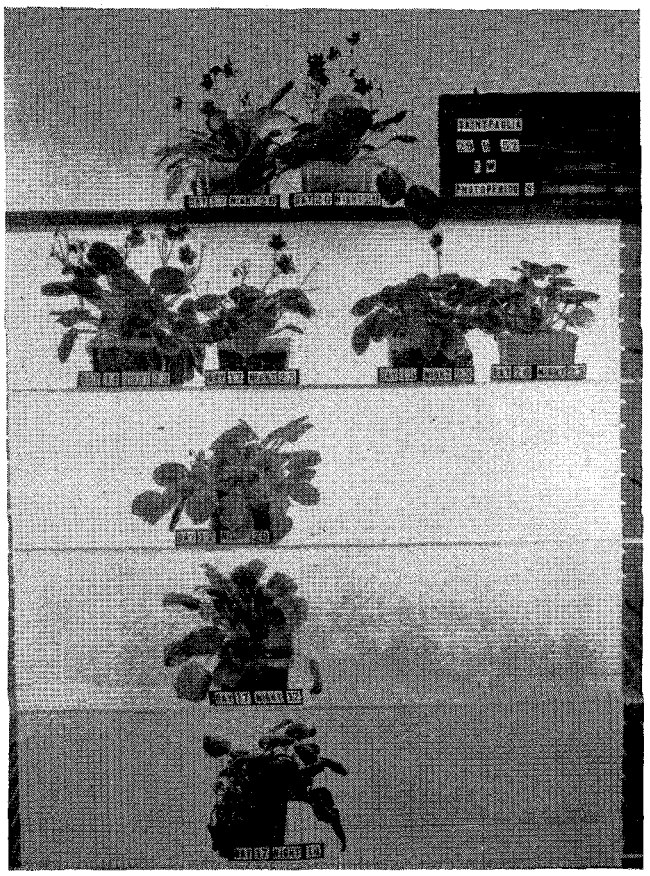
With these three requirements established, we know then what sort of locality *Veratrum* will grow in. The right conditions exist in the higher mountains of Northern Washington. Only in the two field plots which were laid out according to the optimal conditions we had established did *Veratrum* grow well.

So here we have the first case in which the climatic region where a plant has to be grown has been selected according to scientific knowledge of its growth requirements.

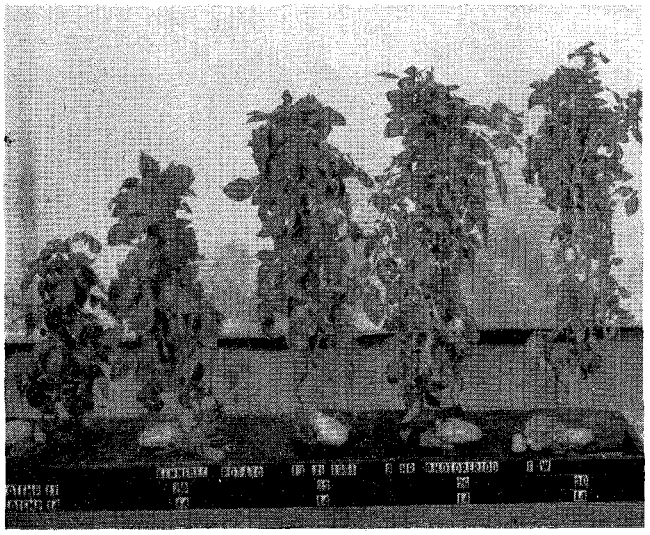
Another interesting case is the work of Dr. Albert Ulrich with sugar beets. Working in the Earhart Laboratory, he has found that a very important factor for the sugar content of sugar beets is temperature—particularly night temperature. There is a very nice straight-line relationship between sugar percentage and night temperature over the 4 to 30 degree range—the lower the night temperature, the higher the sugar content.

In Holland last year growing conditions were such that the beets were low in sugar content at the time harvesting usually begins. Then for one week the night temperature dropped sharply. At the end of that week the sugar percentage had risen considerably.

The director of the Sugar Beet Experiment Station in Bergen op Zoom, remembering Ulrich's results, connected the increase in sugar percentage with the cool nights. Therefore he got in touch with the meteorological observatory and asked what the forecast was for the following week. When low temperatures and bright weather were predicted, he phoned all the sugar factories and told them to stop or decrease production as much as they could. One week later the sugar percentage had run up one more percentage unit and thousands and thousands of dollars were saved by getting higher sugar yield through a delay in harvesting.



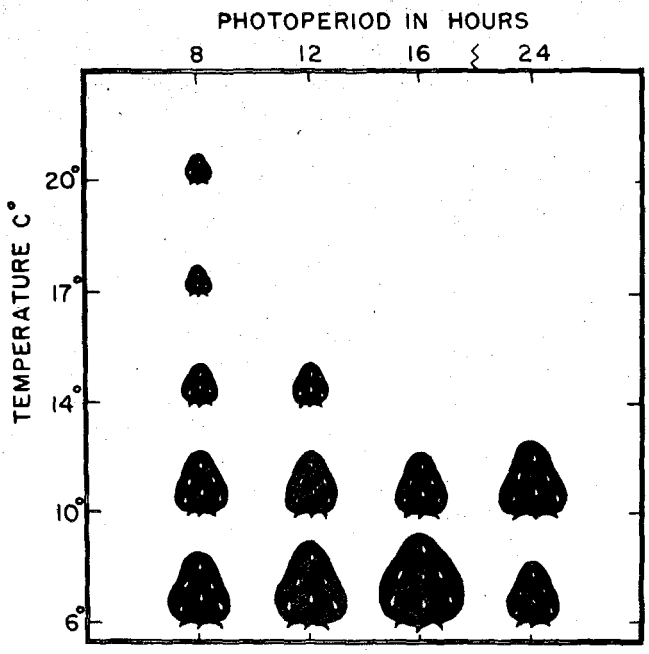
African violets in the Laboratory grow best when night temperature is higher than day temperature. Those shown above were grown at different day temperatures (increasing from left to right) and different night temperatures (increasing from bottom to top).



These five potato plants were all grown at the same night temperature (14 degrees C.) but at different day temperatures, rising from 17 degrees (left) to 30 degrees (right). Note how top growth is affected by day temperature, but tuber formation remains the same, due to the same night temperature.

A number of other plants have been investigated, and in general we find that the optimal day temperature and the optimal night temperature are different in each case. The optimal day temperature usually is higher than the optimal night temperature, which shows that most plants have adapted themselves to this sequence in nature, where the day is warmer than the night.

The only exception that we know of is the African violet (*Saintpaulia*). This plant has a remarkably high night temperature requirement, and unless the night temperatures are in the neighborhood of 20 degrees C. or higher the plants grow relatively poorly. When you give them a lower night temperature—for instance, 10 or 15 degrees—the plants die. However, if you give them the 10 or 15 degrees during the day and 20 degrees



Effects of temperature and photoperiod on strawberries

during the night, you get very large, deeply colored flowers, with deep green foliage.

There is not a single place in the world where the day temperature is lower than the night temperature, so it may be that the relationship we have found between the optimal day and night temperature in this case is completely fortuitous. Yet in most other cases it agrees with what happens in nature.

At present the effects of photoperiod are very well understood in plants; we know pretty well to what extent most plants respond to it. However, in work which is going on now we find more and more often that temperature and photoperiod are interchangeable in certain plants. By giving the proper temperatures, we can bring a plant to flower without changing the photoperiod; we can also bring the plant to flower with photoperiod, but usually *not* without the right temperature.

Ignorance of these inter-relationships can lead to international misunderstandings. In the U.S.A. the chrysanthemum is considered to be a short-day plant, because it flowers only when the days are shorter than 12 hours. The English are convinced that temperature is the most important factor, because they get chrysanthemums in flower even on long days in summer.

This turns out to be a simple matter of the difference in summer temperatures of the two countries. At high temperatures chrysanthemums are strictly short-day plants. At the lower temperatures of the English summer they are more or less indeterminate. So the English can think that the Americans are rather short-sighted in laying so much stress on photoperiodism, and we can think that the English are not too bright in ignoring it so. Actually, both of us are right.

This shows how careful we must be in thinking that our scientific results are independent of geographic location. Not until we have laboratories like Earhart everywhere in the world will botanists be independent of geography.

Work on strawberries has produced some interesting results on the inter-relation between photoperiodism and temperature. Strawberries were generally considered to be short-day plants; that is to say, they need a short-day period before they actually come into flower and bear fruit.

In this case the day temperature is the all-important factor; the night temperature has very little to do with their development. At 20 degrees and 17 degrees (see chart at left) flowering and fruiting occur only in an 8-hour photoperiod. At 14 degrees they occur in both 8 and 12-hour photoperiods, and at 10 degrees and 6 degrees we get flowering and fruiting even at 24 hours of light. Also, the lower the day temperature is, the larger the fruits are.

The same thing is true for tomatoes, but here it is a low night temperature that causes large fruits. So here again photoperiod and temperature seem to be more or less comparable; both of them can do the same thing.

In the Earhart Laboratory we can also study a particular process in detail, and under controlled conditions find out how this process works. The biochemical aspects of photosynthesis (the CO_2-reduction process occurring in green leaves in light) have been thoroughly studied, but practically no effort has been made to find out under which environmental conditions CO_2-reduction occurs most efficiently.

Theoretically, 30 percent of the light energy from the sun can be transformed into chemical energy by a plant, and laid down as carbohydrate material. In reality, only 1 percent, or at the most, 2 percent of the light energy falling on, say, a cornfield can be harvested as plant material.

In recent work, it was found that this low efficiency in field-grown plants is largely due to unfavorable en-

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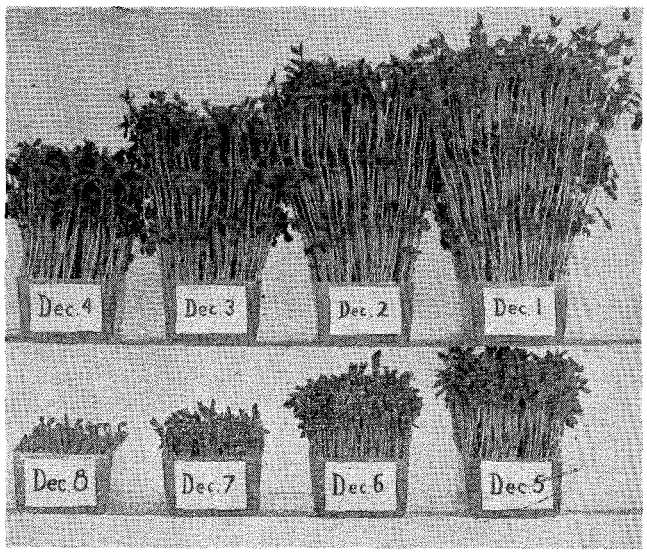
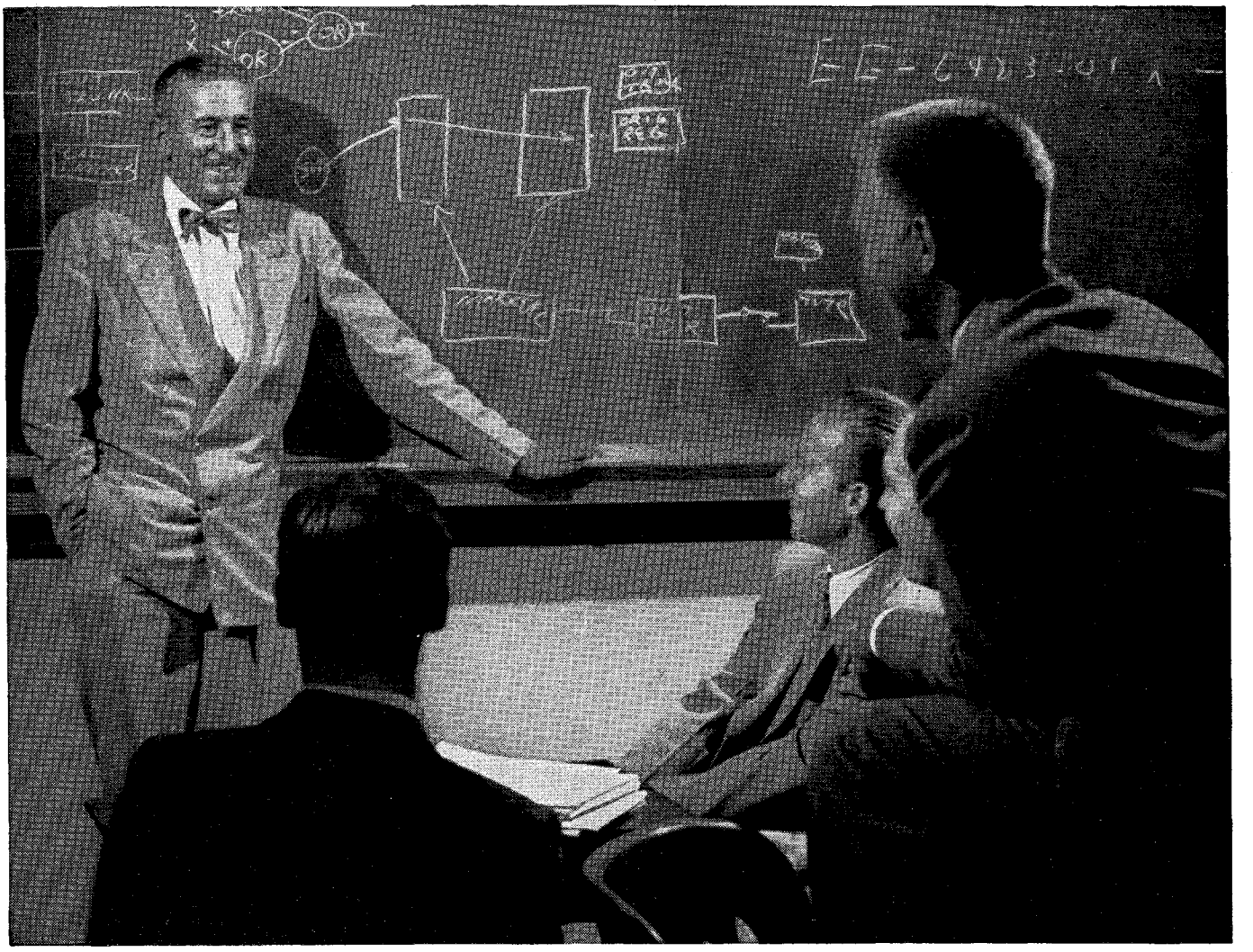


Pea plants show remarkable uniformity when grown in uniform conditions of the Earhart Lab. Picture was taken Dec. 14. Dates show when seeds were planted.



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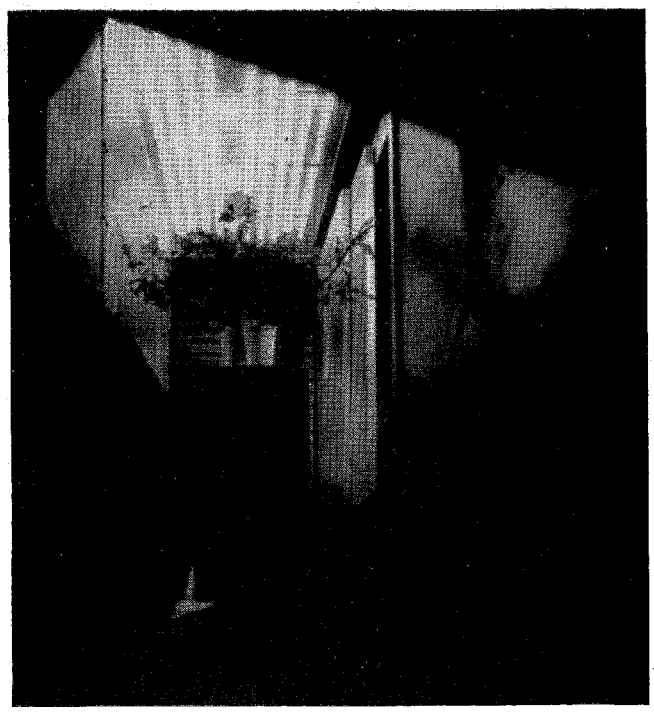


Wind is one of the special problems now under investigation in the Lab. Plants above were photographed through blades of fan in Lab wind tunnel.

vironmental conditions. Under ideal conditions, a tomato plant can transform 20 percent of the light energy that it has received into chemical energy. This fact was determined by measuring the increase in dry weight of sets of plants, which gives an incontrovertible indication of the photosynthesis which has occurred.

We have concluded that the growing and physiological conditions of plants have a great deal to do with the efficiency of their photosynthesis, and that the history of a plant must be considered before we can measure photosynthesis in higher plants accurately.

Ecology in Earhart

We are also working on a large number of ecological problems in Earhart. Ecology is not an experimental science as yet. It is largely descriptive, concerning the relationship of organisms to one another. The reasons for these relationships are seldom investigated. In the Earhart Laboratory it is possible to study the inter-relationship of organisms in great detail.

Our ecological studies were started with desert plants. These make excellent experimental material. In the first place, because they are placed far apart we don't get strong interactions between neighboring plants. In the second place, it is easier in such a violent climate to assign a particular phenomenon to a particular rain or high temperature which has occurred. So it becomes possible to find out the relationship between particular climatic conditions in the desert and the occurrence of certain plants in particular locations.

This was first done by observation in the desert, and then by experiments in the laboratory. It turns out that unless there has been a sufficient amount of rain, no germination occurs at all. Therefore, seeds which are present in desert soil do not germinate unless there has been a sufficient amount of rain and leaching of the soil.

The effect of rain has been studied in the laboratory recently by Alberto Soriano. He has found a relationship between the amount of rain and the degree of germination. Comparing precipitation of 5, 10, 25, 50 and 75 mm., he found that optimal germination occurred at 10-25 mm.

He found that the degree of germination also depended on the intensity of rain, so that 25 mm. given in one hour's time is far less effective than when it is spread over 10 or 24 hours. Apparently, this phenomenon is due to the presence of germination inhibitors in the seeds which can be leached out by the rain. Over short periods they don't have enough time to diffuse out, while prolonged rain leaches them thoroughly. This explains why there is such poor germination after a cloudburst.

It is curious that when you grow tomato plants with and without rain, but otherwise in exactly the same conditions, the plants with rain are about half as big as those without it. Apparently, there is a leaching out of either sugar or growth factors from the tomato plant, which is caused by raindrops running off the leaves. Just as we know that substances can be absorbed by the leaves (a tomato plant will grow faster when you spray it with sugar), it is also logical to assume that we can leach substances out of the leaves. This, of course, would have much to do with the irrigation of plants—whether you use overhead sprinklers or irrigate from ditches.

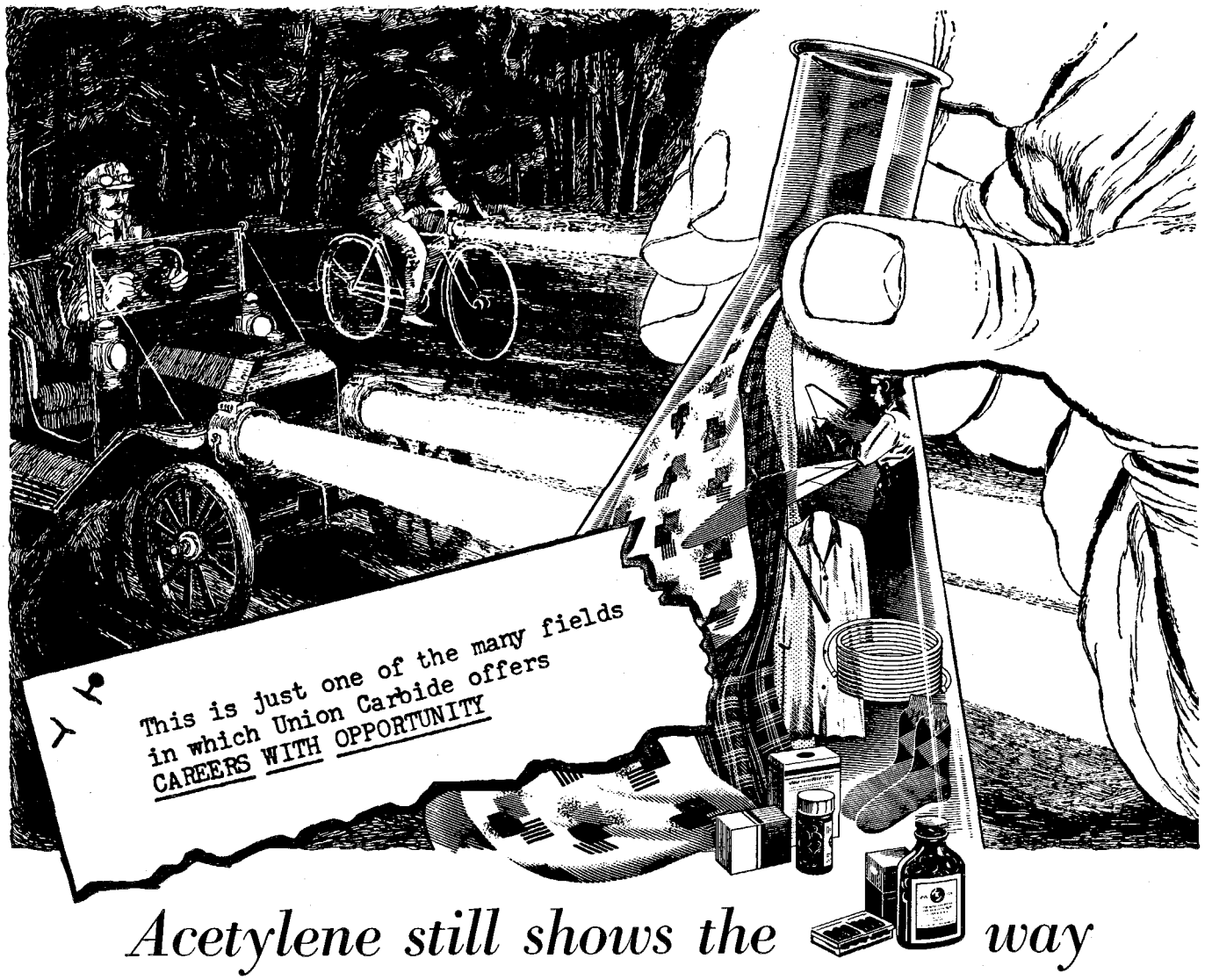
Special problems

There are several other special problems under investigation in the Laboratory now, such as smog (E&S—December, 1950) and wind. But the potentialities of the Laboratory are far from being fully utilized. We don't yet know all the things which *can* be done. We are constantly finding more things which can be investigated under the conditions we have there.

If we want to use the Laboratory to the fullest advantage, we must remember that there are two completely different types of problems which should be investigated there. We know practically nothing about the relationship between climate and plant growth as yet. We need to collect a lot of data before we can actually start to theorize about it. Large theoretical structures have often been built on just a single phenomenon or just a single organism. I think this is dangerous.

In this laboratory it is possible to get a large variety of conditions and organisms on which to base theoretical conclusions; we need this development in breadth. And yet, on the other hand, we must go into detail with specific problems. We should go deeper and deeper into particular problems until we are also able to go into their theoretical ramifications.

But first we have to lay a sound foundation. That is what we have been trying to do in the survey work which has occupied us in the Laboratory to date.



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PAUL EPSTEIN

He has not only contributed to the scientific development of his students at Caltech, but to that of his colleagues as well

PAUL S. EPSTEIN came to Caltech as Professor of Theoretical Physics in 1921. Except for a brief trip in 1913, he had never been in America before. He had studied and taught at some of the great European universities—Moscow, Munich, Zurich, Leyden—and in Pasadena he felt professionally isolated. To keep in touch, he decided, he would have to go back to Europe at least every two years. But he never had a chance to carry this program out. Gradually, the physics group at Caltech grew to be one of the most stimulating in the world.

One of the main reasons for this was the presence of Paul Epstein himself. At Caltech he has not only contributed enormously to the scientific development of his students, but to that of his colleagues as well. His eminence and authority extend well beyond the field of physics, and science, into such diverse fields as philosophy, psychoanalysis and art. He is, in the true sense of the word, a scholar, and his field of interest is the whole field of knowledge.

His regular reading, for example, includes scientific journals and publications in Russian, German, French and English. When he has exhausted these, he relaxes with the Encyclopedia Britannica, which he is reported to be steadily working his way through.

His encyclopedic knowledge is a source of constant astonishment on the campus, as it was to the colleague who once made a wildly inaccurate statement concerning, of all things, cheese-making, in Epstein's presence. He was calmly deluged with a jumbo assortment of accurate facts about it.

"Just my luck," the man said later. "He was probably on 'C' in the Encyclopedia."

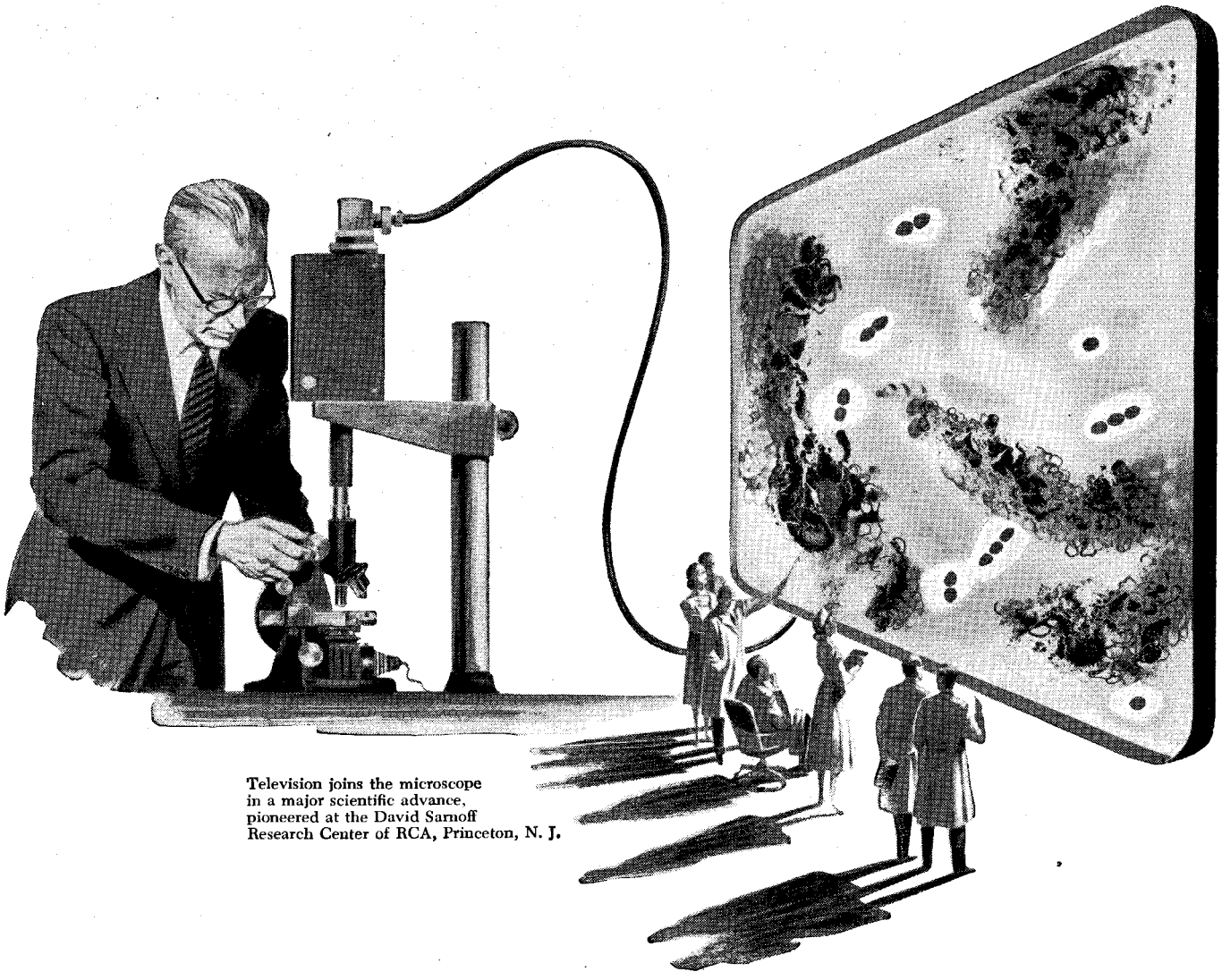
But Epstein's uncanny memory is a source of equally constant astonishment.

"I happen to know," another colleague explained, "that he's on 'M' by now."

He first became interested in psychoanalysis in 1912, when he met the great Freud in Switzerland. As usual, there was nothing idle about this interest, and he is even reputed to have carried it to such an extent that he was able to analyze himself. True or false—if *anyone* has ever done it, it would have been Paul Epstein.

He was born in 1883 in Warsaw, Poland, which was then in Russia. His parents died when he was quite young, so that he was largely raised by his grandparents in Minsk.

Education wasn't taken for granted in those days, and in that place. At the age of nine Paul was eligible to take the entrance examinations for the local school, run



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by the central government, in Minsk. A good many of the students dropped out of school after the eighth grade because they could then go into the army, and eventually become officers, but Paul went on to the end.

In 1901 he entered the school of mathematics and physics of the University of Moscow. He was one of 60 students accepted, out of a total of 300 applicants. The school of mathematics and physics was the smallest of the separate schools (biology, chemistry, history, etc.) which made up the University of Moscow. The law and medical schools were the largest, with about 2,000 students each, and total registration at the University was between 9,000 and 10,000.

All students were rigidly disciplined, and had fatigue uniforms for everyday wear, with splendid dress uniforms for special occasions. Despite the discipline, however, there were frequent and violent student disturbances, for these were the years leading up to the Russian Revolution. In 1905, the year of the first revolution, classes at the University had to be discontinued entirely. Paul worked through the year in the laboratory, boarding in a private home near the University.

The University reopened in 1906, and after he was graduated that year, Paul became an instructor in the physics lab of the Moscow Agricultural Academy in the suburbs, while he continued studying for his graduate degree at the University.

Aspirant to Magistrant

In order to teach, which was what Paul intended to do, it was necessary for him to get the Russian master's degree, which would entitle him to become an assistant professor. The requirements for this degree were far more stringent than those for the doctor's degree in this country. First, a student had to be appointed an Aspirant—meaning that he was qualified to proceed. Then, two years after starting his graduate studies, he was admitted to the examinations for Magistrant. There were five separate examinations, which had to be taken in the presence of the faculty—which met only about seven or eight times a year. The process took between one and two years, and if a man came through all five exams he had only to defend his thesis and make it public—and he was a Magistrant.

Paul got his degree in 1909 and was appointed Assistant Professor of Physics at the University of Moscow. After a short term of service, however, he took a leave of absence and went to Munich to study under Sommerfeld.

He lingered on in Munich, getting frequent extensions of his leave. Actually, he had no intention of going back to Moscow. The threat of revolution hung over the country, work at the University was difficult, and, most important of all, it did not seem to Paul that the revolutionists had any more idea of freedom than did the Czar.

In 1913 Paul made a trip to America to see something of our universities. Being unfamiliar with American ways, he came in the summer when most of the universities were closed. So he went sightseeing across the country instead. At Berkeley, where the university *was* in session, he met Richard Tolman, later his friend and colleague at Caltech. In Pasadena, visiting friends, he journeyed to the Mount Wilson Observatory—by pack mule from Sierra Madre.

In 1914, still in Munich, Paul got his doctor's degree—fortunately just before war broke out. As an enemy alien he was interned for a short time, then released and allowed to continue with his research throughout the war, though he had to report daily to the police. In time, when every available man was in the German Army, he even began teaching again, but this had to be sub rosa; his name was not listed in the university catalogue.

Zurich, Leyden and Caltech

In 1919, after the war, Paul became Assistant Professor of Physics at Zurich University in Switzerland, then went to Leyden University as assistant to Professor H. A. Lorentz. It was there that he met R. A. Millikan, who was scouting for Caltech personnel, and in 1921 Paul came to the California Institute.

Except for two stints (1927-29) as Exchange Professor at the Aachen Institute of Technology he has been here ever since. Though he lost his desire early for a bi-annual refresher trip to Europe, after 32 years he still lends a European air to the Caltech campus. He is the guiding spirit of at least two informal evening discussion groups which are probably the best local substitute for those he used to lead in the Munich beer-halls. He writes English as well as most English professors, but still calls on colleagues to check his writing for Teutonisms.

"Is it because you still think in German?" a colleague once asked him.

"No," he explained, "I *think* in Russian, translate into German, and then write in English."

Some Honors

He is a Fellow of the American Physical Society, of the French Physical Society, and of the Russian Physical Society—"if they still keep me on." He let his membership in the German society lapse. He was a member of the National Research Council from 1928-30, and has been a member of the National Academy of Sciences since 1930. He is a Trustee of the Psychoanalytic Institute of Los Angeles, a Board Member of the Psychoanalytic Study Group of Los Angeles, President of the Jewish Academic Society of Southern California, Chairman of the Los Angeles Chapter of the Academic Council of the Friends of the Hebrew University, and a member of the Congress for Cultural Freedom—the international body recently set up to organize professional men, writers, scientists and artists in the fight against Communism.

Here we go again!

"March 15th, Tax Day, is around the corner . . . and here I am, wrestling with Form 1040 again! You, too, I'll bet.

"Sure, I gripe about it *every* year. Who doesn't? It's like yelling at the umpire. Or beefing about the weather. That's our privilege!

"But this year's taxes really hurt. Now don't get me wrong . . . I *believe* in taxes. Can't run a government without taxes. And when it comes to our government spending money *honestly and efficiently* for Defense, Freedom or Good Government . . . it can have the shirt off my back.

"But down at the Republic plant I work hard for my dough. And, naturally, I get burned up when I read about a lot of money being spent *foolishly* by our government. That, of course, goes for all levels of government . . . federal, state, county and local. They're *all* run on our tax money . . . yours and mine.

"And when I say 'our' tax money, it reminds me that *companies* groan about taxes, too. *They've* got 'living expenses' same as we do, and taxes take an even bigger bite out of their income than they do out of ours.

"What's left of *our* pay, we call savings. What's left of a *company's* 'pay', is called profits. It is profits that create new jobs by improving and expanding industry. Without company profits, a lot of us citizens would *lose* our jobs.

"To get back to this business of *spending* . . . my wife runs our home with simple, sensible day-by-day economy. And so do my neighbors' wives. So does any well-managed business. So why shouldn't our government . . . national, state, county and local . . . practice that same common-sense economy, too? With, I repeat, *our* hard-earned dough!"

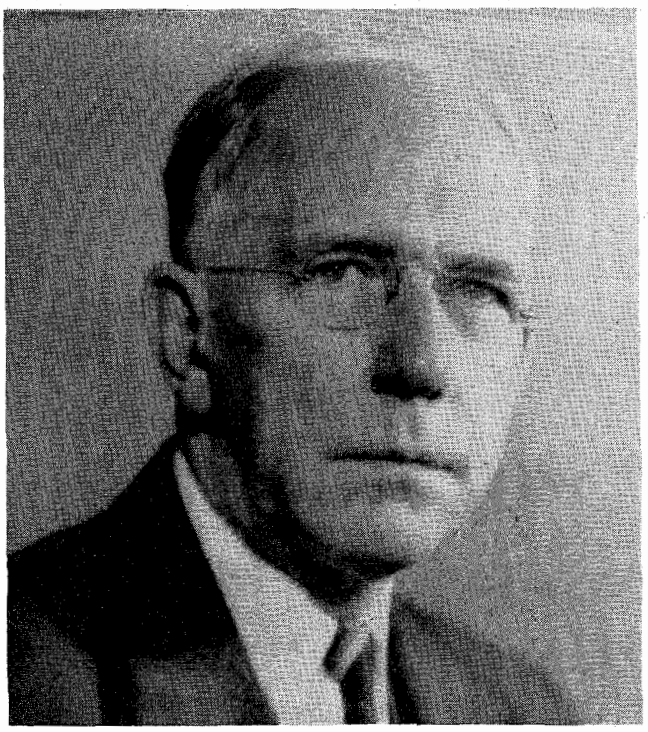
REPUBLIC STEEL

Republic Building • Cleveland 1, Ohio

Republic BECAME strong in a strong and free America. Republic can REMAIN strong only in an America that remains strong and free . . . an America whose vast Railroad Industry is unsurpassed. *And through railroading, Republic serves America.* Republic steel goes into track bolts and spikes...and into powerful locomotives that thunder over the tracks. Republic's famed Enduro Stainless Steel is found, inside and out, on gleaming streamliners that crisscross the nation. And in roundhouses and repair shops, tools and machines made of Republic steel help keep America's rolling stock rolling, come peace *or* war.

* * *

For a full color reprint of this advertisement, write Dept. H, Republic Steel, Cleveland 1, Ohio.



Edward C. Barrett

THE MONTH AT CALTECH

Ned Barrett, 1880-1952

EDWARD C. BARRETT, Secretary of the Board of Trustees and Comptroller of the Institute, died of a heart ailment at the Huntington Memorial Hospital on February 23. He was 71 years old.

Ned Barrett had been associated with Caltech—and with Throop Polytechnic Institute and Throop College of Technology before it—for 41 years, one of the longest periods of service among the Institute staff.

Born on March 20, 1880, in Springfield, Massachusetts, he moved with his family at the age of nine to Burlington, Iowa, when his father became Secretary of the YMCA there.

He studied law at the University of Iowa, where he received the Bachelor of Arts degree in 1906. From 1906 to 1911 he was Registrar and Secretary to the President of the University. He married a former classmate, Mary Parsons West of Sioux City, Iowa, on June 19, 1907.

Mr. Barrett came to Throop Polytechnic as Secretary of the Board of Trustees and Business Agent in February, 1911, during the presidency of Dr. James A. B. Scherer. He was appointed Assistant Treasurer of the Board in 1912 and a lecturer in business law in 1914, serving the school in that capacity for seven years.

He was Secretary of the Executive Council during its entire existence from 1921 to 1945 as the administrative body of Caltech under the chairmanship of Dr. Robert A. Millikan. He was also Assistant Secretary and Assistant Treasurer of the California Institute Associates, organized in 1925. In 1934 he was named Comptroller of the Institute.

He was a member of the All Saints Episcopal Church in Pasadena, which he had served as a vestryman. His other affiliations included membership in the Twilight Club, of which he was President in 1936-37.

Survivors include his wife, Mary, and three sons: George West Barrett, Rector of the St. James Episcopal Church in Los Angeles; Edward Newell Barrett, attorney, of Pasadena; and Donald Parsons Barrett, attorney, of Oakland, California.

Among those who paid tribute to Mr. Barrett for his long and faithful service to the Institute was James R. Page, Chairman of the Board of Trustees. "His loyalty and devotion to the Institute," said Mr. Page," and his meticulous care of all affairs entrusted to him made him of inestimable value to the Board. He was an ideal Comptroller and a greatly respected friend."

Caltech President Lee A. DuBridge said: "Mere words are wholly inadequate to pay proper tribute to Edward C. Barrett for his four decades of wise, kindly and loyal service to the Institute. From his arrival in 1911 to the present time he carried major responsibilities for the business and financial affairs of the Institute and for many years he was its only full-time business officer. His personal knowledge of all aspects of the Institute's history and affairs was unsurpassed. But Ned Barrett was more than just a corporate officer; he was the beloved personal friend of most of the members of the faculty and administration. He and Mrs. Barrett made a special effort to befriend new faculty members and their home was the frequent gathering place for an ever growing group of new and old friends."

CONTINUED ON PAGE 26

When You Find the Work You Like

STAY WITH IT!

GORDON W. CLOTHIER

by GORDON W. CLOTHIER, *Manager, Transformer Section, Electrical Department*
ALLIS-CHALMERS MANUFACTURING COMPANY (*Graduate Training Course 1938*)

THAT'S a good plan, but there's just one little catch in it; sometimes it takes a good while to *find* the work that's right for you. If you're worried about that, perhaps my own experience will point out a practical shortcut.

I got my E. E. at the University of Washington in 1935, and went on with graduate work and teaching for another year. Then—into the practical business world. That's when I found the shortcut. I enrolled in the Allis-Chalmers Graduate Training Course in 1936, and very soon I got interested in the big transformers. I've been with them ever since, and they've given me a lot in accomplishment and satisfaction.

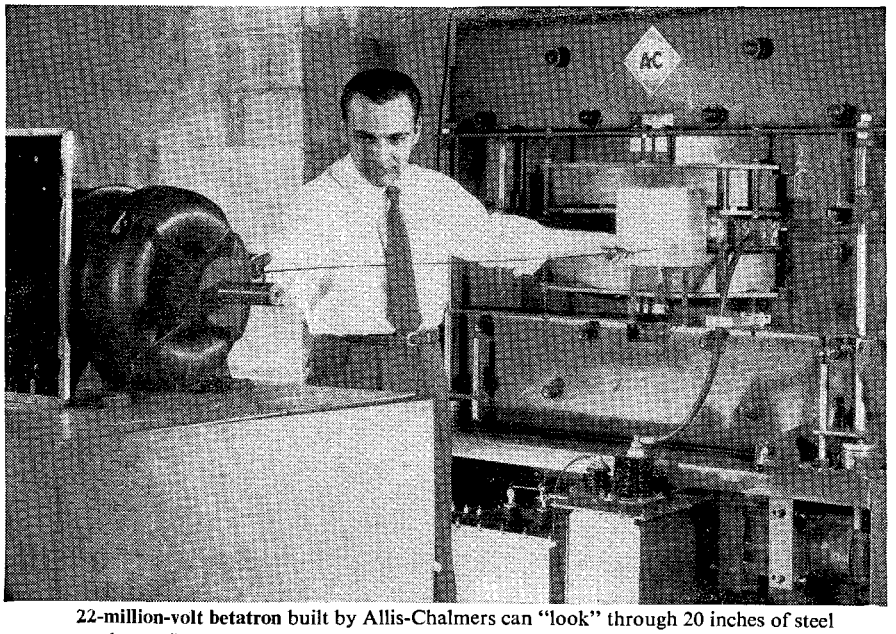
Back to Stay

Of course, during two years in the Graduate Training Course I got around a good deal in the big West Allis works. Had some time in the shops, got acquainted with the work of many departments, tried my hand at design, test, sales application work. But I came right back to transformers and have always been a lot more satisfied because I'd seen a broad range of other types of products and work at Allis-Chalmers.

In 1941 I became engineer in charge of transformer sales, and in 1947 was made manager of the transformer section.

This field offers both challenges and rewards. It needs and seeks men of superior intelligence, imagination and creative ability—men who will strike out into new paths of study and development.

If you think a transformer is an inert mass of iron and copper windings in a tank of oil—look closer. There are advanced problems in magnetostriction that if solved, will eliminate transformer hum and revolutionize the business. It's the same with problems in metallurgy, insulation, measurement and control of electric field shapes and the effects of time on materials. Perhaps some young engineer, even during his Graduate Training Course days here, may make important contributions. The opportunity is waiting.

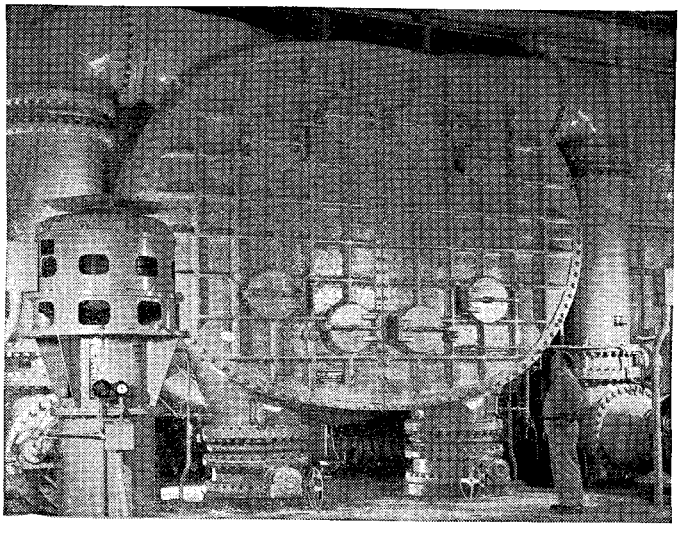


22-million-volt betatron built by Allis-Chalmers can "look" through 20 inches of steel to detect flaws. Here a technician is setting up motor specimen for radiography.

What Do You Want to Do?

It's the same in other departments at Allis-Chalmers. Ore processing methods and machinery—electronic equipment—public works—steam turbine and generator design—hydraulics—manufacturing—research—sales—they all hold opportunities. Here you'll have a chance, as a Graduate Training Course engineer, to look over the widest range of industrial fields covered by any manufacturing firm in the country. You can help plan your own course, get advanced degrees. It's a shortcut to finding the work of your choice.

Write for information and literature, or call on the Allis-Chalmers district office in your locality.



Two-pass 45,000 sq. ft. surface condenser and two 42" x 30" vertical mixed flow pumps. Allis-Chalmers oval design saved space in this big new power plant.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

Said Dr. Millikan, Professor of Physics, Emeritus, and Vice President of the Board of Trustees: "It is the lot of very few men to be as deeply mourned as Ned Barrett will be. He was a very much beloved man, friendly, capable and of unimpeachable integrity. His great interest in the Institute, his love of his work, his excellent memory and grasp of detail, his sure hand in financial matters, and his helpfulness, justice, and understanding in all his relations with his colleagues made him a most valuable member of the staff. His death will be felt keenly not only by the whole Institute family but also by his host of friends in the community."

Dr. William B. Munro, Professor of History and Government, Emeritus, and Treasurer of the Board of Trustees, said: "He was a grand person and one of the best-liked men on the campus even though in his difficult position as Comptroller he usually had to say no to people who came to him for concessions in their financial appropriations. We all admired him for his patience, good humor and kindly cooperation. He was the good friend of many and we will miss him."

Religion and Science

DR. ARTHUR H. COMPTON, Chancellor of Washington University in St. Louis, Nobel prizewinner and internationally-known physicist, spoke on "Religion and Science Shaping Man's Future" at a public meeting in Pasadena on February 18. The meeting was arranged by the Religion in Education Foundation of Los Angeles, and was sponsored by Caltech and Pasadena City College, in cooperation with Pomona, Occidental and Whittier Colleges and the University of Redlands.

"The world's most important chain reaction will occur when men catch a spirit of world brotherhood," Dr. Compton said. "We are on the threshold of such a reaction that will make the world truly free.

"In an atomic reaction there are some atoms that capture neutrons and won't let them go, thus poisoning and slowing down the entire reaction. Just so, in human relations, those individuals who only receive, and never give, poison the brotherhood of man.

"We have now entered the second half of the twentieth century. If I am not mistaken, the first half of this century will be remembered in the long view of history as epochal in the effect that the advance of science has had on man's view of himself. We have come to understand at long last our place in space and time. We have learned that we are an integral part of the great cosmic event which we call nature, but with certain distinctive characteristics: We are aware of our world, we are able within expanding limits to shape the world to our needs, and reaffirming that we are indeed our brothers' keepers, we find in this fact real meaning for the life of which we are a part.

"The social forces that science and industry are bringing into being are working directly for giving new life to the American dream ('not a dream of motor cars and high wages merely,' said the late historian James Truslow Adams, 'but a dream of a social order in which each man and each woman shall be able to attain to the fullest stature of which they are innately capable, and be recognized for what they are regardless of the fortuitous circumstances of birth and position').

"Thus as the counterpart to specialization there is increased stimulus toward working for each other's welfare. With our greater interdependence we feel an increasing need for humane goals on which we will unite. Our world demands of us more education, not only in techniques and skills but also in human understanding. Travel becomes easier and more widespread. Ideas are more readily interchanged. There thus arises better acquaintance with our neighbors. Our own best development we see arising from our endeavor to bring into being the world of our dream.

"Science offers us the means whereby the dream can be realized . . . The thrilling discovery of the twentieth century is that man may reasonably hope to free himself very largely and permanently from the curses of poverty and disease as causes of premature death. Instead he may reasonably hope for continued improvement of his lot, not only as to his physical needs, but also as to his human understanding.

"Such advances will not come, however, as the automatic result of advancing science. High aspiration, guided by appreciation of the worth of one's fellows, is necessary if the powers of science are to meet the human needs that we see ahead. Because the desire to enable our fellows to live is so clearly demanded as a condition for survival in a society based on science, one has confidence that the spirit which has been effective toward making possible our recent advances will itself continue to grow."

National Science Foundation Grants

THE INSTITUTE last month received $54,900 in grants from the National Science Foundation for research in biology. This was the largest sum given any California institution. Nationally, the Foundation made a total of 28 grants, amounting to $410,000.

Dr. Frits W. Went, Professor of Plant Physiology, received a three-year grant of $21,700 for studies of differences among races and varieties of higher plants.

Dr. James F. Bonner, Professor of Biology, received a two-year grant of $17,700 for studies of photoperiodism and vernalization, and a one-year grant of $10,500 for work on the biochemistry of plant growth.

Dr. Arthur W. Galston, Associate Professor of Biol-

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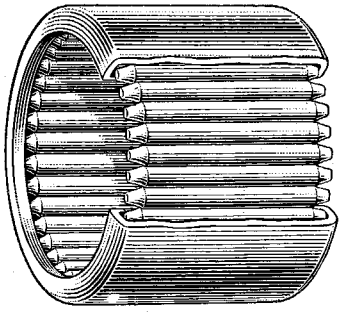
The Torrington Needle Bearing is designed for high radial loads



The many lineal inches of contact provided by the larger number of small diameter rollers give the Torrington Needle Bearing an unusually high load rating. In fact, a Needle Bearing has greater radial capacity in relation to its outside diameter than any other type of anti-friction bearing. This is illustrated in the table below, which compares the dimensions of three bearings with identically rated radial load capacities.

	O. D.	I. D.	Axial Length
Torrington Needle Bearing No. B-1616	1¼"	1"	1"
Ball Bearing No. 405	3.15"	.98"	.83"
Bronze Bushing 3 sq. in area of bearing surface	1⅞"	1½"	2"

Dimensions for three types of bearings, all having the same rated radial load capacity.

Precision Manufacture and Unique Design

The exceptional load capacity of the Needle Bearing is the result of proper selection of steels, precision workmanship to close tolerances, and the application of modern anti-friction principles.

The one-piece shell, which serves as the outer raceway and retains the rollers, is accurately drawn from carefully selected strip steel. After forming, it is carburized and hardened. There is no further grinding or other operation that might destroy the wear-resistant raceway surfaces. The full complement of thru-hardened, precision-ground rollers is retained by the turned-in lips of the one-piece shell.

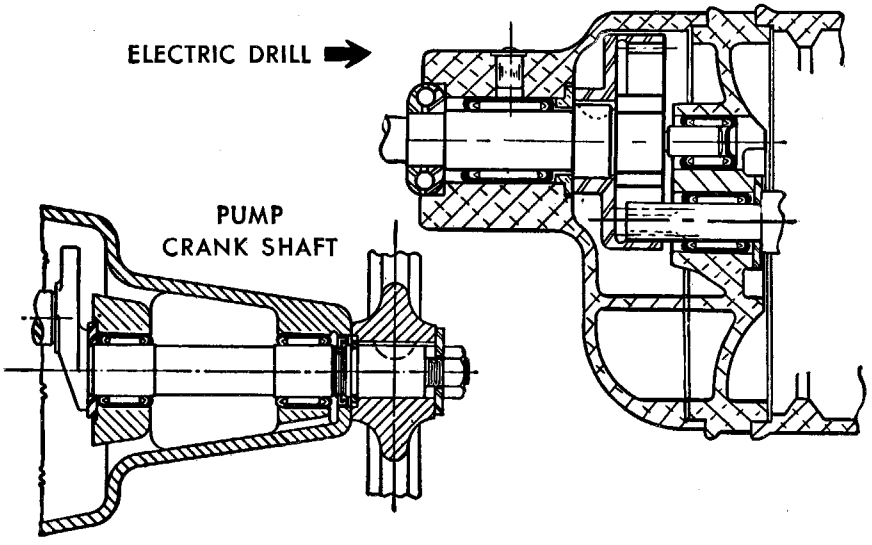
As the shaft is intended to serve as the inner race in most applications, it is hardened and ground to correct size. If an unhardened shaft is desirable, inner races can be furnished with the proper hardness.

Plus Features For Modern Design

The unit design and compact size of the Torrington Needle Bearing provide other, related advantages which are being utilized in more and more applications.

The outer shell is easily seated by press fit into a straight bore housing, machined to the proper dimensions. No complex housing structures are needed — no spacers, retainers or snap rings required. And the compact size and light weight of the bearing itself also help make the end product lighter and less bulky.

Wherever high radial load capacity is vital, but space and weight are at a premium, Torrington Needle Bearings provide an ideal solution.



High radial load capacity is vital in many bearing applications.

Future advertisements in this series will discuss other specific advantages of Needle Bearings. If you would like further information on these or any other type of anti-friction bearings, our engineering department will be glad to be of assistance.

THE TORRINGTON COMPANY
Torrington, Conn. • South Bend 21, Ind.
District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON NEEDLE BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • STRAIGHT ROLLER • BALL • NEEDLE ROLLERS

ogy, received a one-year grant of $5,000 for studies of auxin physiology.

Harrington Wilson Comet

DR. ALBERT G. WILSON and Robert G. Harrington, of the Mount Wilson and Palomar Observatories, discovered a new comet on January 30. They've named it the Harrington Wilson Comet.

The comet is invisible to the naked eye, and was recorded on a photographic plate with the 48-inch Schmidt telescope. It's the first new comet to be found this year, and the fifth to have been discovered during the past two years by astronomers working on the National Geographic-Palomar Observatory Sky Survey. It's located in the constellation of Virgo (the Virgin) and is moving toward the constellation of Coma Berenices (Bernice's Hair).

Civilization Against the Sea

ENGINEERS AND SCIENTISTS specializing in water supply problems and atmospheric phenomena met at Caltech on February 8 and 9 for a Pacific Southwest regional meeting of the Hydrology and Meteorology Sections of the American Geophysical Union.

Of the 27 papers presented—dealing with water supply and its utilization, winds, rain, the upper atmosphere and related subjects—the most interesting was probably "Civilization Against the Sea." Prepared jointly by Harvey O. Banks and Raymond G. Richter of the California State Division of Water Resources, the paper revealed that California is confronted with a constant battle with the sea to keep salt water from intruding into ground water basins bordering the coast and inland bays.

Several methods of control have been suggested to stop the encroaching sea: (1) Raising ground water levels to or above sea level by reducing or rearranging the pumping pattern; (2) Maintaining a fresh water pressure ridge above sea level along the coast; (3) Building artificial subsurface dikes along the coast and inland bays.

The California State Legislature during its 1951 session appropriated $750,000 to the State Water Resources Board for an experimental program to discover the best control methods.

In another paper, "Water Quality Problems in California," Harvey O. Banks and Jack H. Lawrence of the State Water Resources Board reported that the Board is currently conducting a state-wide investigation of water pollution, which has been on the rise ever since California's phenomenal wartime industrial development and population increase.

Tau Beta Pi

FOURTEEN CALTECH students were initiated into the campus chapter of Tau Beta Pi, national honorary engineering fraternity, last month.

The initiates included Wilbur J. Barmore, Manuel J. Crespo, Robert S. Deverill, Alan M. Haire, Rolf C. Hastrup, Clinton Lew, J. Crawford Noll, Hajimu Ogawa, William J. Rihn, Sheldon Rubin, Howard A. Shugart, Augusto L. Soux, Edwin J. Stofel, and Perry H. Vartanian.

Tau Beta Pi members are selected from the upper fifth of the senior class and the upper eighth of the junior class on the basis of undergraduate scholastic performance in scientific and engineering pursuits, as well as high qualities of character and participation in extra-curricular activities.

The Caltech chapter, one of 88 in the United States, was founded in 1921.

THE BEAVER

Some Notes on Student Life

THE ASCIT ELECTIONS this year were unusual. In each election for at least the last four years, only two men ran for president; this year there were three. This year's student body elections were further distinguished in that only one man was nominated for the important office of vice-president.

For almost a whole week members of the student houses and Throop Club looked up from their dinners and heard the time-worn speech:

> My name is....., and I'm running for the office of..... I feel that I am well qualified for this office. In high school I was..... and here at Tech I have..... Now the duties of the office of..... are..... I have the experience, the interest, and the enthusiasm to serve YOU, the students, as a responsible.....

The triteness of the campaign speeches was not to be found in the campaign posters adorning the Olive Walk. A revolving sign encouraged voters to consider La-Tourette and Fazio, and a sign one foot high and a half block long admonished, DON'T GO INCHES, GO

CONTINUED ON PAGE 30

Even in Sub-zero Weather...

COLUMBIA-SOUTHERN CAUSTIC CARS HELP INSURE EASY UNLOADING WITHOUT STEAMING!

During the transporation delays of the 1951 winter, a car of liquid caustic soda was shipped January 25 from Columbia-Southern's Natrium, West Virginia, plant . . . arrived Chicago January 30 . . . spotted February 9 . . . unloaded February 12 *without the use of steam, and with a full line within a minute.*

During this nineteen day period the car was in transit, outside temperatures were mostly below freezing, twice reaching as low as 15 degrees below zero! Yet easy unloading was assured by the efficiency of the Columbia-Southern designed car.

The Columbia-Southern caustic tank car is one of the many valuable contributions to industry made by Columbia-Southern, pioneer in better transportation and handling of liquid caustic soda.

Columbia-Southern's policy is not only to make the highest grade caustic soda, but to ship it with caution and care.

Among the tank car features pioneered by Columbia-Southern are:

· the patented tank car lining which permits delivery of liquid caustic soda without metallic pick-up in any concentration · the fusion welding which eliminates rivets as a possible source of leaks · increased tank car insulation · greatly improved heating equipment · and numerous other unloading and safety improvements.

COLUMBIA-SOUTHERN
CHEMICAL CORPORATION

SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY

EXECUTIVE OFFICES:
FIFTH AVENUE AT BELLEFIELD • PITTSBURGH 13, PA.

DISTRICT OFFICES: BOSTON • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • HOUSTON • MINNEAPOLIS • NEW ORLEANS • NEW YORK • PHILADELPHIA • ST. LOUIS

MILES! RALPH MILES FOR SECOND REP! DON'T GO INCHES, GO MILES . . . There was no shortage of pin-up girls (pictures, that is) to remind one that various candidates were in the running, and one pin-up said nothing more than I DON'T GIVE A DAMN—JUST VOTE!

Election Rally

In addition to speeches and posters, the candidates had an opportunity to present to the masses of voters their views upon less vital topics at the annual Election Rally, held this year, as during the last few years, in Culbertson Hall. Shorn of the formalities and respect traditionally given candidates for public office, the ASCIT hopefuls had an opportunity to get down to bare facts in an atmosphere more like a typical college than Caltech. It was here that stage personality and the ability to tell a joke became decisive assets.

The Machines

ASCIT elections have no formal relation to the political institutions of the student houses. But it seems to be a tradition, understandably enough, for each house to regard with much pride its own men elected to the ASCIT Board of Directors. And more often than not, the houses prepare their own unofficial slates, each house trying to sweep as many ASCIT posts as possible without letting the obvious seem too obvious. Very seldom do two men from the same house run for the same office, and almost never for a high office. But this year's election was again unusual in that two of the three presidential candidates were from Dabney House. Both lost, the second in a close runoff with John Gee of Fleming House.

Posing for publicity pictures comes natural to candidates running for the job of Publicity Manager.

The elected members of the ASCIT Board were, however, very evenly distributed among the houses.

House Elections

Candidates defeated in the ASCIT elections have another chance to run for office in the student house elections which are held by each house and Throop Club the week after the ASCIT elections. The house candidates are well known by all the members of their respective houses, and thus campaigning has far less effect. The campaigns are generally limited to a short

CONTINUED ON PAGE 32

John Gee, shown here (left) doing a little campaigning on his own account, won the election in a close runoff vote.

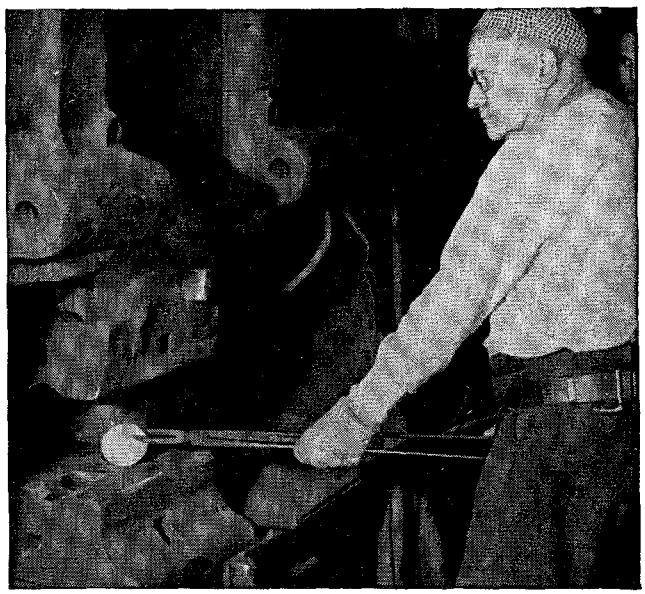
What's Happening at CRUCIBLE

about tool steel forgings

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

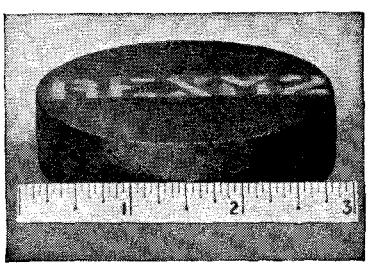
Crucible's reputation as the specialty steel leader is built on a devotion to the smallest detail . . . regardless of the size of the order.

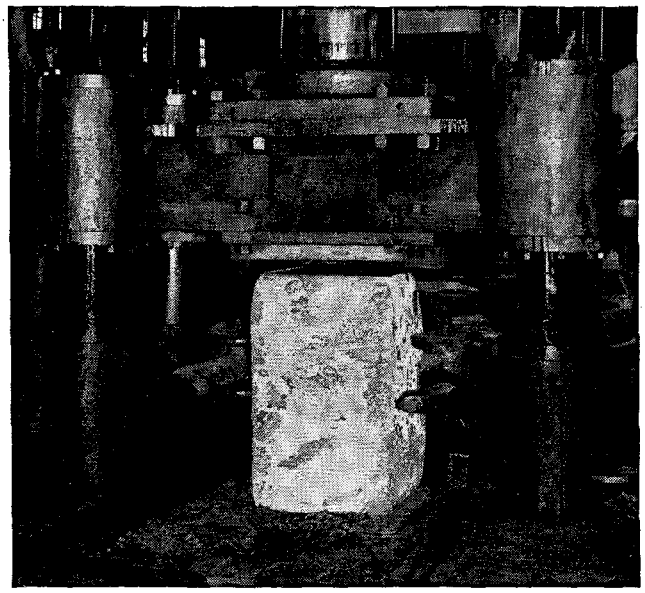
These forgings are good examples of Crucible specialists at work:

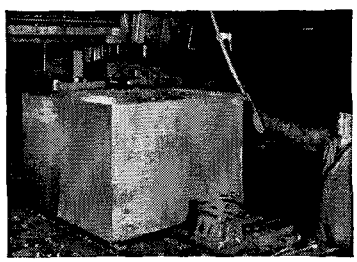


Rex M-2 High Speed Steel Disc Forging (1½ pounds)

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







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

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

Engineering service available

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

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

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

campaign speech, which is often a vehicle for humor. Last year one candidate took advantage of this opportunity to produce a rabbit to the surprise and amusement of his audience.

It is often difficult for potential house candidates to maintain that virgin-like look of political innocence when the subject of the approaching elections crops up in a bull session. An obvious candidate for a student body office who declines because he "doesn't have the time" surprises no one a week later when he suddenly finds the time to run for a house office. For a week before the nominating meeting, certain individuals are seen doing more than the usual amount of talking and joking in the lounge, attending a relatively large number of social and athletic functions, and generally calling the attention of their fellow house members to the fact that they exist. From then on, it is only a question of which office they will seek.

It is then that platforms are solemnly drawn up and personalities are considered with a thoroughness one usually reserves for such important decisions as buying a car. And it seems strange to those few who stop to think about the whole subject of the houses and their elections, that despite the varied personalities who have led each house in the past few years, the personality of each house has remained remarkably constant.

To the freshmen, the choice of who shall lead their house is nothing short of momentous; to the sophomores, the elections afford one last interesting diversion before the onslaught of second term finals. To the juniors, the elections are of some importance, and generally it is the juniors who run for the highest offices, always for president.

The seniors look upon elections as dispassionately as we moderns look upon the Battle of Marathon. It may be important—but then, so what? This is representative of all attitudes developed by Caltech seniors in the home stretch of the maddening race which constitutes their college career. As one senior, who only a year ago was completely enmeshed in the web of campus politics, haughtily remarked: "It all seems like a bunch of little men, running around on a little checkerboard, without any purpose."

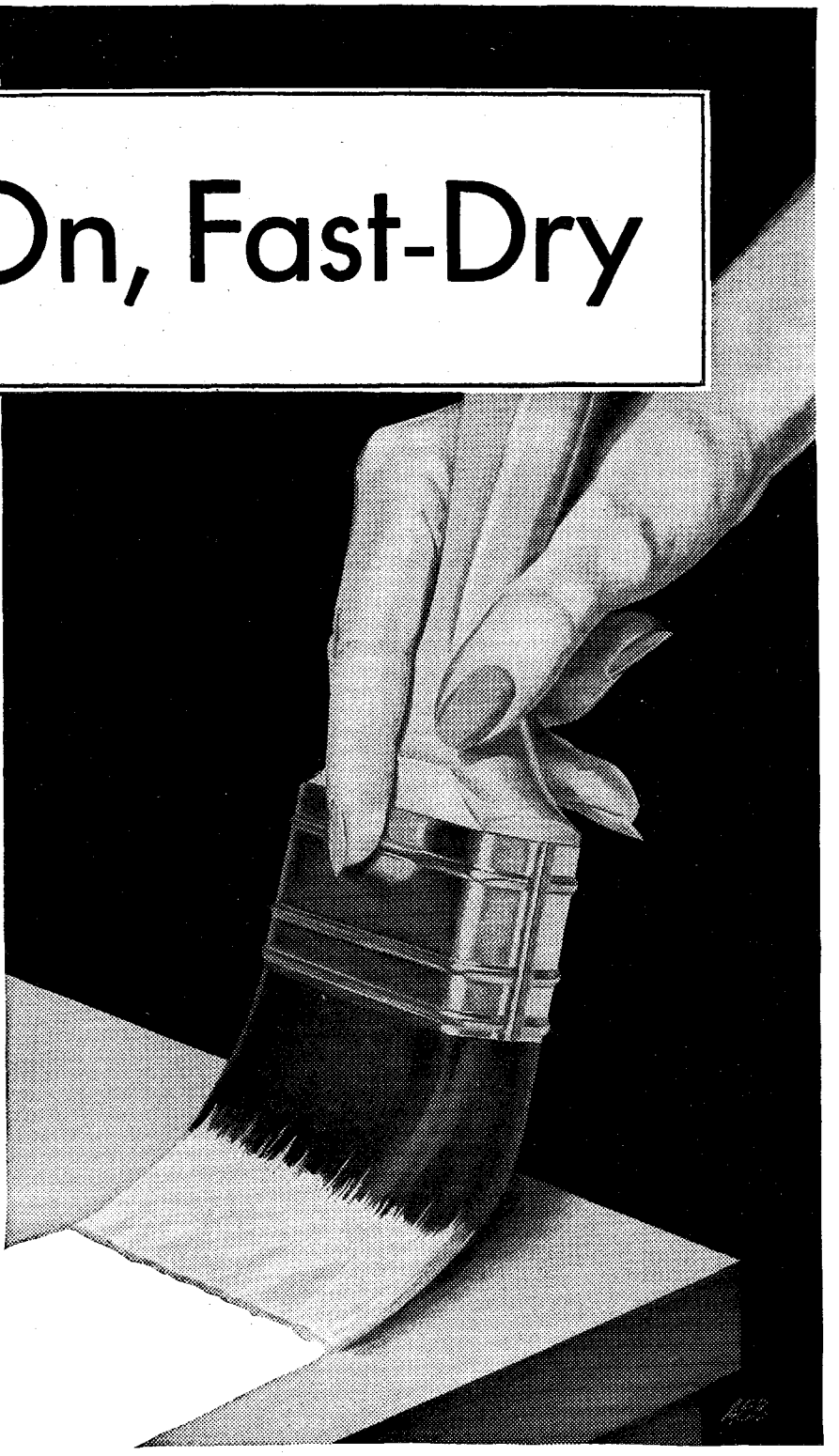
For the Stragglers

For those who are left after the ASCIT and house elections at the end of the second term, the class elections are held during the third term. A man unknown before the ASCIT elections can gain enough prestige just from running in a few elections, even though he loses, to try his luck running for a class office.

Yes, Caltech is most certainly a land of plentiful opportunity!

—Al Haber '53

Easy-On, Fast-Dry



CHEMICAL PROBLEM...

. . . to help make enamels that combine fast drying and easy brushing—advantages not always found together in the two types of enamels most used today. One type of enamel brushes easier, the other dries faster.

SOLUTION...

. . . a new Hercules resin, Pentalyn® B-56. It reacts chemically with the other paint ingredients to favor neither drying speed nor brushing qualities unduly, but to provide the very best combination of both.

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...

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

HERCULES

HERCULES POWDER COMPANY (INCORPORATED) *Wilmington, Delaware*

Sales Offices in Principal Cities

EC52-3

ALUMNI NEWS

New Board Members

THE BOARD OF DIRECTORS of the Alumni Association met as a nominating committee on February 14, 1952, in accordance with Section 3.04 of the bylaws. Five vacancies will occur on the Board at the end of the current fiscal year, one vacancy to be filled from the present Board and four members to be elected by the Association. The present members of the Board and the years in which their terms of office expire follow:

T. C. Coleman '28.....1952	H. N. Marsh '22.....1953
J. P. Foster '49.....1953	R. P. Sharp '34.....1952
P. W. Hubay '49.....1953	J. E. Sherborne '34....1952
K. E. Kingman '29.....1953	D. C. Tillman '45.....1952
W. O. Wetmore '37.....1952	

The four members of the Association nominated by the Directors are:

F. H. Felberg '42	A. A. Ray '35
F. M. Greenhalgh '41	K. F. Russell '29

Section 3.04 of the bylaws provides that the membership may make additional nominations by petition, signed by at least ten (10) regular members in good standing, provided the petition is received by the Secretary not later than April 15. If further nominations are not received by April 15, the Secretary casts a unanimous ballot for the members nominated by the Board. Otherwise a letter ballot is required.

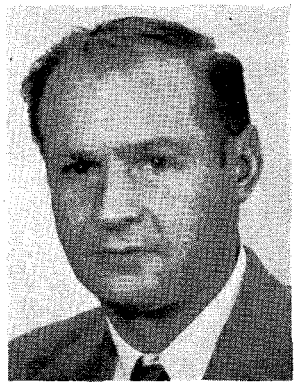
Statements about the nominees of the Directors are presented in this issue of *Engineering and Science.*

—Donald S. Clark, Secretary

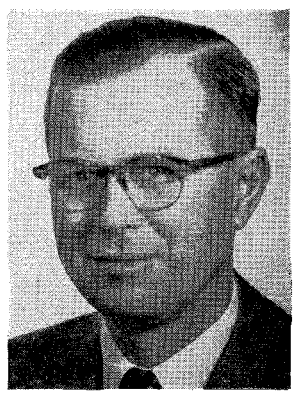
The Nominees

FRED H. FELBERG got his B.S. in 1942 and stayed on at Tech to work on the staff of the 10-foot wind tunnel in the Aeronautics Department and get his M.S. in 1945. That year he joined the staff of the Southern California Cooperative Wind Tunnel, operated by Caltech, and has been there ever since. In 1946 he was appointed Lecturer in Aeronautics at the Institute and has continued in this appointment, teaching courses in airplane aerodynamics in the Aeronautics graduate school. In 1951 he was appointed Modification Project Coordinator to handle scheduling, budget control, and materials priority problems in connection with the 6½ million dollar expansion and modification program in progress at the Cooperative Wind Tunnel.

FRANCIS M. GREENHALGH, after receiving his B.S. in Mechanical Engineering in 1941, started work for the Caterpillar Tractor Company in Peoria, Illinois. He entered and completed their engineering training course, which covered experience in engineering, research, manufacturing, and sales departments. At the close of the training program, he went into Caterpillar's purchasing department. From 1943 to 1946 he served in the U. S. Navy, doing ordnance specialty work, then returned to the purchasing department at Caterpillar Tractor Company as assistant buyer. Since 1949 he has been in the purchasing department of the Southern Counties Gas Co., and is now technical buyer of electrical equipment, fabricated materials, tools, and special items.



ALLEN A. RAY received a B.S. in Mechanical Engineering in 1935. His first job was with the Union Oil Company of California as an engineering trainee at Wilmington and Oleum, Calif. From 1940 to 1942 he taught at Cogswell Polytechnical College in San Francisco, then worked for two years as a process engineer with the Permanente Metals Corp. at San Jose. In 1944 he entered the plastics field and in 1949 started Ray Products Company, manufacturing and fabricating plastic items for the medical profession. Allen is now Vice-Chairman of the Alumni Fund Committee for classes 1933-40.



KENNETH F. RUSSELL graduated in 1929 with a B.S. in Mechanical Engineering. Shortly thereafter he was employed by the Vortox Company (they make air cleaning devices) in Claremont. He's been with them ever since. He started out in the engineering laboratory, then worked his way through product engineer, production engineer, and chief engineer, to become general manager of the Company. He has also acted as a consultant both in design and management. Recently he has served as a member of the Air Filter Industry Advisory Committee for the National Production Authority. Last year he was chairman of the program committee for the Alumni Seminar, and this year he's Seminar chairman. His oldest son, Tom, is a senior in M.E. at Caltech.

Chapter Notes

THE SACRAMENTO CHAPTER held its first annual dinner dance on February 2, at the University Club. Walter Paulson, ex-'32, and Layton Stanton '27, Ph.D. '31, were in charge of the arrangements and decorations. Present with their wives were: Tracy Atherton '25, John Bailey, ex-'47, Herbert Deardorff '30, George Fleming, Oliver Folsom, ex-'41, Fred Goat '24, Edward Ida '46, Wayne MacRostie '42, Return Moore '47, M.S. '48, Henry Nies, '23, Arthur Root, ex-'26, Richard Silberstein '41, M.S. '42, and Jeffrey Wineland '31.

THE SAN FRANCISCO CHAPTER held an informal dinner dance in the Garden Room of the Hotel Claremont in Berkeley on Sunday evening, February 10.

PERSONALS

1917

A. R. Kemp, M.S. '18, has joined Narmco, Inc. as vice president, to direct research on new products in the company's plants in Costa Mesa and San Diego, Calif.

1922

R. W. Ager, Ph.D. '33, has been working on the problem of making U. S. weapons more effective since December, 1951, in the old Vista Del Arroyo Hotel. Whenever possible he spends weekends at Newport Beach where he built two apartments last summer.

1923

Douglas G. Kendall is sales executive for the Square D Company, in charge of special products for the western division. He is also president of the Crystal Cave Mining Company and vice president of L. W. Thompson Company, Inc., (Los Angeles agents for Roller-Smith Breakers) and the Knoxonian Charities Foundation, a charitable Masonic organization in L.A. His son, Jerrold, is at Stanford.

Elmer L. Smith and his wife have just moved into a new home in the Linda Vista district of Pasadena. Elmer is principal engineer for the Water Department of Pasadena, where he has worked for 29 years.

1924

Loys Griswold has moved from Honolulu where he was associated with W. A. Ramsay, Ltd., and is now working for the General Electric Company in Chicago.

1925

Michael Karelitz has been appointed Chief of the Engineering Section, in charge of mechanical engineering of the Research and Development Department of the Olin Cellophane Division, Olin Industries, Inc. in New Haven, Conn. Michael was formerly with the Perkin-Elmer Corporation and General Precision Laboratories. He was also with the U. S. Bureau of Reclamation at Denver, and the Radiation Laboratories at M.I.T.

1926

Allen Laws, since moving to Alhambra as district manager for the Edison Company, has become a member of the Board of Directors of the Alhambra Chamber of Commerce, the Alhambra Community Chest, the San Marino City Club, and fund chairman of the Alhambra Red Cross. These activities, plus the ones he was previously involved in, help to keep him busy.

Stuart L. Seymour has been in the building business since his discharge from the Army in 1946, and he reports a new subdivision in West Covina. His daughter starts South Pasadena High next year, and his son, Robert, is a prospect for Caltech next fall.

1928

Ralph S. Thacker joined the staff of Titeflex, Inc. of Newark, New Jersey, as a consultant, during the past year. He will be handling their engineering problems in the West, and will act as a consultant to their sales agencies, as well as to the factory. They have licensed under several of his patents on electrical connectors, and are now going into production on these. Ralph is living in Flintridge, Calif.

1930

R. Stanley Lord has recently received the Superior Accomplishment Award which is given to Federal employees for outstanding service over and above that normally required in regular line of duty. The award is a "one-step" promotion.

After graduation from Caltech, Stanley entered government service with the Geological Survey. He has served in California, Washington, D. C., Harrisburg, Pa., and Salt Lake City, Utah. He is now assistant district engineer for the California district, Surface Water Branch, with headquarters in San Francisco.

1931

Alex H. Levine writes that he has been manufacturing phonograph records for the past seven years in Los Angeles.

1932

John L. Cox is now assistant head of the design and production department at the Naval Ordance Test Station in China Lake. This constitutes a promotion from his job as assistant division head with the Navy's Underwater Ordnance Department in Pasadena.

William R. Bergren, Ph.D. '41, is Assistant Professor of Biochemistry and Nutri-

ALUMNI ASSOCIATION OFFICERS

PRESIDENT
Robert P. Sharp '34

VICE-PRESIDENT
John E. Sherborne '34

SECRETARY
Donald S. Clark '29

TREASURER
Henry R. Freeman '25

BOARD OF DIRECTORS
Theodore C. Coleman '26
Gerald P. Foster '40
K. E. Kingman '29
Paul Hubay '49
Hallan N. Marsh '22
William O. Wetmore '37
Donald C. Tillman '45

ALUMNI CHAPTER OFFICERS

New York Chapter:

PRESIDENT Howard E. Baker '30
Underwriters Labs., Inc., 161 Sixth Ave.

VICE-PRESIDENT Erwin Baumgarten '40
Calco Division, American Cyanide Co., Bound Brook, N. J.

SECRETARY-TREASURER S. Kendall Gold '42
Texas Oil Co., Ltd., 551 Fifth Ave.

San Francisco Chapter:

PRESIDENT Jerome Kohl '40
Tracerlab, Inc., 2295 San Pablo Ave., Berkeley

VICE-PRESIDENT Robert R. Bowles '41
California Research Corp., 576 Standard Ave., Richmond

SECRETARY-TREASURER Arnold L. Grossberg '42
California Research Corp., 576 Standard Ave., Richmond

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

Washington, D. C., Chapter:

PRESIDENT Comdr. Clarence A. Burmister '25
U. S. Coast & Geodetic Survey

SECRETARY-TREASURER Charles R. Cutler '45
800 World Center Building

Sacramento Chapter:

PRESIDENT Fred Groat '24
California Division of Water Resources,
Public Works Building.

SECRETARY-TREASURER Richard Silberstein '41
Arthur A. Sauer, Consulting Structural Engineer,
2203 13th St.

Chicago Chapter:

PRESIDENT LeVan Griffis '37
Armour Research Foundation, 35 W. 33rd St.

VICE-PRESIDENT Eben Vey '41
Illinois Institute of Technology, 3300 S. Federal St.

SECRETARY-TREASURER Harrison Lingle '43
Cherry Burrell Corp., 427 W. Randolph St.

tion at U.S.C. Medical School. He is also a research fellow in bone metabolism and consultant to the laboratories at Children's Hospital, Los Angeles. The Bergrens have moved to Altadena, and have a four-year-old son, Peter.

Harold Roach, M.S. '33, announced the newest addition to the clan, a daughter, Patricia Lynne, who arrived last February 10. The others include Stephen, 7, and Dennis, 5.

R. E. Foss is now vice president and manager of production for the California division of Sunray Oil Company. In 1935 he joined Barnsdall Oil Company and was still with the company when it was acquired recently by Sunray.

William Shockley has been asked to give the annual lecture of the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.

1933

Harald Omsted, M.S., is at present Chief Structural Engineer with the Los Angeles City Board of Education.

Lt. Comdr. Dick Plank was given 24 hours recently to make up his mind whether or not to take a job with NATO. He decided to take it—which explains why he and his family are now in London, England.

Lt. Col. Bob MacDonald is with the Army Office of Procurement in Ogden, Utah.

1934

Warren L. Patton is still a patent lawyer with Fulwider and Mattingly in Los Angeles. His son, Harvey Michael, was born last August, and his daughter, Kathleen, is now six years old.

1935

Herbert Ribner, together with Maurice Tucker, will present a paper entitled, "Turbulence in a Contracting Stream," at the Second Midwest Conference on Fluid Mechanics in Columbus, Ohio, March 17-19. Herb is an aeronautical research engineer in the division office of the eight-by-six foot supersonic wind tunnel at the National Advisory Committee for Aeronautics' Lewis Flight Propulsion Laboratory in Cleveland.

In 1940, he started to work at NACA's Langley Laboratory in Virginia, where he met his wife, Lelia, who was division secretary of the Pilotless Aircraft Research Division. They now have a daughter 8½ months old. He was transferred to the Lewis Laboratory in May, 1949. The research program there is centered primarily on the propulsion problems created by the advent of supersonic speeds.

Bernard B. Watson, Ph.D., was appointed Professional and Scientific Personnel Specialist of the Labor Department's Defense Manpower Administration. Since 1949 he has served as Specialist for Physics in the Division of Higher Education of the U. S. Office of Education, Federal Security Agency. He will now work in the Defense Manpower Administration's Division of Program Development, and will be responsible for programs involving scientific, engineering and other specialized personnel.

Charles A. Dawson is living in Burbank at present, but will be moving to his "ranch"—2 acres of oat-covered hill top near Hansen Dam, Pacoima—in the near future.

1936

Donald F. Folland, M.S., spent last summer at the Naval Air Missile Test Center at Point Mugu, Calif. Upon returning to New York from this assignment, he was promoted to an engineering section head for systems at the Sperry Gyroscope Company. He is now serving as Sperry representative on special committee 59 of the RTCA to promote the common system of air traffic control for the United States. The Follands have three children and are living in Uniondale, New York.

Jack Paller and his wife, Evelyn, announced the birth of a son, Ronald Lewis—a future Caltech student—on January 12.

R. Lowell Hand, M.S. '37, is working at Lockheed Aircraft Corporation, in charge of manufacturing research in the manufacturing standards department and tool design department.

1937

Wendell Miller is still working for Paci-

PERSONALS . . . CONTINUED

fic Tel. and is in the Chief Engineer's office in Los Angeles. He sums up the last fifteen years by saying he has not become the huge success predicted by his classmates—nor the failure predicted by the professors. He has, however, been extremely active—as evidenced by his four children—but plans to become less active in the near future. He lives in Arcadia, which he claims is the best little city in the world, discounting the traffic from the Race Track.

1938

Henry K. Evans, who is transportation specialist of the Chamber of Commerce of the United States, served as moderator of a panel session at the recent Local Cartage National Conference on "How can local truckers avoid being legislated off the streets?"

Carl F. Friend reports the birth of his first son, John, on September 1. His two daughters are Marie, 8½, and Nancy, 5½. The family has just moved to a new home in Palos Verdes Estates. Carl is supervisor of aerodynamics at Northrup Aircraft.

1939

Lloyd Ibsen is working at Collins Radio Company in Burbank.

1940

James M. Watkins, Jr. is production manager for Hycon Odekerk and Ludwig on a Navy rocket program. The Watkins' new daughter, Laura Jo, was born February 13. Their other daughter, Susan, is now 6½.

Robert W. Alcock, M.S. '41, announced the arrival of a daughter, Janice Amelia, on January 11, 1952.

Robert B. Glassco reports the birth of his first child on December 4, 1951. On December 1, the Glasscos moved into the new home they built in Arcadia.

1942

Lawrence W. Smith and his wife, Jeanne, now have three children, Ralph Stanley, 7, Laurean Ann, 5, and Warren Russell, 1. Since 1948 Lawrence has been president and general manager of the Smith Precision Products Company in South Pasadena, which now employs about 15 people and specializes in the manufacture of positive displacement rotary gear pumps for the liquefied petroleum gas industry.

1943

Art Schneider, Ph.D. '49, has been with the engineering and development division of Given Manufacturing Co., Pasadena, as chief research engineer for over a year. He has two children, a girl 3 and a boy 1½.

Orin J. Mead is working as a design engineer for the Boeing Airplane Company's B-47 project in Renton, Washington. He reports a first addition to his family, Mary Lisa, born January 28, 1952.

A. C. Ridland started work at J.P.L. in December in the design department. His son is over a year old now.

1944

Fred Karstedt and his wife are the proud parents of a baby girl, Karen Anne, born January 19.

1945

John K. Honey and Helen Waughaman of Los Altos, Calif., have announced their engagement. John is studying for his doctorate at Stanford. Helen is a senior at San Jose State College.

Duane McRuer, M.S. '48, is supervisor of the Servo Group at Northrup Aircraft.

1947

Richard C. Gerke, M.S., and his wife announce the arrival of a son, Charles Richard, on Washington's Birthday, February 22. The Gerkes also have a 2½-year-old daughter, Martha.

1948

John O. Rasmussen received his Ph.D. in chemistry from the University of California in February, 1952, and is working as an instructor in chemistry at U.C. for the spring semester of this year. The Rasmussens have twin girls, Nancy and Jane, born last October 17.

James E. Ash, M.S., who was formerly mechanics instructor at Illinois Institute of Technology, has been named an associate research engineer in the heat-power department of The Armour Research Foundation of Illinois Tech.

Wayne E. Sefton is now working for Lockheed as a weight analyst. The Seftons moved into their new home on Shadow Grove Road in Pasadena in October. Wayne claims he spends all his spare time pulling weeds and planting the garden.

Chandos Rypinski is working at Collins Radio Company in Burbank.

1949

Charles H. Arrington, Jr. has been named research supervisor in the chemical department at DuPont's Experimental Station in Wilmington, Delaware. He joined the DuPont Company in 1949 as a research chemist, and has been engaged in fundamental research in various branches of physical chemistry, including fiber research.

Gene D. Six, after graduating from Caltech, worked for seven months with the State of California Division of Water Resources. He then attended Claremont Graduate School and now has a secondary and elementary teaching credential. At present he is teaching math and social studies at John Marshall Jr. High School in Pasadena, and liking his job very much

Frank Beardsley is working at Collins Radio Company in Burbank.

1950

Edward A. Revay, after an 18-month training period with the American Cyanamide Company, is now associated with the company's Pacific Coast office in Los Angeles as technical sales representative. He was married on Christmas Day, 1951.

1951

Dean M. Blanchard is in Sumatra with the Caltex Pacific Petroleum Company, which is jointly owned by Standard Oil of California and the Texas Company. After several months in the New York office of Caltex, he was transferred to the field station in Sumatra with an engineering staff to supervise the construction of plant and facilities for handling the oil from source to loading docks.

Harry Sutcliffe, M.S., and Betty Ann Donnan have announced their engagement. Betty Ann, who holds a doctor's degree from the Victoria University of Manchester, England, is a member of the English Department at the University of Arizona. Harry also graduated from the University of Manchester, before coming to Caltech. The wedding will take place in Lancashire in mid-summer, after which the couple will make their home in London, where Harry is doing special research for the British Railways.

Mitchell Bain is now working at Collins Radio Company in Burbank.

ALUMNI CALENDAR

April 12	Seminar Day
June 4	Annual Meeting
Date to come	Family Day

CALTECH ATHLETIC SCHEDULE

TRACK

Saturday,	March	8	Interclass meet	
Friday,	March	28	Pasadena College and Cal Paly (San Dimas)	at Caltech
Friday,	April	4	Whittier	at Caltech

TENNIS

Sat.	Mar.	8	Caltech at Pomona	
Sat.	Mar.	29	Caltech at Occidental	
Wed.	Apr.	2	Chapman at Caltech	
Sat.	Apr.	5	Redlands at Caltech	

SWIMMING

Fri.	Mar.	7	Redlands at Caltech	
Sat.	Mar.	29	Relays at Occidental	
Thur.	Apr.	3	Fullerton JC at Caltech	

GOLF

Fri.	Mar.	7	Caltech at Pomona	
Fri.	Mar.	28	Occidental at Caltech	
Fri.	Apr.	4	Caltech at Redlands	

BASEBALL

Mon.	Mar.	24	Caltech at Chapman	
Sat.	Mar.	29	Pomona at Caltech	
Sat.	Apr.	5	Occidental at Caltech	

CAMPUS ACTIVITIES OF INTEREST TO ALUMNI

FRIDAY EVENING DEMONSTRATION LECTURES

7:30 P.M. — 201 BRIDGE

Mar.	7	"The Chemical Compositian of the Stars,"	by Prof. J. L. Greenstein
Mar.	28	"The Oldest Profession,"	by Prof. E. T. Bell
Apr.	4	"Piezoelectric Crystals and Their Applications,"	by Dr. W. G. Cady

FIFTEENTH ANNUAL ALUMNI SEMINAR - SATURDAY, APRIL 12, 1952

8:30-9:15 A.M.—REGISTRATION
Dabney Hall of the Humanities

MORNING PROGRAM

9:30 to 10:20 A.M.
Your choice of the following:

A. THE STORY OF EMERGENCY SUBSTITUTES FOR PLASMA

J. R. Vinograd, Senior Research Fellow in Chemistry.

Dr. Vinograd is participating in the Institute's work in development of plasma expanders for emergency relief from shock. An Institute product known as oxypolygelatin is now in the final stage of testing and is being considered for large scale production. This timely accomplishment could become of extreme value to the people of the nation at any time. The requisites of a suitable plasma expander, the history of expanders and the developments by the Institute will be of interest to all alumni.

B. PROBLEMS OF THE DESIGN AND OPERATION OF THE GALCIT HYPERSONIC WIND TUNNEL

Henry T. Nagamatsu, Senior Research Fellow.

However important in today's events, the fact that transonic Mach numbers are being consistently obtained by recent jet aircrafts is no longer news. Concurrently with the progress of this adjustment to higher speeds, investigations on the problems of flight at high altitudes and speeds of many times of sound are being conducted for the design of efficient rockets and guided missiles. Dr. Nagamatsu, who received his Doctorate at the California Institute of Technology in 1949, will discuss some of the hypersonic problems in the design of rockets and will describe the GALCIT Hypersonic Research Facilities.

10:20 to 10:50 A.M. COFFEE TIME

10:50 to 11:40 A.M.
Your choice of the following:

A. CHEMISTRY AND PHYSIOLOGY OF SMOG

A. J. Haagen-Smit, Professor of Bio-organic Chemistry.

A study of the recurrent bane of Southern California, air pollution, has produced some surprising information. Identity of air contaminants, meteorological aspects, economic effects and the manufacture of smog before your eyes are parts of the exposition by Dr. Haagen-Smit, who has devoted a long period of time to the investigation of this intimate Southern California problem.

B. OPTIMUM VEHICLE OF FLUORIDATION—WATER OR MILK?

J. E. McKee, Associate Professor of Sanitary Engineering.

About two decades ago it was observed that fluorine promoted the development of sound teeth, if available in proper form to children between one and ten years of age. Dr. McKee has pursued to a tentative conclusion his idea that a more efficient vehicle than water for the distribution of minute quantities of fluorine could be found. Dr. McKee has an interesting technical, economic and human interest story to tell about this new method of fluoridation.

11:55 to 12:45 P.M.
Your choice of the following:

A. METALLURGY OF TITANIUM

Pol Duwez, Associate Professor of Mechanical Engineering.

Present methods of extracting titanium have recently made this metal available in substantial quantities. Increased production during the last year has made possible utilization of the metal in interesting commercial uses as well as those of strategic importance. Dr. Duwez, Chief of the Materials Section of J.P.L. will compare the important extraction methods, economically feasible production rates and forecast a possible future for this new important metal.

B. THE ENGINEERING CRISIS AND WHAT CAN YOU DO ABOUT IT?

John R. Weir, Associate in Psychology.

The manpower commission for the Society of Engineering Education estimated an annual need for the next ten years of 45,000 engineers for civilian purposes alone. Estimated graduates will number less than 20,000 per year and over half of this number will be committed to or subject to, military duty. How is this situation reflected at Caltech and what can be done about it? Dr. Weir has been giving considerable attention to these questions and will present interesting facts and recommendations, which have resulted from his study of this very crucial national problem.

1:00 to 2:00 P.M. LUNCH—STUDENT HOUSES

AFTERNOON PROGRAM

2:30 to 3:30 P.M.
For old times' sake two of the Institute's most popular demonstrations will be presented again:

Dr. E. C. Watson has consented to speak on and display the phenomena of "Liquid Air."

The Electrical Engineering Department will run High Voltage demonstrations.

These two events will be scheduled to accommodate alumni and guests who wish to attend both.

3:55 to 4:40 P.M.
"OPERATION NANOOK" OR HUNTING COSMIC RAYS IN GREENLAND

H. Victor Neher, Professor of Physics.

In August, 1951, Dr. Neher made a trip to Greenland to conduct an investigation of the relative intensities of cosmic rays between Greenland and North Dakota, U. S. A. by making simultaneous flights at these two locations. He will describe the work done in cosmic ray research, what constitutes the rays, measurements made and some of the conclusions of this most recent study. To provide a more intimate understanding of this interesting lecture Dr. Neher will run color movies and still pictures of the personal experiences of his party and the unusual ice formations of the country.

5:00 to 6:30 P.M. SOCIAL HOUR

Relax and meet your friends at the Elks Club, 400 West Colorado Street, Pasadena. Cocktails available. Dinner will be served at 6:30 in the club banquet room.

EVENING PROGRAM

6:30 P.M. DINNER
Elks Club
400 West Colorado Street, Pasadena
Dress—Informal for men and women.

AFTER DINNER

Introductions by Dr. Robert P. Sharp, President of the Caltech Alumni Association.

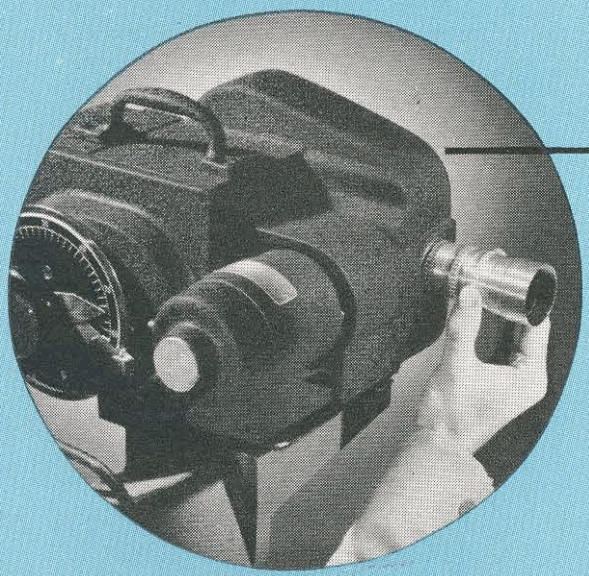
Remarks by Dr. L. A. DuBridge, President of the California Institute of Technology.

NATURAL RESOURCES AND HUMAN POPULATION

Harrison Brown, Professor of Geochemistry.

If the standard of living of all the peoples of the world were raised to the equivalent of that existing in the United States, what would be the balance between demand and supply of natural resources? Dr. Brown will speak on this and related socio-economic matters. He left the Institute for Nuclear Studies at the University of Chicago to join the Division of Geological Sciences of the California Institute of Technology in 1951. His war work during the years from 1942 to 1946 included the assignment as Assistant Director of Chemistry on the Plutonium Project at Oak Ridge.

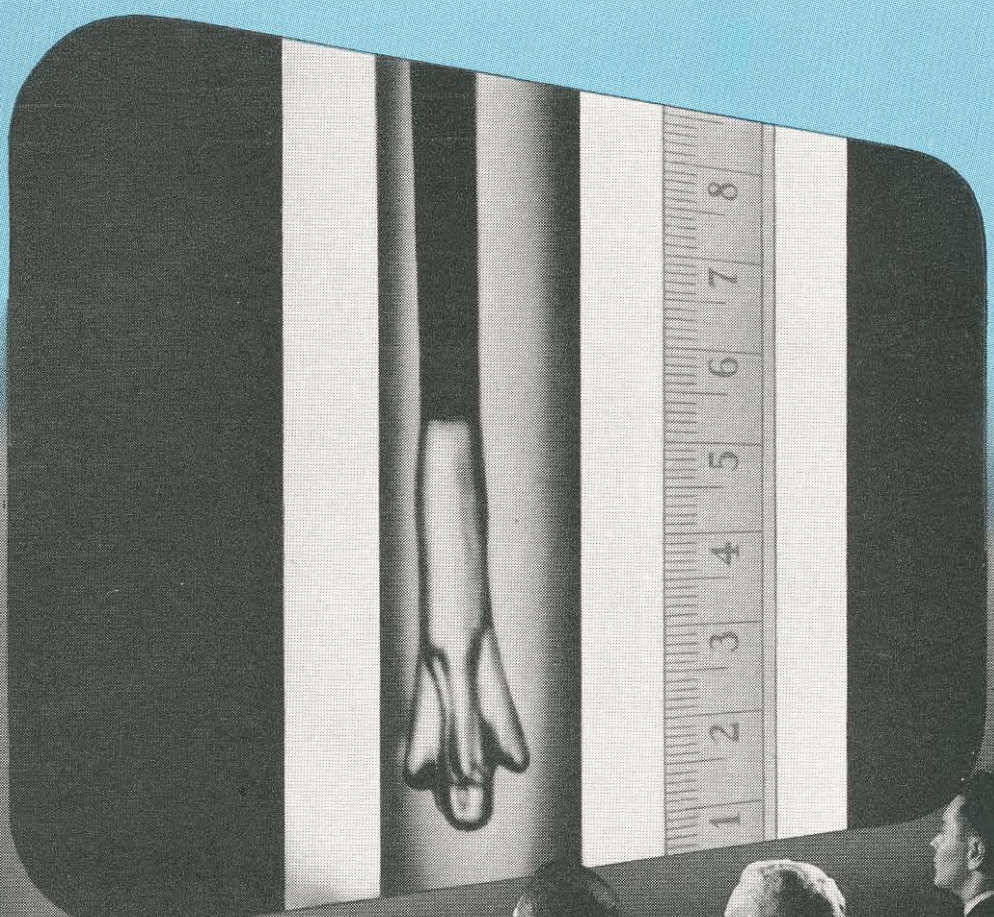
Engineering has a precision tool in photography



WHATEVER YOUR BRANCH of engineering, you'll find photography an increasingly valuable aid. With it you can picture lightning-fast operations—or extremely slow processes—at speeds suitable for study. You can capture fleeting instrument traces, study internal stresses in machine parts, examine metal structure and do countless other things.

The application of photography to engineering problems has become a specialty in itself. This has led graduates in the physical sciences and in engineering to find positions with the Eastman Kodak Company. If you are interested, write to Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N. Y.

Here high speed motion-picture photography shows a cavity in a column of water produced when a 5-mm rod was shot through it at 12.2 meters per second. By taking the pictures at 3200 per second and projecting them at the standard 16 per second, time is "magnified" 200 times.



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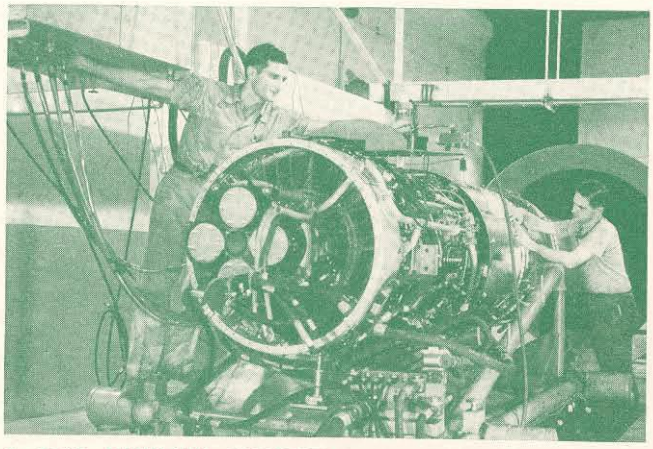
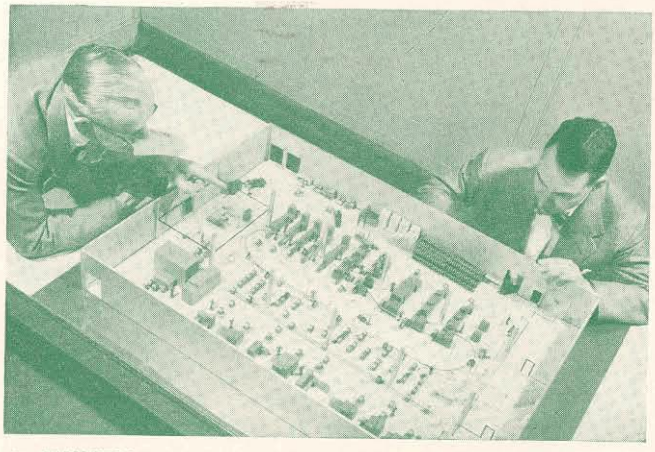
Five Ways to Begin Careers with General Electric

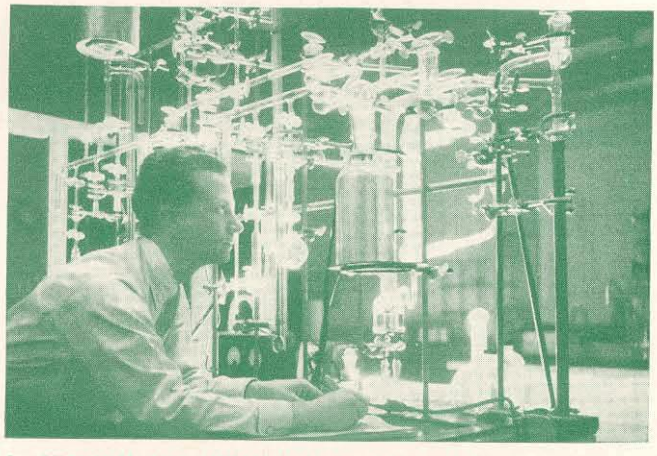


1. TEST ENGINEERS PROGRAM—gives engineering graduates opportunities for careers not only in engineering but in all phases of the company's business. Rotating assignments plus opportunities for further classroom study.

2. BUSINESS TRAINING COURSE—open to business administration, liberal arts and other graduates...for careers in accounting, finance, administration.



3. MANUFACTURING TRAINING PROGRAM—for developing manufacturing leaders. Open to graduates with a technical education or a general education with technical emphasis.



4. CHEMICAL AND METALLURGICAL PROGRAM—offers rotating assignments and studies for chemists and for chemical and metallurgical engineers.

5. PHYSICS PROGRAM—the gateway by which physics majors begin G-E careers. Program graduates have gone into such fields as research, development, manufacturing, design, marketing.

If you are interested in entering one of these five basic General Electric programs after graduation, talk with your placement officer and the G-E representative when he visits your campus. Meanwhile, send for further information:

- **On Test, Chemical and Metallurgical, and Physics Programs, write to Technical Personnel Services Dept., Schenectady, N. Y.**
- **On Business Training, write to Business Training Course, Schenectady, N. Y.**
- **On Manufacturing, write to Manufacturing Personnel Development Services Department, Schenectady, N. Y.**

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