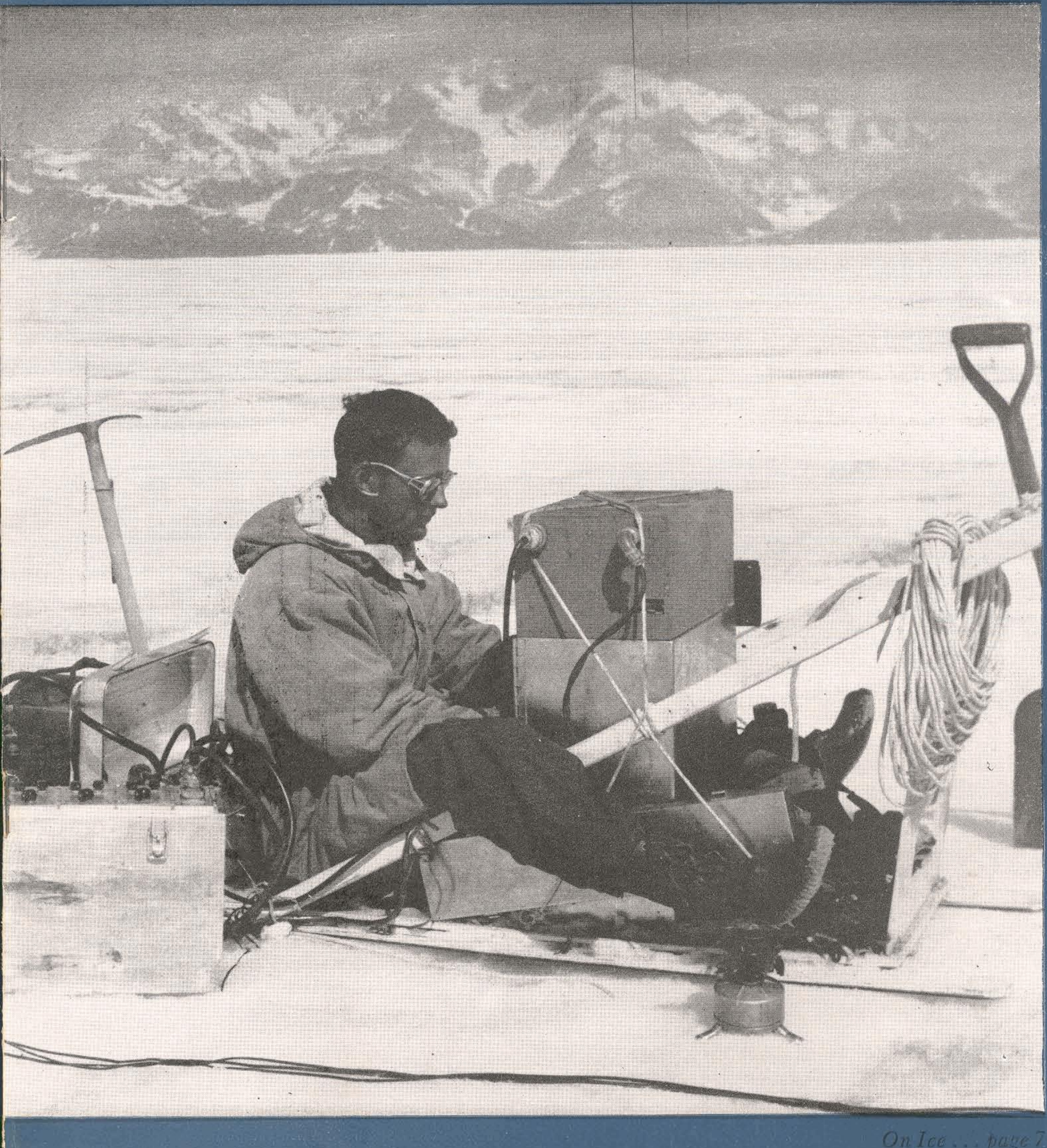
ENGINEERING | AND | SCIENCE

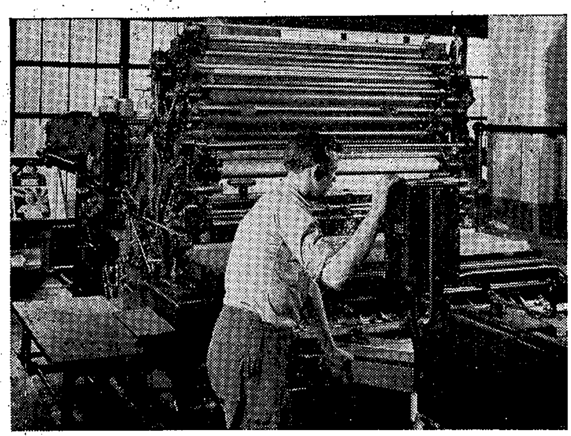
JANUARY/1952



On Ice . . . page 7

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Another page for **YOUR BEARING NOTEBOOK**



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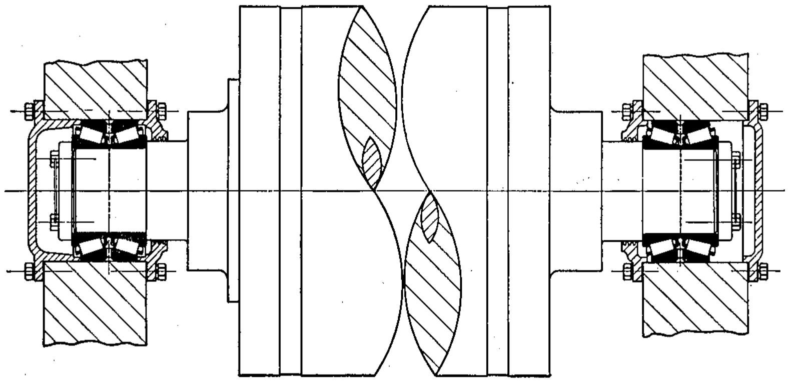

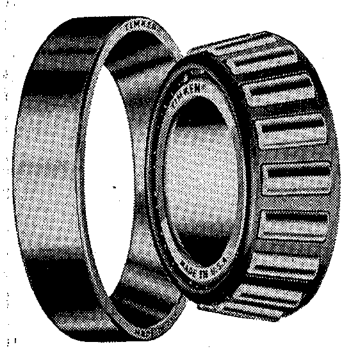

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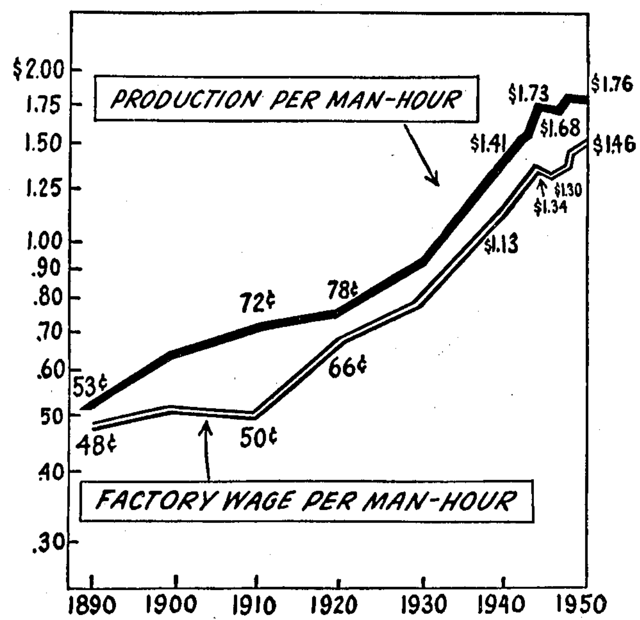
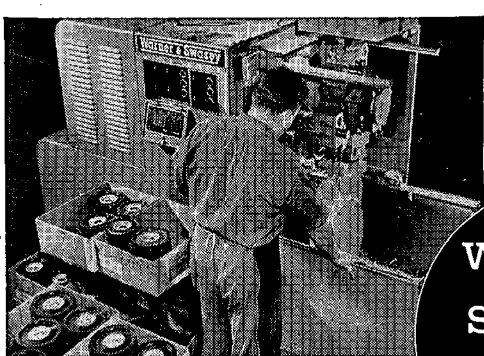


Production per man-hour represents the total national income produced per man-hour worked by all employed persons. Factory wage represents average hourly earnings of factory workers. All figures are in dollars of 1950 buying power to eliminate price changes, and show real purchasing power.

Source: Labor's Monthly Survey, American Federation of Labor.



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WHAT'S THE WORLD COMING TO?
By A. M. Low
J. B. Lippincott Co., N. Y. $3.00

Reviewed by E. T. Bell
Professor of Mathematics

If the question had been "Where's the world going to?" it might have been answered by a pessimist in one word. In forecasting the next hundred years, the author is by no means downhearted, and his readers will doubtless be greatly cheered till they realize that the book is based on the appalling assumption that the human race is to survive another century. This, for our battered and dissolute old world, is a fate worse than atomic disintegration. What has the world done to deserve it?

Nothing spectacular

The spectacular end promised less than a decade ago is not going to arrive: "A hundred years hence atomic fission will be a commonplace. People will be so used to radio-activity in its various forms that they will instinctively protect themselves against it when necessary."

Nor is there any prospect of extinction by starvation. Under scientific farming and the like the world food supply is to go on increasing indefinitely. People will raise more food to feed more people to raise more food to feed more people to raise . . . till the welkin bursts.

A contributory cause will be artificial insemination, by which "it will be possible for a single man to be the father of many thousands of children by different women." With the aid of a slide rule, a world almanac and some elementary physiology the reader may apply this to all the nubile human females of Asia alone, to see where the population will stand in 2051. (On one another's heads, several hundred deep.)

Interesting legal problems are suggested: "Our"—that is, England's—"legislators are so busy discussing whether a man may marry his divorced wife's sister that they do not worry to make sure that he cannot marry his own daughter produced by"—artificial insemination. The issue might well be debated by our Supreme Court before it is too late.

Many of the predictions in the ten chapters of the book are already well on the way to realization; others are reasonable extrapolations from what we are now trying to enjoy.

"War in the future" surveys push-button weapons, biological warfare, radio-active bombs, etc., all in so temperate a tone that the Pentagonal brass could safely recommend this chapter as a sedative for jittery civilians.

The future of radio is apparently to be normal and as dull as its past. Color is to boom television. What is to happen to commercials is left to the realm of nightmare.

Nothing very exciting is forecast for health and medicine, and likewise for sport and leisure. The author somewhat rashly predicts that "educated people will probably revolt" against professional boxing on account of its alleged coarseness and occasional danger. Boxing is polite compared to the wrestling television brings to us in our own homes, and no revolt against it has started yet.

Religion, like boxing, is to be reformed by neglect. It will be replaced by "the power of thought" which gave us aircraft, including long-range bombers, although we had no wings with which to fly.

Forecast of knowledge

The conclusion of it all is that "the greatest lesson of the past century has not yet been learned by every scientist. It is that the sum of our present knowledge is virtually nothing at all." By crossing out "virtually" we get what may be an accurate forecast of knowledge a hundred years hence. At our present rate of progress there may be nothing at all in 2051 capable of knowing anything.

On the whole the book is amusing entertainment for those who can relish a gruesome joke not always intended as such.

A CENTURY OF SCIENCE: 1851-1951
Edited by Herbert Dingle
Roy Publishers, New York $4.75

Reviewed by Charles E. Bures
Asst. Prof. of Philosophy and Psychology

This volume, written by seventeen British specialists, spans the century between the Great Exhibition of 1851 and the Festival of Britain in 1951. The purpose of the symposium is to survey and assess the major changes in science during that period. No earlier century can match the scientific developments of the era just past, and this survey succeeds in giving one a sense of the fascinating sweep of those achievements.

Looking backward

It is difficult to understand today how much was yet undone and unknown in 1851. To give some samples of the time, by 1844 Darwin had written the first sketch of his *Origin of Species* in his notebook. Ether was used in surgery in 1846 and the first Public Health Act (in England) was passed in 1848. In 1850, Bond made the first successful astronomical photograph. In 1850, Helmholtz measured the speed of a nerve impulse, and the next year invented the ophthalmoscope. In 1851, Joule calculated the average speed of a gas molecule. In 1852, the notion of valency was introduced into chemistry by Frankland. In 1854, Lord Kelvin used the term "energy" in its modern sense.

Sciences like physics and biology were on the threshold of great advances; others, like chemistry and geology, had been basically formulated by mid-century. Thermodynamics, field and particle physics were yet to come. Synthetic organic chemistry, stereochemistry and physical chemistry were largely untapped. Speculations about the structure of the universe were just beginning. Fundamental problems of astrophysics and cosmology could just be formulated.

The year 1859 marked the beginning of the Darwinian era in biology. Virtually non-existent at that time were such fields as genetics, human paleontology, biochemistry, animal nutrition, bacteriology, endocrinology, modern surgery, psychodynamics, psychometrics and many others.

In general, the promise shown by science in 1851 has been fully achieved. Important new developments can be expected in the coming century, with special acceleration

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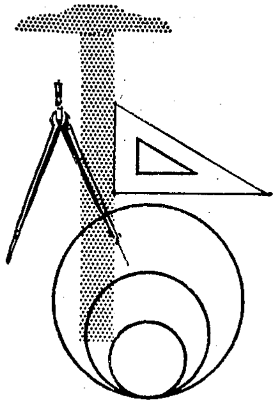

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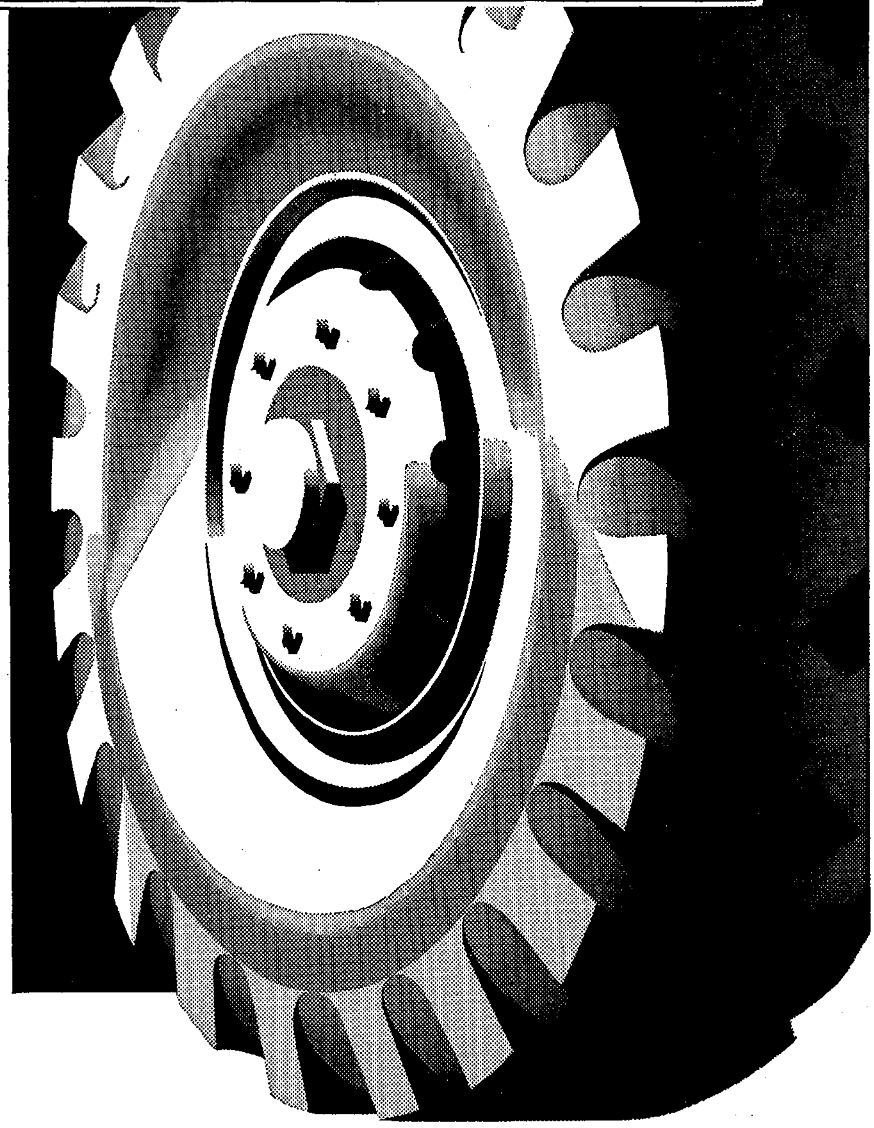

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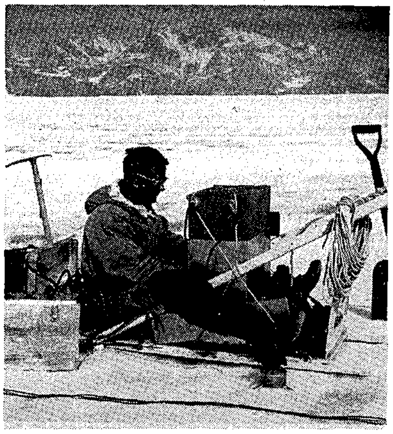
ENGINEERING AND SCIENCE

IN THIS ISSUE



This month's cover shows G. I. Smith, M.S. '51, developing a photographic record of the waves reflected from the rock floor beneath Malaspina Glacier after an experimental charge of dynamite had been set off beneath the ice. Though it's pretty hard to make out in the picture, his hands and forearms have been stuck into two large black sleeves on the developer, to protect film from the brilliant glare of the ice.

Smith is sitting on a sled, which not only carries photographic equipment (in the center) but amplifying and recording equipment as well (behind him). The sled proved to be the only practical vehicle for transporting this and all the other equipment used by the Caltech team of field workers which spent last summer studying Alaskan glaciers.

You may have read an earlier report in *E&S* on these glacier studies—by R. P. Sharp '34, Professor of Geology at the Institute. That one ran in our November, 1948 issue, and told about the initial phases of this activity. Last summer was Caltech's third season of field studies on Alaskan glaciers and Bob Sharp brings us up to date on the project in his article, "On Ice," on page 7 of this issue.

PICTURE CREDITS

Cover	George P. Rigsby
pps. 7-11	Robert P. Sharp, George P. Rigsby, and George I. Smith
p. 15	Ross Madden—Black Star
p. 20	William V. Wright

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STAFF

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

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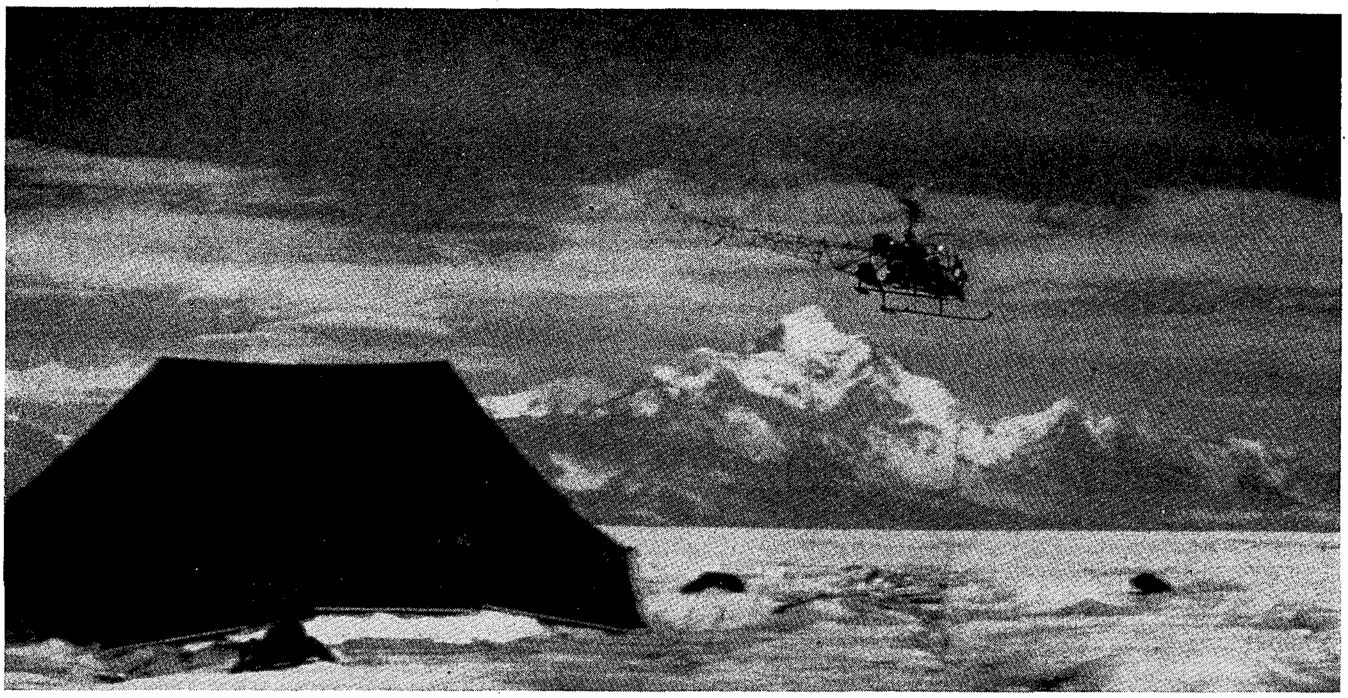


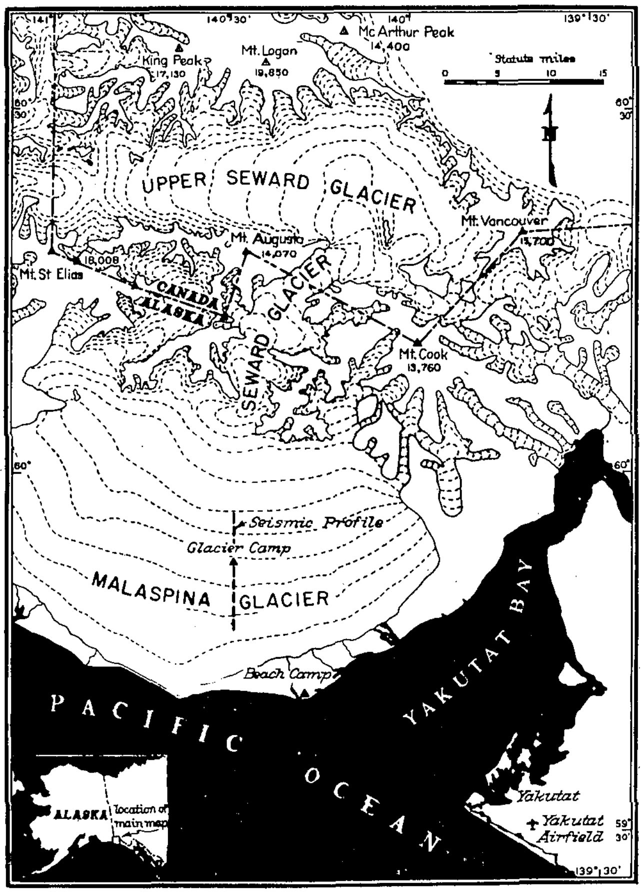
Field camp near the center of Malaspina Glacier was linked to the outside world by means of a helicopter.

ON ICE

A report on Caltech's third season of field studies on Alaskan glaciers

by ROBERT P. SHARP

"HERE COMES THE EGG BEATER" was always a welcome cry at our camp on ice (above) near the center of Malaspina Glacier. It meant that our heliocopter, the last link in a somewhat tenuous chain of communication with the outside world, was coming in from the "Beach Camp" (left) with news, mail, supplies, equipment, and possibly a highly prized box of cereal flown in from Yakutat to brighten up the breakfast menus. Pilot Al Luke and mechanic Bob Luman successfully maintained their link in this chain in spite of difficult operating conditions, but communication between the "Beach Camp" and Yakutat, the main source of supplies, was broken in mid-summer by the tragic disappearance of the expedition's Norseman plane during a routine flight from the upper Seward Glacier. Its fate remains unknown to this day.



Map showing field area for "Project Snow Cornice"

East margin of Malaspina Glacier, covering more than 1000 square miles of the flat coastal plain of southern Alaska.

The summer of 1951 constituted Caltech's third season of field studies on Alaskan glaciers as part of "Project Snow Cornice," an endeavor of the Arctic Institute of North America directed by Walter A. Wood. Initial phases of this activity have been earlier reported in *Engineering and Science* (November, 1948). Field work in 1949 yielded good data on temperature regimen, meltwater behavior, the processes and mechanisms converting snow to glacier ice, and the items of income and expenditure in the glacier's budget. This work will not be treated here except to note that even in an average year the budget of the Seward-Malaspina glacier system shows a deficit in the neighborhood of 850 billion gallons of water, thus overshadowing in size at least, the deficit in our national monetary budget.

In previous years, most of the work had been devoted to the upper reaches of this glacier system, but in the summer of 1951 attention was focused on the Malaspina Glacier, a great sheet of ice covering more than 1000 square miles of the flat coastal plain of southern Alaska along the foot of the St. Elias Mountains (above). Our principal objectives were to determine the mode of flowage within this sheet of ice and to relate it to the structures developed therein (below). Geologists have

Study of structures like those shown here leads to a better understanding of the mode of flowage within a glacier.

long been interested in glacier movement, because ice is a rock which undergoes solid flowage on the Earth's surface where the process can be observed and not, as in the case of most other rocks, far beneath the surface beyond the view of man.

It is perfectly logical to suppose that an ice stream flowing down a steep mountain canyon moves in part by sliding over its rock floor, especially where its base is well lubricated by meltwater. Nonetheless, studies of glacier flow show that only a small fraction of the total movement occurs in this manner; the rest is by adjustment within the ice body itself. Some of this movement takes place by slippage along discrete shear planes, at least in the brittle and somewhat rigid crust of a glacier, for displacements of this type have actually been measured. However, it seems equally certain that at greater depth within the ice much of the yielding is by a type of solid flowage that obeys some of the laws of fluid mechanics. The laminar character of this solid flow is recorded by the prominent banded or foliated structure in glacier ice. This foliation closely resembles that of metamorphic rocks which are thought to have experienced similar flowage deep within the Earth's crust. The major problem is to determine the mechanism by which this solid flow occurs.

Glaciological theories

Glaciers consist of relatively large ice crystals, some many inches in diameter, all in close contact. One theory holds that the ice mass yields by shifting and rotation of these individual crystals, a process presumably facilitated by local and temporary pressure melting. Another concept calls for yielding by slippage along distinct planes within the individual crystals. Neither theory is necessarily exclusive of the other, and just how much of the solid flow in ice is due to intergranular shifting and how much to intragranular slippage remains an open question.

Preparing a thin-section of ice for study on an oversized universal stage, which is shown at the left.

Aspects of this problem were attacked on the Malaspina by George P. Rigsby ('48), assisted by Donald R. Baker ('50), using an oversized universal stage (above), constructed by Rudolph von Huene ('34). Rigsby was able to determine the size, intercrystalline relation, and crystallographic orientation of the grains in thin-sections of ice cut from the glacier. This study showed that the various ice crystals were complexly and intricately intergrown, a relation previously demonstrated by Dr. Henri Bader during the 1949 work. If the same intercrystalline relations exist deep within the glacier as on the surface, significant flowage by intergranular shifting is out of

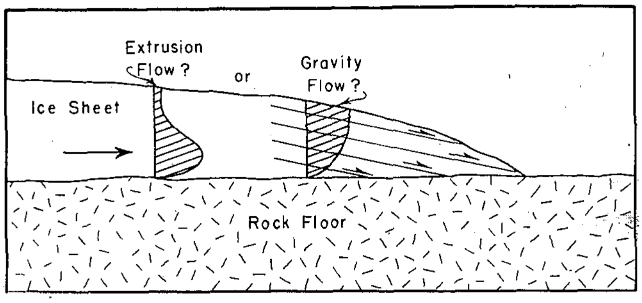
This sensitive micro-altimeter determines elevations accurately for use in gravity survey calculations.

The gravity meter is used for determining the configuration of the rock floor beneath the glacier.

Field workers operate seismic recording equipment for measuring thickness of ice.

the question. It was also found that optical axes of the crystals in the Malaspina ice had strong preferred orientations. According to theory, the orientation should be such that the direction of easiest yielding (a glide plane) in each crystal is parallel to the direction of shear in the ice body. Heretofore, it has been thought that only one direction of easy gliding existed in an ice crystal, but the results obtained here suggest that the picture may be considerably more complicated and that at least two other directions of gliding may be involved. We feel reasonably certain that a considerable amount of the flow experienced by Malaspina ice has occurred by slippage along glide planes in the individual crystals, because the optical orientations of these crystals bear a definite and consistent relation to the banding in the ice created by flowage.

Let us now return briefly to the mental picture of an ice stream flowing down a steep mountain canyon. It is easy to see how a component of gravity parallel to the sloping canyon floor can be the prime motive force for this movement, no matter what the detailed mechanics. But how about a sheet of ice resting on a flat surface?



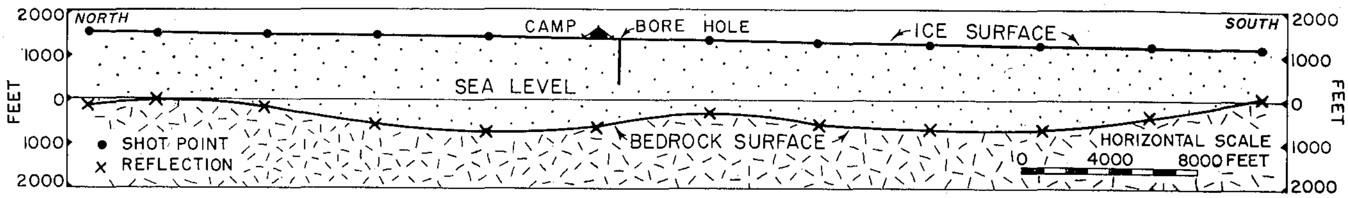
Diagrammatic representation of two possible modes of flow in a sheet of ice resting on a horizontal floor.

It is known that such masses flow, but the motive force cannot be a component of gravity parallel to the flat rock floor. In the early stages of World War II, Max Demorest, an American glaciologist who later perished during a rescue mission on the Greenland Ice Sheet, expressed more clearly than before the idea that flowage in such a sheet is caused primarily by pressure differences within the ice mass arising from unequal thicknesses. According to this concept, plastic ice deep within the glacier is squeezed or extruded from regions of high pressure toward regions of lower pressure, usually the margins of the sheet (below).

This deductive idea has been attacked on theoretical grounds by British glaciologists and physicists, with the counter suggestion that a sheet of ice flows across a flat land surface by movement along planes within the glacier which slope downward toward the margin. It was obviously time for a return to the field to gather further data and to test these opposed concepts. This was another objective of the Malaspina work.

Field testing

First, we had to know something about the configuration and slope of the rock floor beneath Malaspina Glacier. This problem was attacked by C. R. Allen (M.S., '51) and G. I. Smith (M.S., '51) with seismic equipment (above) and a gravity meter, the latter generously loaned by Atlas Exploration Co. of Houston. The gravity work was greatly aided by a sensitive micro-altimeter loaned by United Geophysical Co., Pasadena. Allen and Smith, briefed and trained by Dr. C. H. Dix of the Institute staff, obtained observations along a 10-mile north-south radial profile on the Malaspina. These showed that the floor beneath the center of the glacier slopes back



A ten-mile radial profile on Malaspina Glacier obtained from seismic reflections. Vertical exaggeration is 2x.

toward the mountains and that the ice thickness ranges between 1130 and 2075 feet (above). It was also discovered that the floor beneath the center of this glacier is at least 685 feet below sea level.

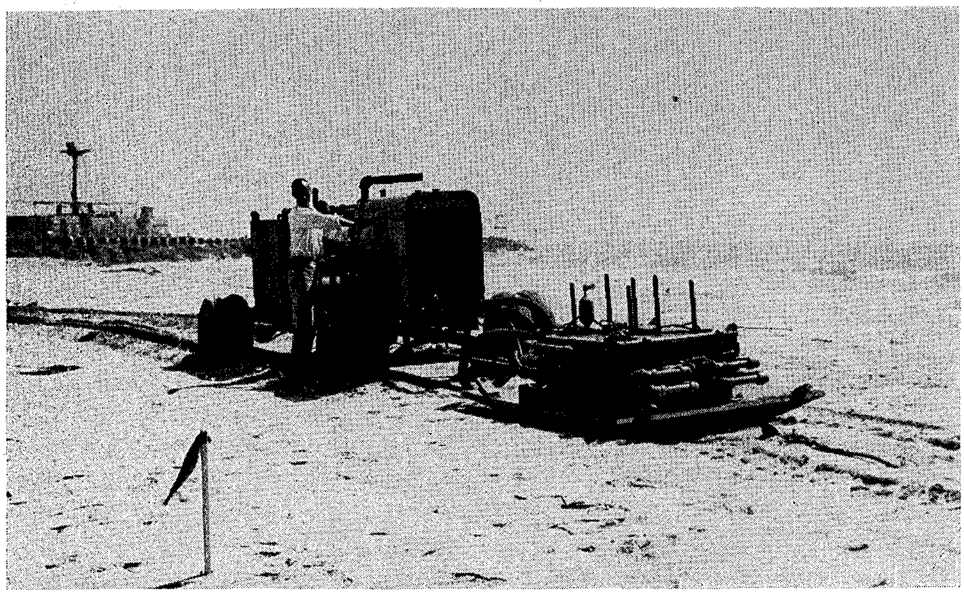
Thus, the sheet of ice constituting Malaspina Glacier moves uphill on much of its journey outward from the base of the mountains. This it cannot do by gravity, at least in so far as movement over its floor is concerned. Nor can the thrust of the Seward Glacier pouring out of the St. Elias Mountains provide the motive force, for this would be a little like trying to shove a sheet of tissue paper up a slope by pushing on one edge with a toothpick.

To solve the problem of mode of flow within the Malaspina sheet the vertical velocity profile within the glacier must be known. To obtain this information, we proposed to sink a vertical hole as deep into the glacier as possible, leave the drill pipe in the hole, and to measure the subsequent deformation as the pipe was bent by the flowing ice. No very satisfactory mechanical drilling methods simple enough for our use and suitable for penetrating to any great depth in ice have been developed. Our hole was bored with an electrically heated hot point (below), a gigantic soldering iron, so to speak. This was designed and fabricated in the Caltech Electrical and Mechanical shops on the campus—largely through the good efforts of Tex Mangum.

Space does not permit a recounting of the trials and tribulations experienced by Don Baker and the rest of us in boring this hole. It is sufficient to say that a depth of 1000 feet was finally attained. The orientation of the pipe was successfully determined by means of an inclinometer generously loaned by the Parsons Company of South Gate, California, before the glacier camp was evacuated at the end of August. A resurvey of the pipe is planned for 1952 which should yield data bearing on the opposing theories of flowage in a sheet of ice like Malaspina Glacier. Ultimately, the pipe will probably be sheared through or crushed, and measurements of its deformation will no longer be possible. However, a similar experiment in a Swiss glacier suggests that this is not likely to happen for several years.

If the theory of pressure-controlled extrusion flow is correct, the pipe should show a deformation or flowage curve in which the lower part moves outward more rapidly than the top. If the reverse occurs, then support will be given to some other concept, perhaps that of the British in which movement is by gravity flow along planes sloping outward toward the margin. Study of surface structures in the Malaspina Glacier makes us doubt that flow occurs along such outward sloping planes.

Boring a thousand-foot hole into ice by means of an electrically heated hot point.



Vibrator, designed by Caltech engineers for compacting soil, is tested by the Navy at Port Hueneme, Calif. Trailer hauls vibrator, which is at right.

SOIL COMPACTION BY VIBRATION

Basic research produces a highly practical machine to compact soil for airfields

by FREDERICK J. CONVERSE

As airplanes grow larger, wheel loads get heavier and tire pressures become higher. The problem of constructing runways for handling planes on the ground therefore becomes increasingly greater. To obtain a firm foundation, the soil below the runway pavement must be compacted to a high density to considerable depths. At the present time the soil is compacted by very heavy rollers or "super compactors" working over many thin layers of soil until thicknesses up to two, three, or even four feet are compacted into a hard base on which to place the pavement.

The heaviest "super compactors" weigh up to 400,000 pounds. There is a definite need for a lighter machine which will obtain the required densities in a shorter time. Vibration compaction appears to offer a solution. However, attempts to develop such a machine in the past have not been very successful. Much of the trouble seems to have come from a lack of basic knowledge of the laws governing the compaction of soil by vibration. The engineers for the armed forces are keenly aware of this need, and it was through their sponsorship that a team of engineers at the California Institute of Technology was given the opportunity to study the problem.

From September 1948 to March 1950 the study was sponsored by the Department of the Army, Engineer Research and Development Laboratories, Fort Belvoir, Virginia. This was primarily a basic research project. The principal objective of the investigation was the development of a method for calculating the resonant frequency of the entire system in terms of the vibrator loads and dimensions and certain elastic constants of the soil. The complete system, which includes the vibration mechanism and the soil being vibrated, is called the vibrator-soil mass.

Resonant frequency means that the natural frequency of the vibrator-soil mass is the same as the frequency of rotation of the vibrator eccentrics. Since maximum dynamic displacements occur at the resonant frequency, it was anticipated that operation at such a frequency would produce maximum compaction of the soil. A second objective was to measure the degree of compaction and depth to which the soil could be compacted.

The problem was attacked from two angles. The first was purely theoretical and required certain simplifying assumptions as to the character of the soil in order to make the mathematics at all possible of solution. The second was experimental, and involved tests in a pit 10 feet square and 6 feet deep filled with sand.

A solution was obtained from the theoretical studies, which pointed the way toward the development of an empirical formula from the field tests.

The field tests were made by placing a vertical oscillator on circular steel plates of various diameters and running it at frequencies varying from about 7 cycles per second to 30 cycles per second. Dynamic forces from 300 pounds to 1200 pounds were used in these tests, and the dead load of vibrator and plates varied over about the same range.

In these tests the frequency was gradually increased and the resonant frequency was assumed to have been reached when the rate of settlement was a maximum. The resonant frequency was easily recognized by observing the violence of the oscillation. No difficulty was experienced in determining the resonant frequency to within half a cycle per second.

Factors found to affect the resonant frequency were: magnitude of the dynamic force, weight of the oscillator, size of the base plate, density of the soil, and shearing modulus of the soil. A formula involving these variables was developed as a result of the tests and the resonant frequencies predicted by this equation agreed closely with all values determined experimentally, including several observations made on a compact beach sand, using base plates 19 and 45 inches in diameter.

How much compaction?

The best speed at which to run the vibrator having been determined, the next problem was to find out how much compaction resulted and how deep the increased density extended below the surface. This was accomplished by measuring in-place densities before and after vibration by means of a penetrometer, or drive rod, calibrated to measure densities in terms of the number of blows of a standard weight falling through a standard height.

The results of these tests indicated that very excellent densities were obtained to depths of at least one and one-half times the width of the surface plate.

Based on the results of this work, the Institute undertook the design and testing of a large vibrator for the U. S. Navy Civil Engineering Research and Evaluation Laboratory, Port Hueneme, California. It was anticipated that this larger unit would provide data for checking the theory of resonance in the range of machines of practical size.

Newly-designed vibrator

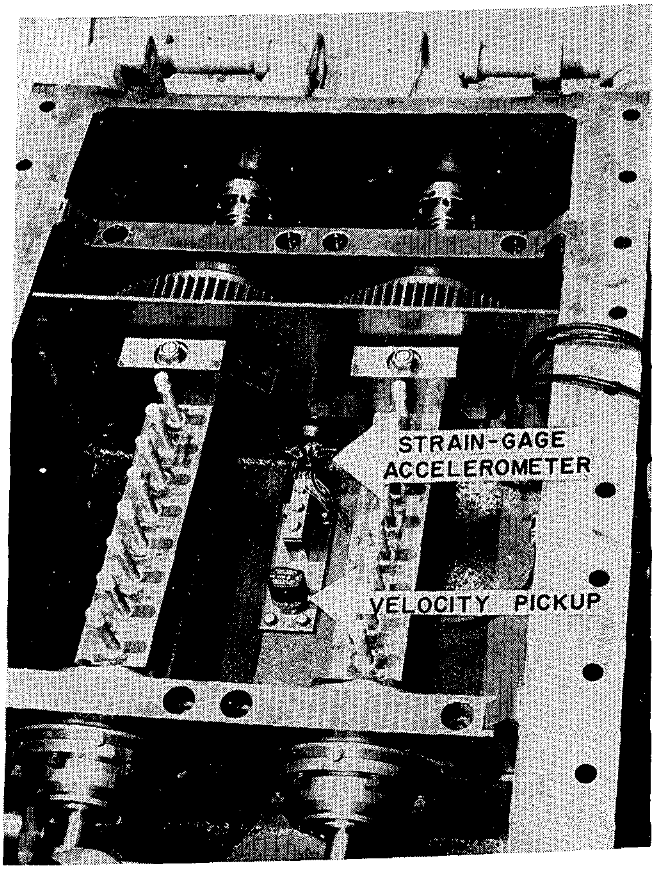
The new vibrator was designed with a base area of 15 square feet and a maximum weight of 6.6 tons, of which 2 tons were in the form of removable plates. This machine produces vertical dynamic forces by means of two oppositely-rotating shafts carrying eccentric weights. By this means the horizontal components of the centrifugal forces are balanced out and the vertical components are additive. At 720 revolutions per minute (12 cycles per second) the unit has a maximum dynamic force of 7.5 tons.

The photograph at the right is a view looking down into the vibrator, with the shafts and connecting gears visible. The design calls for nine removable eccentric weights on each shaft, held in place by stud bolts. Each eccentric weighs 18.3 pounds and its center of gravity is 3.05 inches from the center of the shaft. The studs provide an additional unbalance of 6.65 inch pounds. This arrangement permits nine different dynamic forces to be developed at any speed. A pair of the eccentrics are visible at the far end of the eccentric box, the rest having been removed. The photograph also shows a velocity pickup and an accelerometer, part of the vibration measuring equipment used in testing.

The shafts are driven by four hydraulic gear motors with oil as the fluid. Two of the motors are visible at the bottom of the photograph. There are two similar motors on the opposite ends of the shafts.

The vibrator and trailer assembly are shown in the picture on p. 12. The vibrator is at the right, on the sled type base plate, and the trailer is at the left, carrying the engine, the pumps and the oil storage tank. Power is supplied by a Chrysler engine driving two Vickers vane type double pumps through a two to one reduction gear. At 1200 revolutions per minute and 1000 pounds per square inch these pumps deliver 131 gallons per minute and require 70 hp. to drive them. Actually the pressures developed during the tests were less than one-third of the maximum and the power required was correspondingly lower.

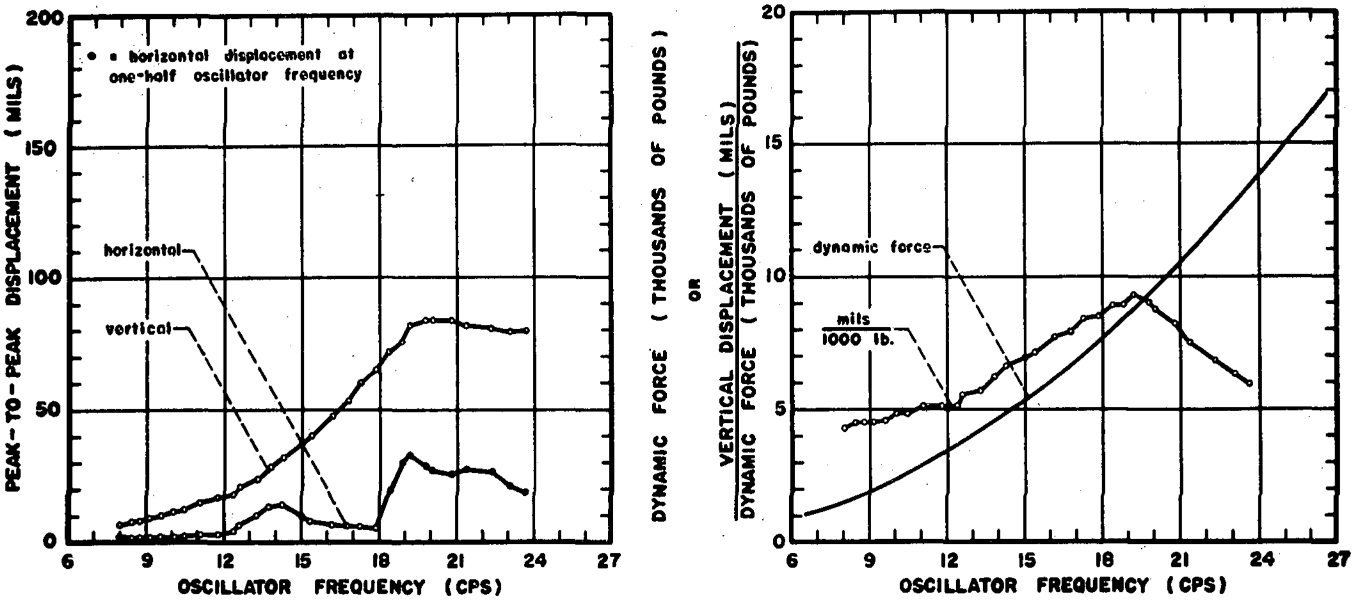
The first field tests were designed to determine the resonant frequency of the vibrator-soil mass under various conditions of dynamic force and weight of vibrator, and to compare these results with the theoretical predictions. To do this the vibrator was kept in one spot and operated through a range of speeds, while the dead weight of the oscillator and the number of eccentric weights were varied. The amplitude of the oscillations, both vertical and horizontal, the frequencies, resonant point, and the pipe line pressures, were obtained by means of electronic recording equipment.



The new vibrator—as seen from above

RUN NO. 13

VIBRATOR DEAD WEIGHT = 9,700 POUNDS



Typical results are shown in the chart above. At the left is shown the total displacement at various values of oscillator frequency. The curves show both vertical and horizontal movements. Resonance occurs at the maximum peak-to-peak displacement. The sharpness of the peak is somewhat masked by the fact that displacement also varies with dynamic force, and dynamic force varies with frequency. To overcome this difficulty the curves at the right were plotted. This figure shows how the dynamic force varies with frequency. The other curve was obtained by dividing each displacement value by the corresponding dynamic force in 1000 pounds. This gives equivalent displacement per 1000 pounds of dynamic force. The resonant point is sharply defined in this later curve.

The results of these tests checked very closely with the theoretical predictions based on the tests with the small oscillator, and indicate that the smaller unit modeled the larger one very satisfactorily.

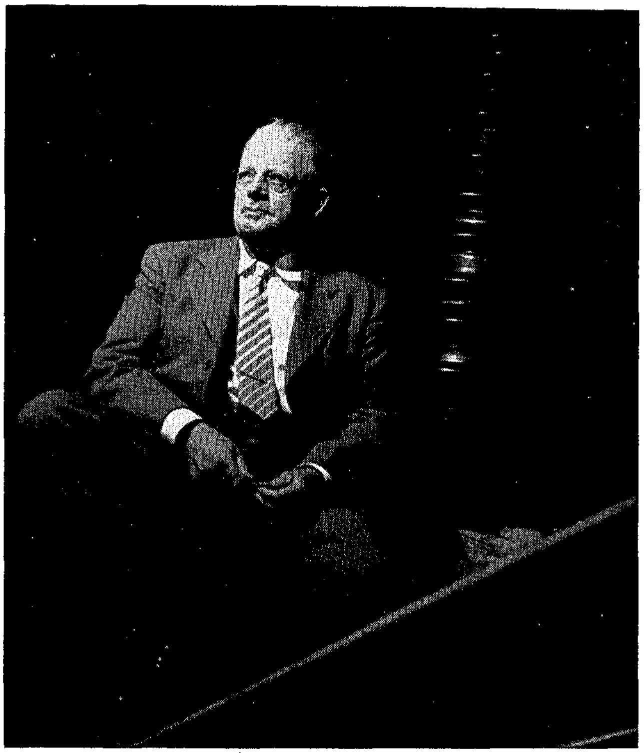
A further check on the theoretical approach exists in the results of experiments by Professor Adrian Pauw on the behavior of heavy concrete blocks under vibratory loading. These results are included in a thesis entitled "A Rational Design Procedure for Machine Foundations," presented as partial fulfilment of the requirements for the degree of Doctor of Philosophy in Engineering at the California Institute of Technology. Professor Pauw worked on the compaction project while developing his thesis, and his contributions to the theory have been especially important.

The effectiveness of the machine as a compactor was determined by towing it along the beach and recording densities of the sand both before and after the machine had passed. The values of density in pounds per cubic foot were converted into percent of the maximum obtainable by the standard laboratory compaction procedure for comparison with the requirements of engineering practice. In this procedure the soil is compacted in a 1/30 cubic foot cylinder by 25 blows of a ten pound hammer falling 18 inches on each of three layers. The soil is compacted at different moisture contents and its dry density is found to vary with moisture. At a certain moisture content the density is a maximum. This density is called "maximum density of the soil." Ninety-five per cent of maximum indicates excellent compaction. In these tests values close to or even above 95% were obtained to a depth of five feet. This is especially remarkable because the sand contained only about 3% moisture, while 13% is required for maximum compaction by standard laboratory methods. The density in the field was actually approximately 100% of the value obtainable in the laboratory at the same moisture.

The theory and the testing to date have all been on granular material, specifically sand. New theoretical considerations will have to be developed for use with other types of soil. The effects of cohesion, and the manner of variation of the modulus of elasticity of cohesive soil with depth are two important variables affecting resonance and damping, about which little is known. During the coming year an attempt will be made to modify the theory used in the studies of granular soils to include these variables. Both theoretical and experimental work will be carried on simultaneously.

The members of the Institute staff contributing to the project are Professors Converse, Director; Housner; Hollander; and Martel. Special mention should be made of the work of Mr. Delbert Hausmann, class of '48, who has been project engineer throughout the entire program. Professor Adrian Pauw of Rice Institute and Professor Patrick Quinlan of University College, Cork, Ireland, contributed heavily during their residence as graduate students at the Institute. Professor Walter Johnson of Pasadena City College assisted in the mechanical design of the large vibrator.

ROYAL W. SORENSEN



He came to Caltech for five years —and look where he is now

IN 1910, when he was five years out of college and working in the engineering department of the General Electric Company in Pittsfield, Massachusetts, Royal W. Sorensen was invited to come to Throop Polytechnic Institute and start a department of electrical engineering.

Sorensen was not particularly interested in teaching and his limited knowledge of California made him think it was a place too hot for comfortable living. He had already turned down several other teaching offers, but the prospect of starting his own department and working with George Ellery Hale and James A. B. Scherer in producing a new type of engineering college turned the trick. He packed up his family and came to California—fully determined to stay at Throop for five years and then go back into industry.

As next to nobody needs to be told, Royal Sorensen is still on the job here. He has not only outlasted Throop Polytechnic Institute itself, which became Caltech in 1920; he has stayed far enough beyond his self-imposed five-year limit to have totted up the longest record of service of any member of the Caltech staff.

He hasn't regretted a day of it either. He still tells students that the best advice he can give them is to do what he did himself—hitch their ambitions to the ideas of good men.

Born in, believe it or not, a log cabin in Wabaunsee, Kansas, Royal W. Sorensen grew up in Golden, Colorado, home of the Colorado State Industrial School and the Colorado School of Mines. The town had a considerable Scandinavian population, and for 35 years Royal's father, Soren Sorensen, ran the Scandinavian grocery store there—and taught the trade how to vote the straight Republican ticket.

After his graduation from high school in 1900, Royal went to work as an apprentice with the Flint Lomax Company in Denver, manufacturers of electrical equipment. He hadn't been on the job long, however, before it occurred to him that a college education would do him a lot more good than working his way up from the bottom of a small machine shop. He quit and went to work for six months as engineer and packer in a flour mill, to earn enough money to enter the University of Colorado at mid-term in February, 1902.

He worked his way through college on the usual assortment of odd jobs, the oddest probably being the one he held for a solid year, running the graveyard shift at the University's power plant. The job took eight hours a night, seven nights a week, which meant that Royal had to snatch his sleep when he could find it, which was usually in the afternoon as soon as college classes were over. He claims to have fallen asleep on the job only once.

After graduation in 1905 he went to work for General Electric in Pittsfield, Massachusetts, first as a test man, then in the engineering department.

When he came to Throop in 1910 the school had 31 students. There were three engineering graduates in the class of 1910. Two of them received their degrees in electrical engineering, and one in mechanical engineering—though, frankly, all three took the same course.

From the beginning, the whole idea of engineering education at Throop was to require students to take 25% of their courses in the humanities as well as to get a sound foundation in the sciences along with their regular engineering studies. In 1912, when Throop Hall was the only building on the campus, George Ellery Hale asked Sorensen to plan an electrical engineering building as the school's second structure. Sorensen turned the idea down, and Hale then agreed with him that the Institute's science facilities should rightly be expanded first. As a result the second building on campus was the Gates Laboratory of Chemistry—and Sorensen hasn't got his new electrical engineering building to this day.

In 1923, however, with funds supplied by the Southern California Edison Company Sorensen did get a high-voltage laboratory. It was the first laboratory in the country to have a 1,000,000 volt power frequency, provided by a cascade system of transformers designed by Sorensen himself.

Available for research as well as industrial tests, the facilities of the high-voltage laboratory have been used to aid the Southern California Edison Company in the development of high-voltage transmission lines, to furnish lightning protection of oil storage tanks for the oil industry, and for numerous other researches of undeniable benefit in the industrialization of southern California.

For a number of years Caltech and Stanford (whose alumni banded together and built the Ryan high-voltage laboratory soon after Caltech's was completed) were the outstanding schools in the country in the teaching of high-voltage work. For a few years Caltech was even giving more Ph.D. degrees in electrical engineering than M.I.T.

Perhaps the best indication of the place held by Royal W. Sorensen in the field of electrical engineering can be given by noting a few of the scores of professional honors which have come to him during his career.

Some honors and awards

His alma mater, the University of Colorado, has twice honored him, with an E.E. degree in 1928 and a D.Sc. degree in 1938. The Engineers and Architects Association of Los Angeles presented him with its "most valuable engineering service" scroll in 1944. The National Academy of Sciences selected him as one of a six-man Scientific Advisory Committee which was sent to survey the reorganization of scientific and industrial development in Japan in 1947. In 1950 he was elected an Eminent Member of Eta Kappa Nu, a national honorary organization of electrical engineers. In 1951, upon the recommendation of the American Institute of Electrical Engineers, he was made an honorary member of the Institute of Electrical Engineers of Japan.

He served as consulting engineer for the Pacific Light and Power Company (now a part of Southern California Edison) when power was first transmitted 231 miles from Big Creek to Los Angeles at an unheard of 150,000 volts.

He was president of the American Institute of Electrical Engineers in 1940-41, and is a Fellow of that organization. In 1950 the AIEE Fellows in the Los Angeles area set up an organization known as the Royal W. Sorensen Fellows. He is a member of the California State Board of Registration for Professional Engineers and the Society for the Promotion of Engineering Education as well as such organizations as the American Association for the Advancement of Science, Tau Beta Pi and Sigma Xi.

Not that Sorensen's activities have all been confined to engineering: Like a good many active men, he seems to have been hyperactive. He was president of the Pasadena YMCA for six years, and is still a board member. He is chairman of the Board of Trustees of the First Baptist Church of Pasadena, a Rotarian and a Mason.

On the campus Sorensen has of course served on an uncountable number of faculty committees, and was, in fact, chairman of the faculty in 1938-39. His most impressive jobs, though, have been on the Alumni Relations Committee and on the Physical Education Committee.

Always a favorite of students and alumni, Sorensen was signally honored last year when a group of his former students took the occasion of his retirement to establish a $900 annual graduate fellowship in electrical engineering in his name. This honor is particularly fitting because of Sorensen's outstanding pioneer work in graduate engineering training. His plan of graduate study in electrical engineering at Caltech was based solidly on physics, mathematics and engineering analysis rather than on the infinite details of modern technology which men can learn better in industry. Unique at the time, the plan has since spread to other schools.

He was chairman of the Physical Education Committee from 1913 until his retirement last year. From the start, Caltech has had a faculty-controlled physical education program—with, incidentally, a large student participation. In the early days of Throop Polytechnic Institute, however, there was a ruling that the school was to have no competitive teams. By 1913 the students did their best to persuade the school that they should at least be allowed a football team. Sorensen took their side and as a result was given the job of putting the new team together. How about a little money to get started? No, there was no *money;* he'd have to get that himself. So he did. He solicited enough around town to hire a coach and buy some uniforms.

The coach turned out to be something of a problem. For one thing, *he* was determined to win every game—and apparently even in those days that was not a primary consideration with the students themselves. In the first game of the season, with Redlands, the panicky coach began to give his team a series of signals, involving his tipping his hat at various angles, which would call for specific plays.

This kind of coaching was strictly unethical, and one of the sturdy young men on the Throop team listened patiently for a short time and then stepped up to the coach and said, "You can go to hell, mister. We don't play that way here." They didn't either.

The coach, not having the confidence of his team—and not being as big as they were besides—didn't last much longer.

Professor Sorensen officially became professor emeritus last year. Though he was relieved of administrative responsibilities, he has actually continued to be as active as ever in the electrical engineering department. This is at least partly due to the fact that activity is a habit he's unable to break—and partly because, in his position as head of the electrical engineering department at the Institute, Royal Sorensen has come about as close to being irreplaceable as a man can get.

CONFERENCE IN THE CLOUDS

Among the undergraduates on any college campus, you'll find the talk reaching up to the clouds. And once in a while — in a classroom, around a study table, or even in a bull session — a really big idea is born.

Big ideas come, too, from the men and women in laboratories, business offices, shops. But often these professionals are exploring a path first glimpsed in college.

How do we know? Because of the many college people who have come into the Bell System, where big ideas and a lot of dreams have taken their place in progress. The human voice, carried along a wire, first across a town, then a state, a nation, and now the world. Music and pictures and things happening delivered into cities and hamlets all across the land by radio and television networks.

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THE MONTH AT CALTECH

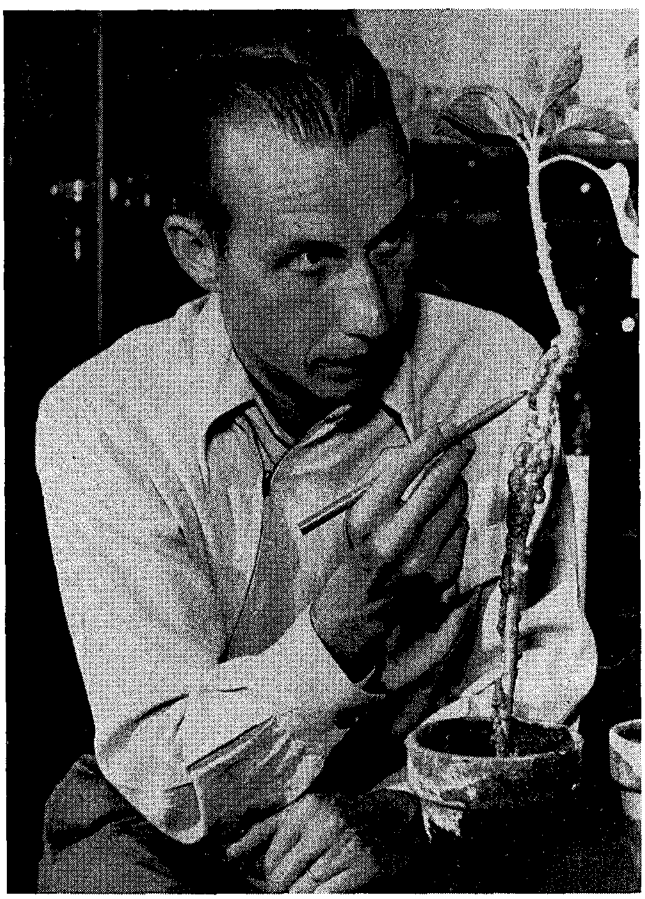
New Moon

ADDITIONAL OBSERVATIONS and computations have confirmed the discovery of a new moon of Jupiter (*E&S*—November, 1951) by Dr. Seth B. Nicholson of the Mount Wilson and Palomar Observatories.

The object was found on a photographic plate exposed with the 100-inch telescope on Mount Wilson on the night of September 28, but further studies had to be made before it could be definitely identified as a twelfth satellite of Jupiter. The path of the object is still not known, because of the short arc observed, but the computed orbits show that it requires more than 600 days to make its circuit around the planet. It moves in a clockwise direction, which is counter to the motion of most objects in the solar system.

Its period of more than 600 days identifies it as one of the outer group of Jupiter's satellites, which are about 14,000,000 miles from the planet. It is roughly one one-hundred-thousandth as bright as the faintest object visible to the unaided eye, and its diameter is estimated at about 15 miles.

This is the fourth moon of Jupiter discovered by Dr. Nicholson. He found Satellite IX in 1914 while at the Lick Observatory, and X and XI in 1938, at the Mount Wilson Observatory.



Guy Camus

AEC Fellows

SEVEN CALTECH MEN have been awarded Atomic Energy fellowships by the Oak Ridge Institute of Nuclear Studies in Oak Ridge, Tennessee.

Dr. Thad H. Pittenger of Albion, Nebraska, Research Fellow in Biology at the Institute, received a post-doctoral fellowship from the AEC. Predoctoral fellowships went to Bruce Ames, New York City, in the field of biology; Tucker Carrington, Lynchburg, Virginia, chemistry; George Dubes, Sioux City, Iowa, biology; and Ronald Greene, South Gate, California, biology. Extensions of fellowships awarded during the past school year went to Claude Hinton, Catesville, North Carolina, biology; and Lionel Jaffe, Pasadena, biology.

Rapkine Award

DR. GUY CAMUS, Research Fellow in Biology at the Institute, has been granted the first award of the Louis Rapkine Foundation of Paris for distinguished work in biology.

He was notified of his selection for the 100,000-franc prize by Dr. Andre Lwoff of the Pasteur Institute, Paris, on behalf of the Rapkine Foundation. This organization was established in memory of Louis Rapkine, an eminent young French biologist in the field of cellular physiology who died in 1949 at the age of 42.

Dr. Camus came to Caltech as a Rockefeller Foundation Research Fellow in July, 1949, on leave from the Sorbonne at the University of Paris, where he had worked on cell differentiation and made physiological studies of tumor tissue in plants.

His early work at Caltech was done in the Earhart Plant Research Laboratory in collaboration with Dr. Frits Went on effects of light and temperature on plants. Since early in 1950 he has been engaged primarily in plant biochemistry studies with Dr. James Bonner, Professor of Biology. Working under a grant from the American Cancer Society, they have found that a virus-like entity is involved in the tumor transformation of plant cells.

The Rapkine award is the second won by Dr. Camus during his scientific career. The first, which also reached him after he had begun his work at Caltech, was the Louise Darracq 6,000-franc prize awarded by the French Academy of Sciences in December, 1949, for his work on plant cancer. It came a decade after he received the Bachelor of Science degree at the University of Lille in 1939 and just eight months after he was

CONTINUED ON PAGE 20

awarded the Doctor of Science degree at the University of Paris in April, 1949.

Dr. and Mrs. Camus plan to return next spring to Paris, where he will rejoin the faculty of the sciences at the Sorbonne.

Visiting Professors

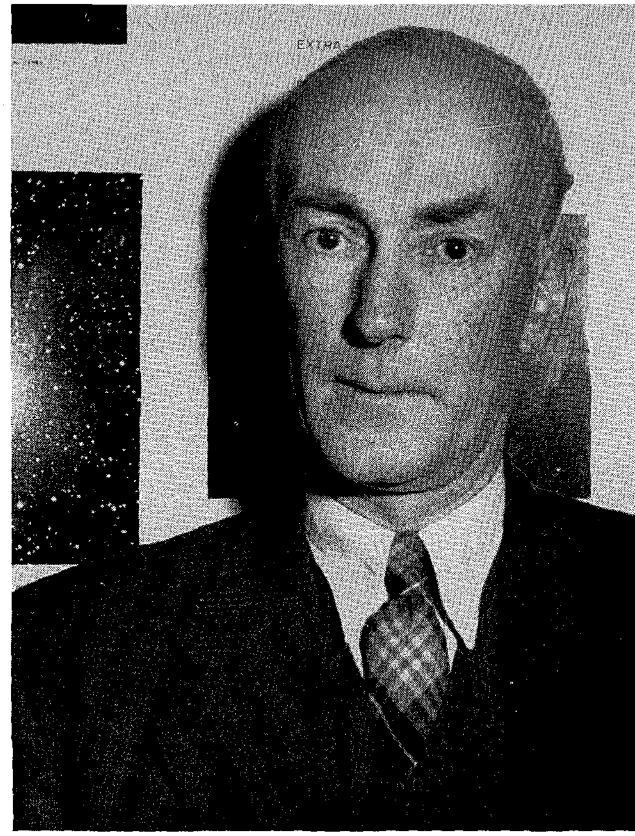
TWO NEW VISITING professors join the Institute faculty this month, which brings the total for the academic year to seven.

Dr. John von Neumann, Visiting Professor of Mathematics, is one of the world's leading mathematicians. A member of the Institute for Advanced Study in Princeton, New Jersey, Dr. von Neumann received his Ph.D. at the University of Budapest in 1926 and joined the faculty of Princeton University in 1930. He has been a Research Professor in Mathematics at the Institute for Advanced Study since 1933. Dr. von Neumann is to deliver a series of six special lectures in mathematics at Caltech between January 4 and 15.

Dr. Jan H. Oort, outstanding Dutch astronomer, is Visiting Professor of Astronomy at Caltech. Director of the Observatory of the University of Leiden in The Netherlands, he is noted primarily for his work on the structure and rotation of the Milky Way. He is a former General Secretary of the International Astronomical Union. At Caltech he will conduct a graduate course in astronomy on "The Structure of the Galaxy."

Caltech's other visiting professors include Dr. David Bishop of the University of Massachusetts, Visiting Professor of Biology; Dr. Noboru Yamada of the National Agricultural Research Institute in Knosu, Japan, Visiting Professor of Plant Physiology; and Dr. Egbert Havinga, Director of the Laboratory of Organic Chemistry of the University of Leiden, Visiting Professor of Chemistry.

John von Neumann



Jan H. Oort

During the first term at Caltech Dr. Hans G. Borei, of the Wenner-Gren Institute of the University of Stockholm, was a Visiting Professor of Biology; and Dr. E. G. Bowen, of the Australian Commonwealth Scientific and Industrial Research Organization, was a Visiting Professor of Physics.

Men of Science

THE BUREAU OF LABOR STATISTICS, in cooperation with the Department of Defense, has just published a bulletin which reports on the "Employment, Education and Earnings of American Men of Science."

The study covers 42,000 of the 50,000 scientists listed in the 1949 edition of *American Men of Science*. Scientists studied were predominantly research workers. Next to research, teaching was the activity most often reported. Chemists were the largest group, comprising about one-fourth of the men listed in the directory. Biologists were second, and engineers third. The relatively small proportion of engineers included reflects the fact that a large proportion of all engineers are engaged in administration, production or development work rather than in scientific research.

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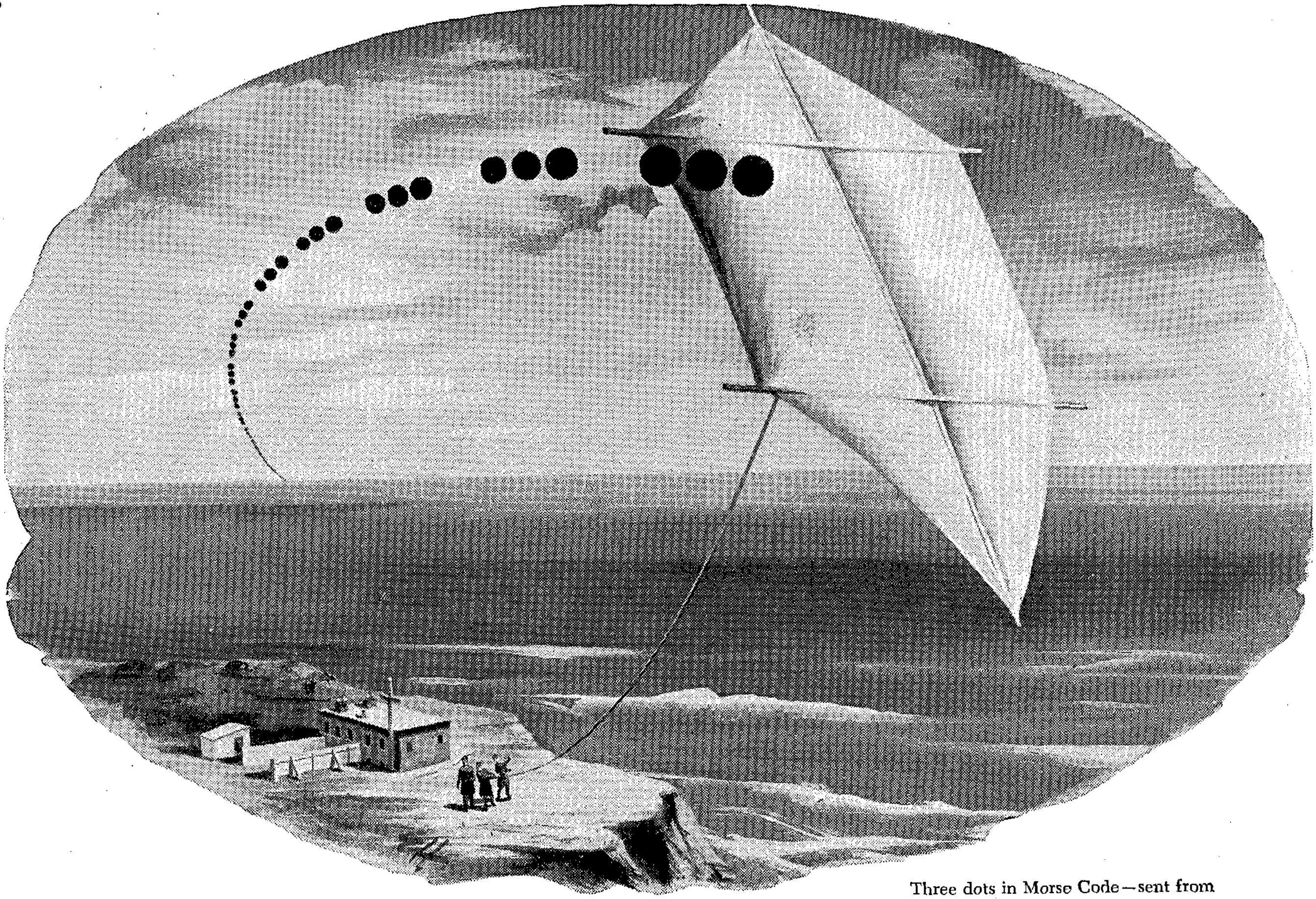

Three dots in Morse Code—sent from England and received by Marconi in Newfoundland—proved that wireless signals could span the Atlantic.

Three dots that opened a new era!

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Before this historic event, wireless telegraphy had been limited primarily to communications between the shore and ships at sea. Marconi's success, however, was the forerunner of many other developments which led eventually to RCA world-wide radiotelegraph service that now operates more than 80 direct circuits to 67 countries.

As radio progressed, its usefulness was expanded by invention and development of the electron tube, the harnessing of short waves which made world-wide transmission a reality, and the automatic transmission and reception of messages at high speed.

Radio, with its magic of spoken words and music broadcast over the world . . . *television*, the miracle of pictures in motion transmitted through the air . . . these mediums of modern communications have added notable links in the chain of electronic advances first forged in 1901 from the mere sound of three dots.

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Educational institutions were the principal field of employment for these scientists, with private industry second and government third. Thirty-seven percent were employed solely by colleges and universities, and an additional 13 percent combined education with some other type of employment. Twenty-seven percent were in private industry, and 14 percent in government.

Earnings were highest in private industry, the median salary for all Ph.D.'s in industry being $7,070, in government $6,280, in education $4,860. Ph.D. engineers had the highest median salary and biologists the lowest in every type of employment—though biologists working for business firms earned more than engineers on the college campus.

A Report on the Congress for Cultural Freedom

by Paul S. Epstein
Professor of Physics

EVEN MORE DANGEROUS than the shooting war which the Russians have instigated in Korea is the war of propaganda which they are conducting all over the world. Many times they have expressed their intentions of gaining control of the Western countries, of destroying the democratic way of life and of imposing their system on the whole world. Having been successful in Czechoslovakia, they have the fond hope of using the propaganda weapon to bring about the downfall of the other nations of the West.

Hence, the struggle against Communistic propaganda has become the concern of every thoughtful and patriotic citizen, and numerous organizations are springing up to help in the struggle. One of these organizations, *The Congress for Cultural Freedom*, is interesting because of several distinctive features setting it apart from the usual run.

Firstly, the Congress is intended as an organization of *intellectuals* — professional men, writers, scientists, artists. It tries to bring home to these men that their freedom of cultural pursuits will come to an end if totalitarian Communism gains control.

The reason for singling out the intellectuals is not the idea that they are more vulnerable to Communist blandishments than other men. Indeed, the leaders of the Congress hold the opposite view, but they think that persons engaged in cultural pursuits will be particularly useful in the struggle. They are the men who write articles and books, who deliver lectures, paint posters and draw cartoons—in short, who create public opinion. When it comes to a war of ideas, the intellectuals are the natural first-line soldiers.

Secondly, the Congress tries to mobilize only men and women of politically progressive ideas. The main issue of the strife is that the Western democracies stand for freedom and the Soviets for police regimentation and oppression. Reactionaries, who confuse liberals with Communists and who advocate the suppression of both by police methods, are not wanted. They would do more harm than good.

Thirdly, the Congress regards the struggle against Communist propaganda as an international problem. The position of America would be seriously endangered if Soviet Communism were successful in one of the important countries of Western Europe. Hence, its whole organization is conceived on an international scale.

The headquarters of the Congress of Cultural Freedom is set up in Paris, as the most strategic location, with the musicologist, Vladimir Nabokoff, as general secretary and the noted Swiss sociologist writer, Denis de Rougemont, as chairman of the executive council. Both these men lived many years in America and have various American associations. Closely affiliated with the Congress are the *National Committees for Cultural Freedom* which exist in America, England, and Italy. The chairman of the American Committee is the well known philosopher of New York University, Sidney Hook.

The activities of the Congress so far have been directed along two main lines: (1) publication of literature, (2) organization of international conferences.

In addition to pamphlets and newspaper articles the following monthly periodicals are published under the sponsorship of the Congress and its National Committees: (a) *Preuves* (French: Editor, F. Bondy); (b) *The Twentieth Century* (English: Editor, M. Goodwin); (c) *Der Monat* (German: Editor, M. J. Lasky); (d) *Cultura* (Italian: Editor, Ignazio Silone); (e) *Kultura* (Polish: Editor, J. Giedroic). A part of the material in these magazines is identical, another part is original in each of them since the peculiar conditions of each country require independent coverage.

The leaders of the Congress plan to arrange international conferences of seminars at intervals of less than a year. The latest of these seminars took place last September in the village of Andean near Strasbourg (Alsatia) and was devoted to a discussion of the methods of stopping the spread of Communism. The members formed a small group of fourteen persons representing six different countries. For five days they lived in the village inn, devoting most of the day to discussions under the chairmanship of de Rougemont. Limitations of space do not permit us to characterize the many eminent men present, and we restrict ourselves to the names of the three American delegates: Sidney Hook, Alsoph Corwin (Organic Chemist of Johns Hopkins) and Paul S. Epstein (Physicist at Caltech).

The subject matter was divided into two parts: (1) What makes Communistic teaching attractive to some intellectuals? (2) What are the ways to counteract this attraction?

Various causes were listed why intellectuals occasionally succumb to the blandishments of Communist propaganda, some general, some dependent on local

CONTINUED ON PAGE 24

conditions in the several countries. The most important seems to be misguided idealism combined with complete ignorance of the actual Russian life. The idealist becomes dissatisfied with the conditions in his own country, because of cases of injustice and discrimination which he sometimes sees, and taking the Soviet protestations of freedom, democracy, and equal opportunities among the Russians at their face value, he thinks they may have worked out a better order of things.

The obvious way of counteracting such illusions is to spread factual information about the sordid Russian realities and to show up the Soviets as the police and slave state they are. For this purpose the conference recommended, among other things, the preparation of a series of pamphlets, each directed at a special branch of a profession—chemists, musicians, biologists, etc.—and listing the persecutions and annoyances which the members of that branch had to undergo in Russia. This recommendation is now being implemented.

The next international conference of the Congress is scheduled for next month.

THE BEAVER

Some Notes on Student Life

Pendulum

SHORTLY BEFORE the end of the first term a new magazine joined the family of Institute publications. The first issue of the undergraduate literary magazine, *Pendulum*, weighed in at slightly less than forty pages. *Pendulum* was conceived and edited by a small group of enterprising undergraduates, and was published with the blessings and money of the Division of the Humanities. It included nine short stories and prose sketches, eight poems, and two artistic sketches, culled from the selected works of eight undergraduates and two 1951 graduates.

"The reasons for publishing a literary magazine at Caltech, a center of technical interest, are manifold," said Editors Vickman and Wilson. "First, we know that one of Caltech's aims is to broaden the outlook of students beyond specialized technical pursuits. Second, there is a promising amount of interest here in doing creative literary and artistic work."

A total of 750 copies were printed for distribution to the undergraduates and faculty members of the Institute. Since *Pendulum* was copyrighted, two copies were sent to the Library of Congress. The editors hope to make *Pendulum* a triannual magazine, by giving one issue per term to the Institute and posterity. They are not worried about a lack of quality and quantity of contributions for future issues; they recognize that the greatest hurdle is financing the magazine. The Division of the Humanities was gracious enough to finance the first issue in the hope that thereafter *Pendulum* could somehow finance itself on the basis of its artistic merit.

SCIAC

This year the SCIAC (Southern California Intercollegiate Athletic Conference) has eliminated the separate division in the conference for freshmen. Instead of the former division into freshmen and varsity teams, all the athletes are divided into a varsity and a junior-varsity squad for each sport. The differentiation is based solely upon ability and experience. Under this new system, upperclassmen may play on the junior-varsity teams, and freshmen may play on the varsity.

The advantage of the junior-varsity system is that it enables greater numbers to participate. Outstanding freshmen have the opportunity to play varsity ball, and less talented upperclassmen may get a chance to play in junior-varsity games when they would only help fill the bench for the varsity.

This year our basketball prospects are especially enhanced by having freshmen eligible for the varsity squad. Among our first-string five in varsity basketball are no less than three freshmen. Coach Carl Shy should have high hopes for future years, since these three freshmen are accompanied by a sophomore; only one senior rounds out the team.

First Term

In accordance with the time-honored custom, and contrary to the desires of many, finals came on schedule. Their coming, though perhaps momentous, made no one philosophical, except perhaps in the broadest human terms. The last of finals died an inglorious death at the hands of the freshmen. It seemed they had not yet learned that talking about examinations after they were over was not conducive to whatever mental health they had managed to salvage.

In the student houses, informality was the rule after finals, and impromptu celebrations were hastily arranged to release the pressure that had accumulated all week. Soon afterwards, most of the students had departed for home or other points of greater interest. Many others worked on campus, and a few stalwart snakes spent their time in unorganized study and in preparation for next term's courses.

Looking back on the first term, it seemed the undergraduates were a little happier with their lot in life than at the same time last year. Less worry about the draft, and a large and unusually spirited freshman class helped. The student houses seemed more lively, and the food tasted better . . . Maybe it was the weather.

—*Al Haber '53*

ALUMNI NEWS

Membership

On January 1, 1952 membership in the Caltech Alumni Association had reached an all-time high of 2575. The figure represents 44% of the total number of alumni eligible for membership.

By way of comparison, at this time last year the Alumni Association had 2300 members—or 40% of those eligible. The past year has not only seen an increase in the number of members but in the percentage of those eligible for membership as well. From 1945 to 1951 the percentage of those eligible was dropping steadily. In 1951-52, however, this downward trend has been reversed.

Washington Chapter Meeting

President Lee A. DuBridge will address the Washington, D. C., Chapter of the Caltech Alumni Association at a meeting to be held on February 1 in the Red Room of the 2400 Hotel in Washington. Reservations may be made with Charles Cutler, Secretary-Treasurer of the Chapter. His address: Kirkland, Fleming, Green, Martin and Ellis, 16th and K Streets, N.W. Phone Sterling 3200.

Sacramento Chapter Meeting

The Sacramento Chapter of the Caltech Alumni Association gathered at the home of George Fleming for an evening meeting on December 8, 1951, at which Captain James Deyr, U. S. Air Force, showed pictures taken by himself in Japan and Korea. Present were: Paul Jurach and (with their wives) Tracy Atherton, John Bailey, William Berry, George Fleming, Gunner Gramatky, Fred Groat, Howard Hopson, Wayne MacRostie, Henry Nies, Edgar Price, Richard Silberstein, and W. Layton Stanton.

The Sacramento Chapter also has a regular monthly informal luncheon meeting which all alumni are cordially invited to attend.

Time: Noon, the first Friday of each month.
Place: University Club.

—Richard Silberstein '41
Secretary-Treasurer

Alumni Dinner Dance

The Alumni Association holds its 16th Annual Dinner Dance on Saturday, February 9, at the Oakmont Country Club. Laverne Boyer and his Orchestra are supplying the music. Dinner's at 8, dancing at 9. Reservations should be in at the Alumni Office at Caltech by February 4. Dinner is $3.50 per person. Charge for the dance is $1 per person. These charges include tax and tips.

PERSONALS

1918

Munson J. Dowd is consulting engineer for the Imperial Irrigation District in El Centro, Calif. He is also a member of the Districts Securities Commission of the State of California. In his student days Dowd was fullback on the football team and President of the Student Body.

1921

Ernest H. Mintie writes that he and his wife now have five children and five grandchildren. He still owns the E. H. Mintie Company in Los Angeles, and his oldest son Jim is in the business with him. Although their main business is distributing vortox panel and oil bath filters, this has led to some interesting general cleaning jobs—such as removing paint from Howard Hughes' four motor plane, steamcleaning the lower outside of the May Company, tanks for the Union Pacific Railroad, the inside of the Hazel Atlas Glass Company in Pomona, etc.

1925

Robie T. Watkins reports that his son, Bruce, is now a Sophomore at C.I.T., which makes him realize that he has become an "old alumnus."

1926

Charles Bidwell has been transferred by the Bell Telephone Laboratories (for 1 to 3 years) to the Sandia Corporation at Albuquerque, New Mexico. The Sandia Corporation is being directed by the Bell Labs under contract with the Atomic Energy Commission. Charlie entered his first tennis tournament last October—the "Veterans' Doubles" of the Southwest Open Tennis Tournament held in Albuquerque. He lost in the finals to *K. W. Ranney* '25 of Santa Ana. Charlie attributed Ranney's success to the fact that Ranney has played tennis since 1924 when he was on the Caltech tennis team, while he himself has taken it up only in the last ten years.

1929

Gene Atwater, M.S. '30, and his wife have four children—a boy, 13, and three girls, 9, 8, and 6. This year Gene has made a "return to youth." He works with the Woodcraft-Rangers and has an active group of 12-year-olds who go hiking, biking, boating, and are currently building an archery range at the Ranger camp near Castaic.

William G. Young, Ph.D., Dean of the Division of Physical Sciences at UCLA, has been elected to the board of directors of the American Chemical Society.

Homer Reed, M.S. '30, has been appointed chief engineer in charge of engineering and development at the Union Oil Company's new laboratories at Brea, Calif.

R. J. White has replaced *R. E. Offeman* '37, as laboratory manager of the Baroid Sales Division of the National Lead Co. in Los Angeles.

1931

R B. Jacobs, Ph.D. '35, has been appointed technical director of the engineering research department of the Standard Oil Company of Indiana, effective January 1. He joined the company in 1947 as associate director of the engineering research department after serving with the National Research Council.

1932

D. H. Larsen, M.S. '36, has gone into business for himself as Consulting Chemical Engineer and Registered Patent Agent in Los Angeles.

1933

John D. Mendenhall has been working for several years on both Atomic Energy and Guided Missile projects for the Ralph M. Parsons Company of Los Angeles. He is currently project engineer for a G.M. facility. The Mendenhalls have recently built a home in West Pasadena, near the Annandale Golf Club, and have two girls, 5 and 8.

Wendal A. Morgan has taken a position, as of January, 1952, on the consulting engineering staff of Ebasco Services, Inc., a New York City engineering firm specializing in power systems and having numerous foreign contracts. Wendal served ten years on the Chief Engineer's staff of the Bureau of Reclamation in Denver.

Louis A. Pipes, M.S. '34, Ph.D. '36, was promoted to Professor of Engineering at UCLA last July.

1934

Paul L. Kartzke, M.S. '35, has been made Vice-President of Shell Oil Company, Ltd. of Canada with headquarters in Calgary, Alberta. Paul, who is just 39, has been with Shell since he started as an engineering trainee in 1935. He and his wife, Virginia (Harper) Kartzke—who worked at Tech for four years—and their three children will be Canada bound come spring.

J. E. Sherbourne has been appointed assistant manager of research at Union Oil's Brea, Calif., Laboratories.

1935

F. H. Allardt, M.S. '37, has moved into a new home in Pacific Palisades, and is working for Douglas Aircraft in Santa Monica. He has two daughters, 3 and 5.

Jackson Edwards, Engr. '35, is now in business for himself in Hollywood, as a technical electronic representative, representing a group of eastern manufacturers of electronic equipment.

1936

Charles Jordon, M.S. '37, has just returned from a two-month trip to Europe. While in England he visited *Adrian H. Gordon* '35 of 66 Redcliffe Square, London SW 10. Adrian would be very glad to hear from any alumni, especially any who are passing through London.

Theodore Vermeulen, M.S. '37, has been promoted from Associate Professor to Professor of Chemical Engineering at the University of California at Berkeley.

1937

Comdr. Charles A. Van Dusen and Evelyn D. Ott were married on October 24 in Washington, D. C.

R. E. Offeman has been promoted to Director of Sales and Service Laboratories for the Baroid Sales Division of the National Lead Co. He's transferred to Houston, Texas.

1938

William C. Brenner has rejoined the Westinghouse Generator Division as an advisory engineer, working in particular on turbo-generator development. On November 3 he acquired a wife—a young fraulein from Germany.

Joseph Westheimer left Jerry Fairbanks, Inc., last month to join Consolidated Film Industries in Los Angeles. He is a special effects cameraman in the Title and Optical Department, where they make titles, optical effects and inserts for motion pictures and films for television.

Jack F. Dougherty, M.S. '39, is now Vice-President of the Empire Trust Company in New York City.

1940

Jack Tielrooy has been appointed supervisor of chemical processes at the Brea, Calif., laboratories of the Union Oil Company.

1941

Alfred Bersbach recently left General Electric, after ten years, to work for the Hughes Aircraft Company. The Bersbachs now have four sons.

Charles B. Roen has been appointed development chemical engineer in the general development department at the Monsanto Chemical Co. in St. Louis.

Jeremy A. Jones is group materials and process engineer at Lockheed's Marietta, Georgia, plant. He was transferred to Georgia last spring, and claims he likes the Southeast very much.

1942

Robert E. Anderson reports that he is still geologist for the Signal Oil and Gas Company in Los Angeles, but spends a fair amount of time out of town or out of state.

Wilbur D. Crater is executive vice-president—and also in charge of mechanical design—of an engineering and consulting business which was started in Los Angeles a year and a half ago. Now there are 33 employees designing aircraft gas turbines, propulsion pumps, compressors, turbines, etc. The Craters have three children; two girls—ages six and three—and a six-month-old boy.

Fred Felberg, M.S. '45, is Chief of the Operations Department at the Cooperative Wind Tunnel and a Lecturer in Aeronautics at the CIT graduate school. The Felbergs now have two children: Stephen, 6, and Gayle, 1½.

Richard M. Head, M.S. '43, who has been Professor of Aerodynamics at the U. S. Naval Postgraduate School at Annapolis for the past two years, was transferred to Monterey when the school moved to the West Coast on December 14.

1943

Amasa Bishop, after receiving his Ph.D. degree in 1950 from the University of California at Berkeley, went to the Federal Institute of Technology in Zurich, Switzerland, to do research in nuclear physics on a postdoctoral fellowship. He has now accepted a position on the staff of the University of Zurich for a year, to teach and continue his research in physics. With him in Switzerland are his wife, Dr. Barbara Merrill Bishop, and their three children (two boys and a girl).

D. R. Arnold is Assistant Superintendent, Pacific Division, of the Manufacturing and Sales Department of the Superior Oil Company. He was married in 1948 to Miss Agatha Dee Westervelt of Bakersfield.

ALUMNI ASSOCIATION OFFICERS

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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:

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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.

James A. Blayney and his wife have a daughter, Gayle Elizabeth, born November 17. They also have a son, Douglas, who at 18 months "shows promise of becoming a first-rate fullback." Jim is still a mechanical-electrical engineer for Walter Wagner, an architect and engineer in Fresno.

Richard Schamberg, M.S. '44, Ph.D. '47, and his wife Margaret announced the arrival of their first child, Linda Ann, on November 16.

1944

Comdr. Albert Furer, M.S., Engr., writes from the Naval Auxiliary Air Station at Corry Field, in Pensacola, Florida—of which he is the Executive Officer. At NAAS they train embryo naval aviators to (1) fly solely by instruments, which means without visual reference to anything outside the cockpit, and (2) to make a successful landing aboard an aircraft carrier.

Joseph H. Chadwick, Jr. married Betty Virginia Vivier in San Francisco in September of 1950. He got his Ph.D. in electrical engineering from Stanford last June and is now at Stanford where he is in the business of trying to prevent ships from rolling.

1945

Donald C. Dodder has joined the staff of the Los Alamos Scientific Laboratories, working in the Theoretical Physics Division Office.

1946

W. Clifford Taylor is still a partner in the Southwestern Scale Company of Phoenix, Arizona, a national concern manufacturing industrial scales. He is now opening a new office in El Paso, Texas.

Lloyd W. Chamberlain is stationed on Wake Island for a year, as of October, 1951, working as a weather forecaster for the U. S. Weather Bureau. He cordially invites anyone passing through to visit him.

1947

Chad Dauwalter, for the past seven months, has been working for North American Aviation as a research engineer on large rocket development. He was initially employed at the Downey plant but has now been transferred to the Aerophysics Field Laboratory in the Santa Susana Mountains, near Chatsworth Lake.

Lt. Comdr. Loys M. Satterfield, A.E., was decorated for meritorious achievement on December 6, 1951. He received the Navy Commendation Ribbon and Pendant, with Combat "V," and a gold star in lieu of his fifth Air Medal. He distinguished himself as Operations Officer of Carrier Air Group Two during operations against the enemy in Korea from December, 1950, to May, 1951, by effectively coordinating all strike schedules among the squadrons of the air group. He also participated as pilot and strike leader in numerous air strikes against the enemy. His group was attached to the carriers *Philippine Sea* and *Valley Forge*. Lt. Comdr. Satterfield is a veteran of over ten years of Naval service.

Clifford M. Wimberly, M.S., formerly with the California Highway Department, is now with the Portland, Oregon, office of American Bitumuls and Asphalt Company.

1948

J. C. Bear is working at Convair in San Diego.

Joe Wechsler, M.S. '49, A.E. '50, is assistant engineer in structures in the Aircraft Division of the Rand Corporation in Santa Monica.

Glen H. Mitchel, Jr. recently transferred from the Precipitation Company of Canada, Ltd. in Montreal to the Western Precipitation Corporation in Los Angeles.

1949

Edward L. Alexander, M.S., has a new job at the Caltech Cooperative Wind Tunnel, a new home in Culver City, and a new addition to his family—Mark, born on Christmas Day, 1951. The Alexanders already have a daughter.

Bob Willard, M.S., reports that the two-year-old Willard Engineering Company has grown considerably and is currently flourishing. They specialize in machinery hydraulics and pneumatics, i.e. the application of air and hydraulic power to any kind of machine for power, movement and timing. Son Doug, who is just one year old, is also prospering.

Carlos Beek-Navarro was released from the Peruvian Air Force and returned to the United States on December 29, 1951. He was greeted at the Los Angeles International Airport by his wife, the former Marion Mosier of San Gabriel, and a number of friends, including *Dan Markoff* '50, *Hugh Carter* '49, *Ed DuFort* '49, and *Dave Warren.*

1950

William D. Calhoun has been with Northrop Aircraft, Inc. for a little over a year, working in Materials and Process Engineering, primarily in plastics (reinforced laminates).

Gerald S. Mayner announces the arrival of his first son, David Robert, born November 5th, 1951. His wife, Diana, is from Bournemouth, England. Gerald is a graduate student in E.E. and Physics at the Institute, working for a Ph.D.

Bud Larsh married Connie Wille of South Pasadena on December 9. Bud was helped through the wedding by *Bill Proud* '50, and *Johnny Johnston* '51. Some of the other Fleming men who found their way back to Pasadena to wish the couple well were *Don Moore* '50, who came in from NOTS at China Lake; *Carl Anderson,* from Bakersfield; and *Bill Sampson* '51, who left his JPL rockets in New Mexico long enough to take in the affair.

The bride and groom are now living in Berkeley, where Bud is "still trying to push science ahead at the U.C. Radiation Lab."

Cecil Drinkward and his wife, the former Sally Anne Bradshaw, are the parents of a son, Wayne Alan, born last November. Cecil is working for the Del Web Construction Company.

1951

William A. Drake is working at Convair in San Diego on guided missiles.

Robert E. Cobb is doing graduate work in Geology at the Pennsylvania State College.

Francis Haskins, Ph.D., married Dorothy Masters, originally from Indianapolis, Indiana, last December 3. The couple will make their home in Pasadena, while Francis continues his work in Biology at C.I.T.

Dean M. Blanchard, who is an engineer for the California Texas Oil Company, Ltd., has been sent to Sumatra for approximately one year. His address is N. V. Caltex Pacific Petroleum MiJ., Pakanbaru, Sumatra, Indonesia.

Richard M. Libbey and Ann Koover, now a senior at Occidental College, were married on December 15th. Dick is doing graduate work at Caltech in civil engineering.

Gerald D. Fasman, Ph.D., is now at Cambridge University, England, on a postdoctoral scholarship of the Royal Society of Canada.

Robert E. Smith is on the engineering staff of the Panama Canal Commission in the Canal Zone. He is engineer and assistant to the superintendent of the water works serving the Atlantic section of the Canal.

Herbert M. Hull, Ph.D., is a Research Fellow in the Earhart Plant Research Laboratory at Caltech, working on air pollution and its effects on farm crops.

Bruce Hedrick is employed by the Wallace and Tiernan Sales Corporation in Monrovia. In November he married the former Bobby Morris. They are living in Pasadena.

ALUMNI CALENDAR

February 9	Dinner Dance
April 12	Seminar Day
June 4	Annual Meeting
Date to come	Family Day

Science fiction —or only fantasy?

Sirs:

Regarding Mr. Campbell's review of my *Rogue Queen*: I am not complaining about Mr. Campbell's definition of what is and what is not science fiction.* He has a right to any definition he likes so long as he makes it clear to the reader (as he does in this case) what usage he is following.

I should, however, like to point out that Mr. Campbell's use of the term "science fiction" is not that which is current in the field. The *aficionados* divide imaginative fiction into two sections: fantasy, defined as stories based upon supernatural assumptions; and science fiction, based upon scientific (or pseudo-scientific) assumptions. Therefore stories about gods, spirits, witches, mythological beings, magic, prophecy, etc. are fantasies. On the other hand, stories laid in the future, or in the remote past, or on other worlds, or which deal with extra-terrestrial life or interplanetary travel, or time-travel, or the impact of some new invention or discovery, are all deemed science fiction, regardless of whether the story is primarily concerned with some gadget. Only rarely, as in the case of C. L. Moore's Northwest Smith stories, does a tale fall squarely on the boundary-line between the two classes.

According to general usage, then, *Rogue Queen* is properly classed as science fiction.

L. Sprague de Camp, '30

WALLINGFORD, PENNSYLVANIA

*Ed. Note—"*Rogue Queen,*" said Mr. Campbell in *E&S* last month, "is not science fiction (but) a delightful bit of fantasy . . . In science fiction a plausible 'scientific' idea is developed, and the story is centered about the struggle of the characters with the logical consequences of the idea. In fantasy, on the other hand, the fantastic situation serves merely as a background for the development of a normal human problem."

Athletic schedules in E & S?

Sirs:

Why not put schedules of athletic events in *Engineering and Science*, so we can plan ahead instead of having to rely on the microscopic articles in the local papers?

William H. Proud, '50

LOS ANGELES

We'd be glad to run schedules if enough of our readers want them. Anybody else think *E&S* should make this a regular feature?—ED.

in the life and social sciences. But science has already pressed on us strong need for social reorganization. Part of the difficulty lies in attitudes. Problems and social crises are felt as annoyances hindering a state of enduring peace and progress. If one more hurdle could be surmounted, all would be serene. A more realistic attitude would recognize social dislocations as one of the inescapable prices of new knowledge and new techniques. A wiser social policy would recognize the recurrent need for social adjustment and prepare trained men to meet such needs.

A CENTURY OF TECHNOLOGY
Edited by Percy Dunsheath, D.Sc.
Roy Publishers, New York $5.00

Reviewed by Donald S. Clark
Professor of Mechanical Engineering

IT WOULD HAVE BEEN better to entitle this book "A Century of Technology in Great Britain." While the editor states in the preface that many of the advances presented in the book are of British origin, no attempt is made to restrict the story. As one might expect, since it is written by British "experts," the story is from the British point of view and reflects the influence of technological developments over the period 1851-1951 upon life and affairs in England.

Eighteen individuals, reported to be experts in their respective fields, have written the nineteen chapters with varying degrees of success. The fields include metals, nonmetals, chemicals, textiles, fuels, power, production, electrical engineering, petroleum, biochemicals, agriculture, foods, transportation, navigation, communication, printing, recording, and education. An adequate review of technological developments in the past one hundred years can hardly be given in the space provided for so many subjects. For example, the field of iron and steel is covered in seventeen pages, hardly sufficient for a field that has had such a tremendous development in this period.

This reviewer, being best qualified in the field of metals, finds some errors and serious omissions in the section on metals and, therefore, questions the complete reliability of the other sections in so far as accurate reporting is concerned. Most engineers outside of England will probably find this book of relatively little interest and certainly of little value as a review of technological development for the past century on a world-wide basis. The chapter on technological education is written solely about the English educational system, which further emphasizes the suggested change in title. The work of men in other countries is mentioned when it concerns developments in England, but otherwise they are given little, if any, attention.

SCIENCE IN PROGRESS 7th Series
Edited by George A. Baitsell
Yale University Press,
New Haven $6.00

AS IN THE SIX earlier volumes of this notable series, the subjects covered in this seventh book are based on material prepared for the Sigma Xi National Lectureships and were first presented to local groups of the Society.

This 7th series, of course, maintains the high standard of the first six and, if anything, covers a broader area of the science field than many earlier volumes.

Caltech is represented this year by Carl Anderson, Professor of Physics, who writes on "The Elementary Particles of Matter."

The other chapters:

"The First Heart Beats and the Beginning of Embryonic Circulation" by Bradley M. Patten, Chairman of the Department of Anatomy at the University of Michigan; "The Reproductive Cycle of the Rhesus Monkey" by George W. Corner, Director of the Department of Embryology of the Carnegie Institution of Washington at Baltimore; "Human Infancy and the Embryology of Behavior" by Arnold Gesell, Director of the Gesell Institute of Child Development, New Haven; "Radiation Damage to the Genetic Material" by H. J. Muller, Professor of Zoology at Indiana University; "Beyond the Gene—Two Years Later" by T. M. Sonneborn, Professor of Zoology at Indiana University; "The Macromolecular Structures of Biological Materials" by Ralph W. G. Wyckoff, Scientist Director of the National Institutes of Health, U. S. Public Health Service; "Atomic and Solar Energy" by Farrington Daniels, Professor of Physical Chemistry at the University of Wisconsin; "Atomic Structure and Energy" by J. R. Dunning, Dean of the School of Engineering at Columbia University; "The Theory of Braids" by Emil Artin, Professor of Mathematics at Princeton University; "History of the Fauna of Latin America" by George Gaylord Simpson, Chairman of the Department of Geology and Paleontology at the American Museum of Natural History, and Professor of Vertebrate Paleontology at Columbia University; "The Physical Chemistry of Polymers" by Raymond M. Fuoss, Sterling Professor of Physical Chemistry at Yale University.

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