ENGINEERING AND SCIENCE

DECEMBER/1953

Stingray Research . . . page 15

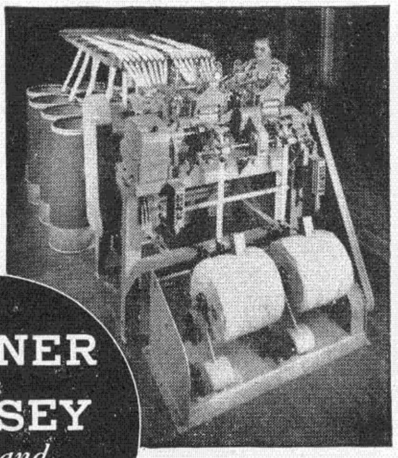
PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

"Friendly" government vs. "selfish" business

THE GOVERNMENT will carry a letter for you from Texas, say, to New York for 3¢. But the government loses money on the trip, and you have to pay taxes to make up the difference.

Business carries a gallon of gasoline the same journey from Texas to New York for 1/5th of 3¢, does it almost as fast. It may not be door-to-door delivery, but it's a lot harder to handle, in spite of which business makes a profit—and out of which it pays taxes to support government business ventures such as the post office.

Since time began, the hope of private profit is what has stimulated the drive for efficiency and low costs, out of which everyone benefits. If that is business selfishness, the world needs more of it.



Pin Drafter processing wool for yarn

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

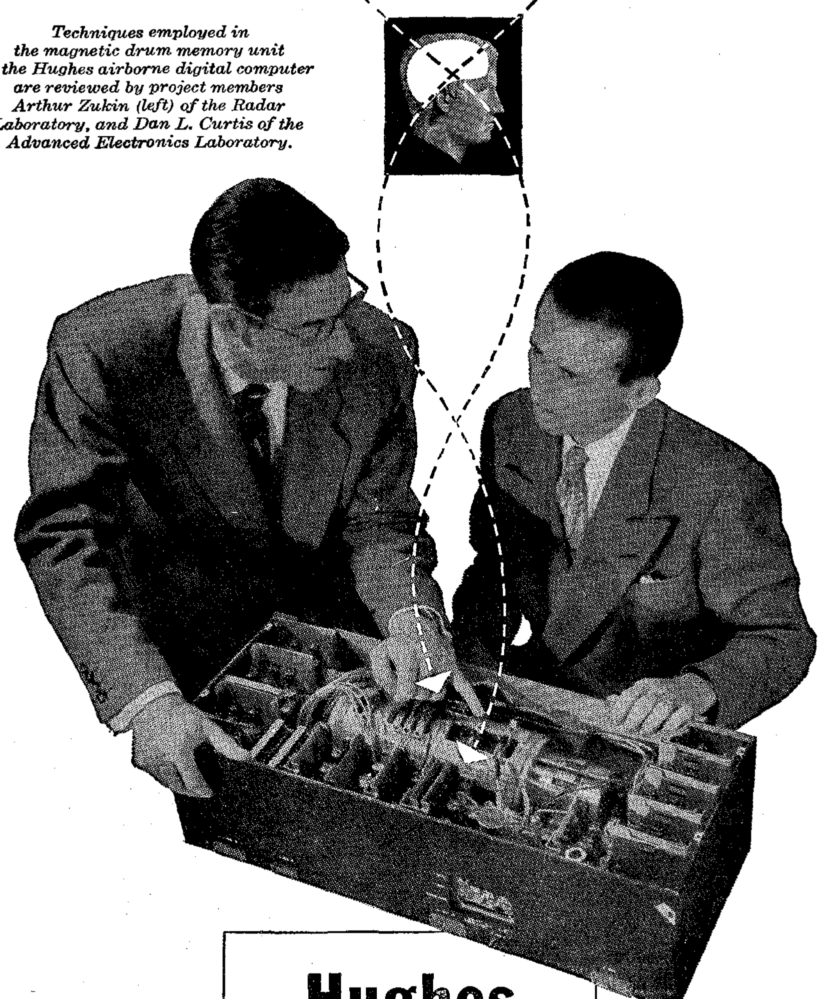
YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY

"Remembering"

160,000 TIMES A SECOND

One of the problems in designing an electronic digital computer for airborne automatic controls is that of storing information used by the system.

Techniques employed in the magnetic drum memory unit of the Hughes airborne digital computer are reviewed by project members Arthur Zukin (left) of the Radar Laboratory, and Dan L. Curtis of the Advanced Electronics Laboratory.



At Hughes, where the airborne electronic digital computer was pioneered, the problem presented by the memory unit was attacked basically by the Hughes technique of systems planning and analysis. This involved an exhaustive examination of the requirements, an evaluation of the best means for satisfying them, and the design of the simplest possible mechanization consistent with superior performance.

A magnetic drum memory unit was chosen as the most compact and rugged storage device for the airborne digital computer. The unit developed by Hughes provides storage space for more than 2500 19-digit words. Density of the magnetic recording is approximately 100 binary digits per inch. Rotating at 8000 rev/min, the 4-inch diameter drum permits computation at a rate of 160,000 binary digits per second.

From an analysis of the logical integration of the memory unit into the computer system, the unique "floating reference" principle was developed. Instead of standard coincidence-type methods for selecting numbers from the magnetic drum storage, a floating reference system is used in which the memory position is determined by counting word times from the *end* of the preceding operation. This technique produces for this application a performance equivalent to a random access memory and results in a substantial saving in equipment.

A major effort at Hughes is also devoted to adapting electronic digital computer techniques to business data processing and related applications — uses unquestionably destined for far-reaching peacetime application.

ADDRESS:
Scientific and Engineering Staff

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

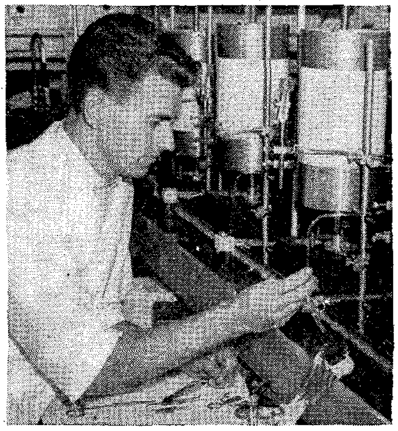
Culver City
Los Angeles County
California

ENGINEERS AND PHYSICISTS

Activities at Hughes in the computer field are creating some new positions in the Laboratories. Experience in the design and application of electronic digital computers is desirable but not essential. Engineers and physicists with backgrounds of component development or system engineering are invited to apply.

ENGINEERING AND SCIENCE

IN THIS ISSUE



This month's cover shows Dr. Findlay Russell, author of "The Stingray" on page 15, at work in his laboratory at the Huntington Institute for Medical Research. Last year, as a research fellow at Caltech, Dr. Russell began an investigation into the effects of the stingray's venom on the various components of the cardiovascular system. He is now continuing this work at the Huntington Institute, where he has been appointed neurological physiologist.

On our cover Dr. Russell is adding stingray venom to a saline bath, which contains a ring section of an artery, connected to a writing arm which traces the amount of constriction or dilation on a Kymograph. You'll find more details on this project on page 15—along with a good deal of interesting information on that queer fish, the stingray.

The President's Report, on page 9 includes some highlights of research in the various divisions of the Institute for the year 1952-53. For those who would like more detailed information, several of the divisions have prepared comprehensive, technical reports on their research activities. A few of these are still available from Biology and Chemistry, and similar reports are due shortly from Engineering and Geology.

PICTURE CREDITS

Cover	Tom Bergeman '56
p. 17	Lloyd P. Tevis, Jr.
	Byron Johnson, Jr. '56
pps. 22, 23	*Rod Supple* '55
	Byron Johnson, Jr. '56
	Rafn Stefansson '56
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Printed in Pasadena PP 6

DECEMBER 1953 VOLUME XVII NUMBER 3

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

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Published monthly, October through June, at the Californa 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. Manuscripts and all other editorial correspondence should be addressed to: The Editor, *Engineering and Science,* California Institute of Technology.

BOOKS

FROM FISH TO PHILOSOPHER
by Homer W. Smith
Little, Brown and Co., Boston, $4.00

Reviewed by A. H. Sturtevant
Professor of Genetics

THIS IS AN ACCOUNT of the evolution of the vertebrates, as the title indicates. The background of physical geology is sketched for each period, and the record, so far as it can be made out from fossils, is described. But the author is a physiologist, whose special interest is the kidney and its function; and it is this fact that gives the book its special character.

The account is that of living, functioning animals—not of dry bones. To Smith, evolution is the story of the way in which animals solved the physico-chemical problems presented by changes in their environment—in particular, how they met the osmotic problems arising from changing from a fresh- water habitat to living in the sea or on land.

The discussion will be interesting and stimulating to geologists, biologists, anthropologists, and chemists. And the last chapter, on Consciousness, will be worth the attention of psychologists and philosophers.

This may seem a large order; but the book is so well written and so clear that one does not feel that it is diffuse or over-popularized. In fact, it's the very best kind of popular science writing.

GENERAL CHEMISTRY
Second Edition
by Linus Pauling
W. H. Freeman & Co.,
San Francisco $6.00

MORE DIFFICULT than most chemistry texts but also more stimulating and rewarding, this new edition of an excellent book emphasizes even more than the first edition the application of fundamental principles, and the development of a background of physical and structural chemistry. As before, less importance is attached to purely descriptive chemistry.

Much of the new material in this edition explains the modern chemist's debt to the new physics, and includes discussions of the properties of the photon, electron, and other basic particles; the photoelectric effect; the Bohr atom; and the quantum theory and its application to chemical problems. A section on X-rays and crystal structure has been added, as well as chapters on biochemistry, and metals and alloys; relatively recent work on the structure of proteins, and the nature of the metallic bond are described here.

Roger Hayward has added many more of his excellent illustrations to the new edition, including two color plates.

CONQUEST OF THE MOON
by Wernher von Braun, Fred L. Whipple and Willy Ley
Edited by Cornelius Ryan
Viking Press, New York $4.50

Reviewed by Howard S. Seifert
Staff Engineer,
Jet Propulsion Laboratory

UNDER THE AUSPICES and editorship of *Collier's* Magazine, the authors have written another speculative opus similar to their book *Across the Space Frontier*. In 36,000 words and 16 handsome illustrations, they discuss the satellite base, the assembly of a fleet of three moon ships, the orbital takeoff and landing on the moon, the lunar base and its vicissitudes, and the return trip.

As the embodiment of a space ship becomes more sharply focused with advancing technology, the story of the moon flight takes on added excitement and plausibility. Only the very sophisticated reader could find reasons to criticize this book, which documents its assertions with numbers and which violates no physical principles.

The authors take the position that all the elements necessary for space flight are at hand and that indeed such flight can be considered more probable than were radio communication and airplane flight only 40 years ago. They maintain that, given a strongly motivated and carefully planned effort (plus a few billion dollars), a satellite is possible in 15 years and a lunar flight in 25 years.

Opposition to this point of view is felt by some guided-missile enginers, who are unable to display all the evidence behind their conclusions because of security restrictions. These engineers feel that the time

CONTINUED ON PAGE 48

"I chose Worthington for opportunities in international trade"

• "Worthington was my choice," Mr. Berger says, "because of the excellent training and the unusual experiences that are possible with a manufacturer having a worldwide reputation, and worldwide distribution. Then, when a company has seventeen divisions, including air conditioning, refrigeration, turbines, Diesel engines, compressors and pumps of all kinds, construction machinery, and power transmission equipment, a graduate engineer's chances for getting into his chosen field are even better.

"Supporting these divisions are research, engineering, production, purchasing, and sales, domestic and export. The real opportunity, however, is in Worthington itself. This is a company that is growing, just as it has for more than a century. It is always looking for new, related products and good men to engineer, produce, and sell them—at home and abroad.

"I began my career with Worthington's training program in the Research and Development Laboratory, where full-scale equipment is designed, tested and improved. This experience gave me an understanding of the tremendous part the company plays in the everyday life of millions of people. Within fourteen months I was sent to Mexico to inspect the facilities of our distributors there.

"The opportunities for first-hand laboratory experience, sales training and contact, travel and field trips, among many others, make Worthington a first-rate company for the young engineer with a desire to learn and progress in his work."

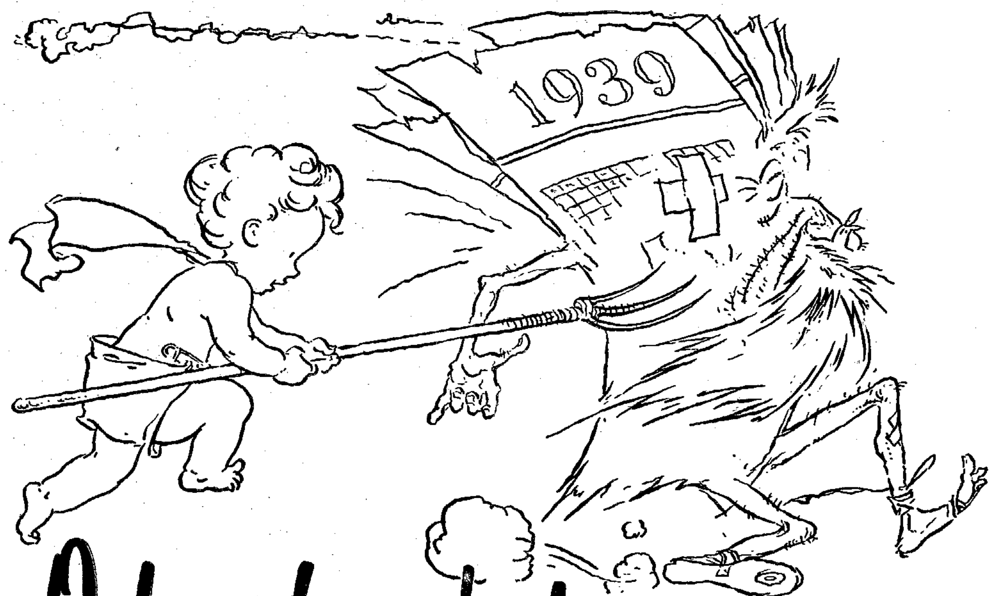
When you're thinking of a good job, think *high*—think *Worthington.*

8.26

FOR ADDITIONAL INFORMATION, see your College Placement Bureau, or write to the Personnel and Training Department, Worthington Corporation, Harrison, N. J.

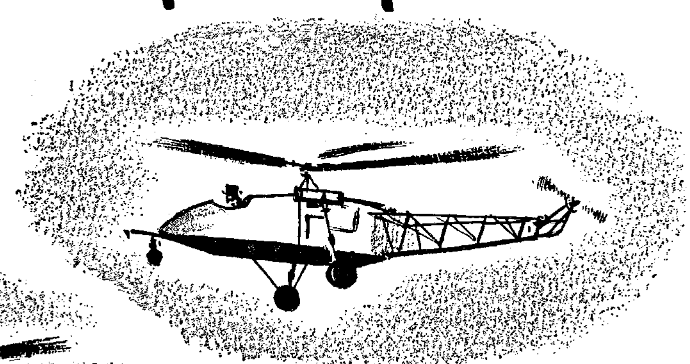
WORTHINGTON

THE SIGN OF VALUE AROUND THE WORLD



Only a few short years ago

the helicopter was thought to be a "stunt" machine – amazing and amusing, and not particularly important. Events in Korea changed that idea – fast! This fledgling among aircraft performed "impossible" military assignments, spectacularly successful missions of mercy. Helicopters came into their own.



In 1939, the VS-300 with Igor Sikorsky at the controls made the first practical helicopter flight in the United States. Hundreds of later Sikorsky's were delivered for service in World War II.

Now in demand for hundreds of jobs, today's most versatile flying machine is the product of ceaseless testing, highest-calibre engineering, work and imagination.

Future Sikorsky's will be built by tomorrow's engineers. Perhaps *you* belong at Sikorsky where your skill and ability will be continually challenged.

You might find – in Sikorsky Aircraft's research departments, drafting rooms, engineering laboratories – a lifetime opportunity in this young, growing and most interesting field of aviation. Write today to R. C. Banks, Personnel Department.

SIKORSKY

Sikorsky Aircraft, one of the four divisions of United Aircraft Corporation, South Avenue, Bridgeport 1, Conn.

THE PRESIDENT'S REPORT

Some highlights from Dr. DuBridge's 1952-53 report on the Institute

IN FUTURE YEARS IT IS almost certain that we will look back on the year 1952-53 as a "turning point" in the history of the nation and of educational institutions. The events following from the 1952 election and the 1953 Korean truce are certain to be of far-reaching importance.

To the extent to which the inflationary spiral is being arrested, there is good news for an institution which has been engaged in the losing race between rising costs and stable or less-rapidly rising income. To the extent to which tax burdens on individuals and on industry will be eventually relieved, there is also good news for private institutions.

The cessation of active hostilities and the re-orientation of the national defense program are certain to have important effects which cannot be fully anticipated. Will a large number of Korean veterans seek college admission? Will draft calls on college students be reduced or increased? Will ROTC programs and quotas be reduced? Will defense research funds be tapered off?

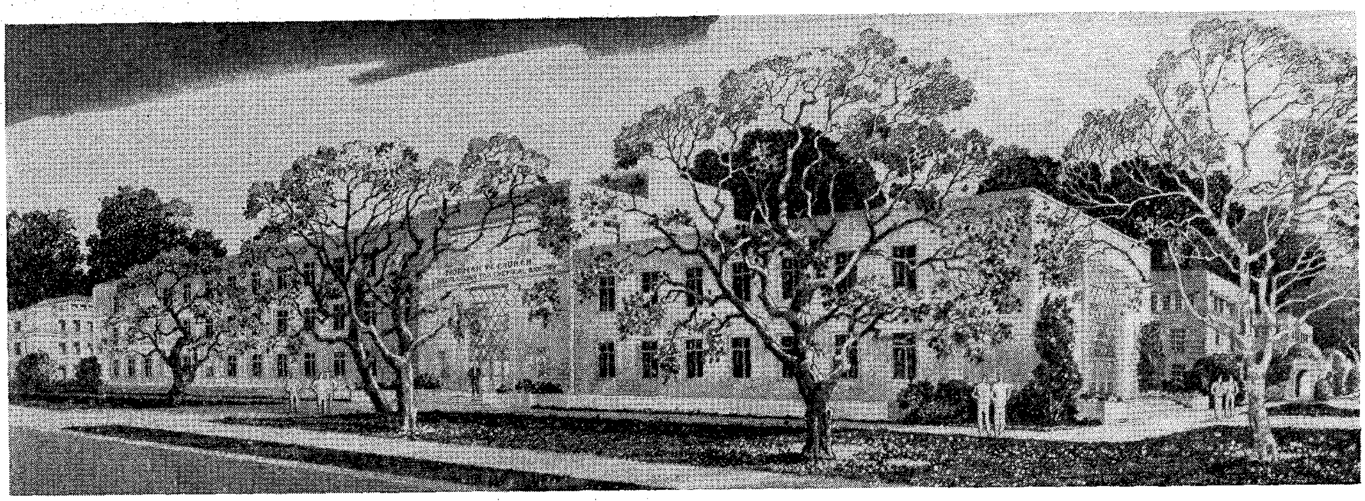
Of these questions, the one relating to federal research funds is the one to which our operations will be most sensitive. Everyone realizes that a military research program which is undertaken while hostilities are actually in progress is bound to be somewhat "wasteful" of effort and funds. When human lives are at stake one will always spend money to speed up progress by examining all lines of development in parallel, by undertaking duplicating or overlapping enterprises in case one should fail or encounter unforeseen difficulties. Even "crazy" ideas will be explored without extended preliminary planning or examination, because lives might be saved if the "crazy" ideas do pay off.

When hostilities cease it is proper that the nation's military research and development program be re-examined; it is proper that it should be reduced. But there is serious danger that the reduction may be "upside down." The reduction should be achieved by eliminating the "crazy" ideas (pending more careful exploration and research); by cutting out duplicating and overlapping projects; and by adopting a more thoughtful and more leisurely pace in development programs and in the building of prototypes.

But *basic research*—the search for new knowledge—should be expanded rather than contracted. As "crash programs" for production of new military equipment are reduced, more scientists are freed for basic research—in universities and in industry. If during hostilities it is true that the short-range and immediately practical projects, which are the expensive ones, must take priority, it is equally true that when hostilities cease (but cold war continues), the more basic long-range research projects—the search for knowledge for *future* use—should be restored and expanded.

It is not yet clear whether this policy is to be followed by the Government. Budget reductions which are uniform and "across the board" are easier to impose than selective ones. Not many people are aware of the importance of basic research—hence not so many voices are raised in its defense. The ill-considered slashing of a relatively small number of dollars could deal a crippling blow to the nation's scientific strength which the federal government has gone to great pains to foster and build up in recent years.

There are hopeful signs, however, that intelligence will be applied to this problem. The new reorganization of the Department of Defense creates a mechanism for more effective management of defense research and development. The slowly increasing support being given to the National Science Foundation is also encouraging.



The Norman W. Church Laboratory for Chemical Biology. Construction should be under way early in 1954.

The Campus

It has been clear for the past two years that our campus program was being stabilized and that current income to finance it could—with effort—be secured. It has been less evident that funds could be found to complete the building of the Caltech campus. Urgently needed campus structures, such as a library, engineering buildings, dormitories, infirmary, and student union, have been dreams for many years and seem destined to remain dreams. Capital funds have not appeared for these purposes.

The past year, however, saw two of our long-cherished dreams approach reality. We will soon have a new athletic center (*E&S*—October 1953) and a new chemical-biology laboratory (*E&S*—February 1953).

The fulfillment of these two dreams should only stimulate us to further efforts toward fulfilling three other terribly urgent ones—a library, a major engineering building, and a graduate dormitory. Preliminary studies for each of these are under way. Indeed a whole new study of the development of the campus is now being carried out by Pereira and Luckman, our consulting architects, so that these and other facilities can be developed in the most efficient and attractive way to make best use of our precious supply of campus space. Fortunately there is just enough such space left to build the essential facilities. There is *not* enough space in sight to take care of the problem of parking 1200 automobiles!

Finances

The report of the Comptroller shows that the Institute expended for its campus program during the past year $5,821,395 and that the income available for this program was less than this by $138,068. In other words our surplus funds had to be reduced by this latter amount—which is about the same as the amount by which they were *increased* as a result of the previous year's operations.

The precise estimate of either income or expenditures a year in advance (when the budget is adopted) is always difficult. The income usually exceeds the original estimate, while the expenditures are less (for no one *exceeds* his budget). The result is that a budgeted "deficit" has frequently turned into a "surplus," or as is the case this year, into a much smaller "deficit" than was expected.

The past five years have seen a most remarkable improvement and expansion in our program and a substantial improvement in faculty salary scales. Our income has risen to meet the new demands—but it has been a close race.

This has been a near-record year as far as increase in the Institute's *total assets* is concerned. The net increase from all sources was $5,200,000. Most of this came from the final settlement of the Balch estate—an estate which had been held in trust and managed for the eventual benefit of the Institute and other beneficiaries for a number of years. Investment transactions during the year added $875,035 to the book value of the portfolio.

The endowment funds of the Institute have now reached the impressive total of $28,843,385, placing it among the top 17 private institutions of the country. However, endowment figures by themselves can be misleading. Many a state university receives annual appropriations which would equal the income on one or two *billion* dollars of endowment. Also an institution with 10,000 students, each paying $600 tuition, receives income equivalent to that on an endowment of $120,000,000. Caltech receives no state appropriations and has only 1,000 students. Our endowment income is about $1,700,000, but we are operating a five-million-dollar-a-year program (excluding off-campus organized research). The endowment provides only three-tenths of the income we use. Student fees provide only one-tenth. The rest (six-tenths) must come from annual gifts, grants and contracts. Clearly the stability of our operations would be more adequately insured if the endowment income were a substantially larger fraction of the total. *Endowment is the assurance of independence.* Our efforts to increase endowment can never cease.

Recent years have seen a satisfying increase in annual support from industry. The Industrial Associates, as a group, now provide an annual income of more than a quarter million dollars. In addition many important research projects and many scholarships and fellowship programs receive industrial support. Industry's debt to educational institutions is now being more and more recognized.

Caltech's appeal to industry has for many years been a very direct one: the new knowledge arising from scientific research is essential to technological progress. The long list of important companies which have helped develop our program is testimony to how well this fact is now recognized.

Faculty

The faculty of the California Institute now comprises 334 members, one for every three students. Almost exactly one-half of these hold the conventional academic titles: professor, associate professor, assistant professor, or instructor. One hundred and thirty hold titles of research associate, senior research fellow, or research fellow. The remainder are professors emeriti, visiting professors, lecturers, etc.

The many honors and awards received by members of the faculty this year bear witness again to the fact that this group of men is one of the most distinguished bodies of scientists, engineers and scholars to be found in the country. It is fitting, however, to emphasize that, though these men are active and distinguished in the field of scholarship, they are also vitally concerned and heavily involved in the teaching activities of the Institute. They not only spend long hours in classroom, laboratory, and in preparation but they also give a large amount of time to student counseling; to the study and improvement of the curriculum; to advising and assisting with student activities and to contributing in many other ways to the operation, advancement and development of our educational program. The results obtained in the research laboratory may more often make newspaper headlines but the vital work of the California Institute goes forward in the classroom, the student laboratory and the conference room.

Undergraduates

The student body in September 1953 was of almost exactly the same size as in 1952 and 1951. The policy of accepting only 180 freshmen each year naturally stabilizes the undergraduate body at approximately 600 students. Our graduate body is not limited in quite the same way but the standards imposed for admission keep the numbers fairly constant at slightly over 400. There is no reason to expect or to desire any change in this situation.

The number of applicants for freshman admission has increased sharply in recent years and in the spring of 1953 reached a high point (755), second only to the veteran flood of 1946 (861). These applicants also were of generally high quality, as demonstrated by scores on College Entrance Board examinations. Because they stood high they were also sought by other colleges and we received a larger than normal number of "regrets" from those who had been admitted and had decided to enroll elsewhere.

While it appears that a freshman class of 180 is about the maximum that our present facilities can accommodate, it is also true that we could accommodate somewhat larger classes than we now have in the junior and senior years. Some transfer students from junior colleges are accepted each year but only a few such students have had the preparation required to pass our transfer examinations.

As a result of this situation, and of inquiries and requests by a number of liberal arts colleges, the faculty has voted to initiate on a limited scale a "3-2 plan" with certain selected colleges. Under this plan a student may enroll in one of these colleges for an agreed-upon program for three years. On recommendation of the college he will then be admitted as a junior at Caltech. Upon satisfactory completion of two additional years of work here he will receive simultaneously our B.S. degree and a Bachelor of Arts degree from the cooperating college.

This program will appeal to certain types of students who will obtain in this way a most valuable college experience. In such a five-year course the student will have more opportunity for work in nonscientific fields than in our four-year course. Also this plan allows in the early years for a somewhat more leisurely pace than is expected here.

Graduate students

Our graduate student body continues its normal size and quality. We were pleased that 30 recipients of National Science Foundation Fellowships—selected on the basis of a national competition—chose to pursue their graduate work here. Only three or four of the largest and most renowned universities of the country attracted a greater number of these top students—an impressive compliment to the reputation of our faculty.

The need for a dormitory for graduate students continues as a high-priority item. We shall continue to hope that someone will see here an opportunity for a fine memorial.

The Air Force ROTC Unit

The Air Force Reserve Officers Training Corps Unit at Caltech ended its second year of operation and again showed up in competition as one of the outstanding ROTC units of southern California.

However, as the unit moved into its third year of operation with the prospects of a group of more than 100 students interested in proceeding with the advanced course, a distressing change in policy was announced by the U. S. Air Force. Because the prospective number of officers graduating from ROTC units all over the country was substantially in excess of officer needs, very restrictive quotas were established on the number of students who could be admitted to the advanced course.

This means that out of approximately 88 students at Caltech who were qualified and interested in proceeding with the advanced course, only 44 can actually be admitted. Only 18 nonflying candidates were allowed. There is still a possibility that an additional 14 might later be admitted but at least 30 students have had to be definitely rejected. In view of the assurances given these students two years ago by the Air Force, and thus through implication by the Institute, this situation represents a serious disappointment to many who had hoped through this program to qualify for officers' commissions in the Air Force.

It is true that no quotas have as yet been set on cadets who agree to undergo flight training, since the Air Force is still short of pilot officers. However, the need for technically trained nonflying officers has apparently been drastically reduced, so that very few can expect to be admitted to the advanced course and to officers' commissions in future years. There are as yet no limitations on the size of the freshman and sophomore ROTC classes.

The Institute undertook to install an ROTC unit at a time when the need of the national defense establishment for technically trained officers was very great. As far as the Air Force is concerned, this need has been reduced to such a low level (at least for the immediate future) that the question of the Institute's continuing the Air Force ROTC unit must now be considered.

Research Highlights

The year 1952-53 saw additional important advances in the Institute's research programs. Some 550 research papers were published. Obviously it is impossible to summarize such a mass of material, but a few highlights may be mentioned here.

Seismology. A conspicuous activity of the Institute's research program this year was the study by the Seismology Laboratory of the series of earthquakes which were set off by the Arvin quake of July 21, 1952. This earthquake, second in magnitude in the past 95 years only to the San Francisco shock of 1906, was the first of a series of several hundred shocks of lesser magnitude which have followed throughout the subsequent year—and which still continue, but with decreasing frequency.

This whole disturbance of the earth's crust might well have been made-to-order for Dr. Beno Gutenberg and the Caltech seismologists, because it enabled them to put the full resources of their laboratory at work to secure all possible data on this major series of fault slippages. More was learned from this series of near-by quakes than from all the previous recordings made during the 25 years of this laboratory's existence.

The Institute has asked a group of corporations (utilities, railroads, insurance companies, etc.) to assist financially in expanding the activities of the Seismology Laboratory. More knowledge about the nature and occurrence of earthquakes will assist in reducing the damage which they cause. Contributions and subscriptions have already been received exceeding $33,000 per year for this purpose. An additional $30,000 annually is needed; plus about $250,000 for a much-needed addition to the Laboratory.

Dr. G. W. Housner and his colleagues in civil engineering also obtained new data for their studies on earthquake-resistant structures. In analyzing their records of earth motion it was found that the seismic waves were of such a form that they could be regarded as produced by a series of pulses, as would result from a series of discrete slippages of a fault. This theory will aid in analyzing the effects of strong earth motion on buildings and other structures.

Astronomy. The interest of both the scientific and the lay public was attracted by the recent discovery that the universe is perhaps "twice as big" as had previously been supposed. The measurement of astronomical distances is, of course, an indirect process, based on measurements of relative apparent brightness of different objects which are presumed to be identical except for their distance from the earth.

If one object appears four times fainter than another object which is believed to be identical, it will be concluded that the fainter object is twice as far away. But if it is later found that the two objects are *not* identical after all, then this "distance scale" is destroyed.

That is essentially the discovery recently made by Dr. Walter Baade—that the groups of stars which previously had been used to establish the distance scale are of two types, one substantially brighter than the other. Since the brighter ones had (unknowingly) been used along with the dimmer ones in the distance estimates, the distances had been correspondingly underestimated.

Thus the most distant nebulae visible on plates taken with the 200-inch Hale telescope at Palomar may be as much as *two* billion light-years away, rather than previous estimates of one billion. It is as though a person who was accustomed to estimating a distance by "pacing it off" suddenly found that his paces instead of being two feet long were actually four feet long! All his distance estimates must now be doubled.

As is well known, the work of Drs. Humason and Hubble on the "red shift" in the spectra of distant nebulae some time ago suggested the idea of an expanding universe. By measuring the velocity of expansion, the time elapsed since the expansion "began" was computed. This turned out to be a little less than two billion years. But there are radioactive rocks on the earth which physicists can prove are nearly four billion years old. This dilemma was embarrassing indeed. Now it may have been resolved.

If the nebulae are twice as far away as was thought, it obviously took them twice as long to get there. So the universe appears, after all, to be nearly four billion years old.

There is still considerable uncertainty in the distance measurements, but the general nature of the revisions in estimates seem now to be understood. It should be emphasized, however, that the expansion idea is not at all fully accepted, nor if accepted is it agreed how the "age" of the universe may be computed. There are some who argue that the age is infinite. This question will not be resolved soon.

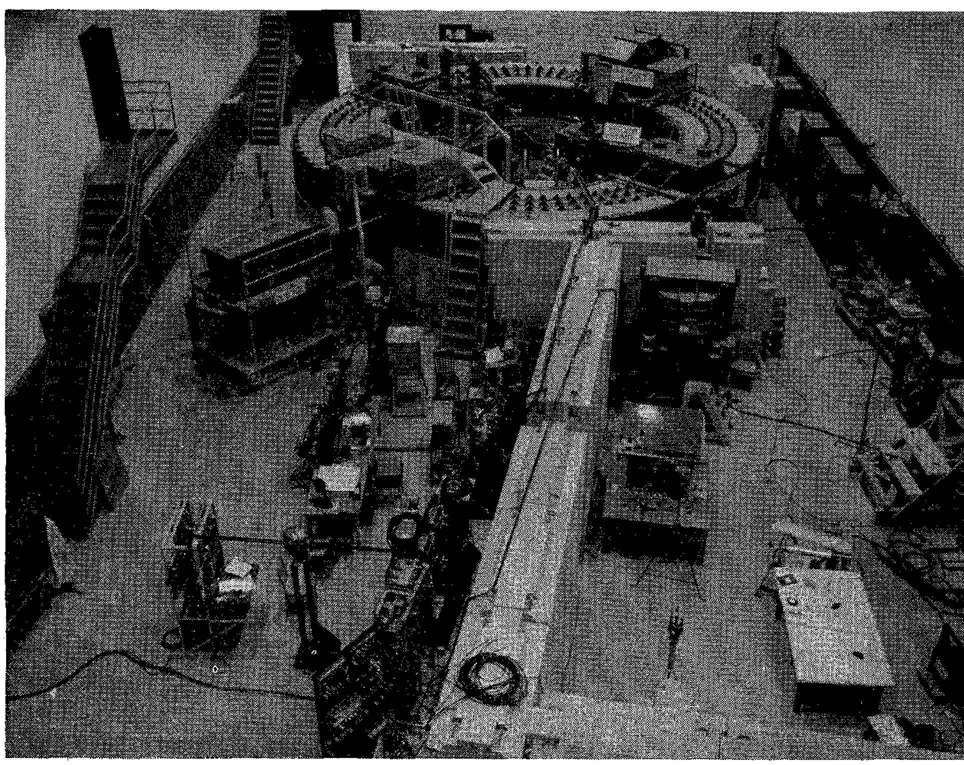
The astronomers and physicists have also been probing further into the age-old question of the source of energy within the sun and the other stars. It has been realized for many years that only some form of nuclear reaction could be responsible for the vast supply of energy continually radiated from the sun. About 15 years ago it was shown that the combination of hydrogen into helium through the so-called "carbon cycle" (the carbon serving as a sort of carrier or catalyst) offered a good quantitative explanation. However, new measurements in the Kellogg Laboratory at Caltech seem to complete the chain of evidence that carbon is not involved at all. Direct reactions between the various isotopes of hydrogen and helium can account for all of the sun's energy.

Thus, to put it grimly, the sun and other similar stars are nothing but continuously operating H-bombs. Each star is a vast mass of hydrogen which is being "fused" into helium through a colossal "thermonuclear" reaction.

Geochemistry. A significant new area of research at the Institute got into full swing this year under the guidance of Professor Harrison Brown—the field of geochemistry. A suite of rooms in the Mudd building has now been equipped with the most modern instruments for analysis of minute quantities of certain elements, for measurements of abundance of isotopes and of minute traces of radioactivity.

An unexpected problem arose when it was found that measurements on minute traces of lead in certain igneous rocks were thrown off by contamination from the air. Smog-laden air contains lead from the "ethyl" (lead tetraethyl) of antiknock gasoline. The normal air-conditioning equipment of the laboratories thus had to be supplemented with special "smog-removing" filters to keep the laboratory sufficiently lead-free. (The Earhart Plant Laboratory went through this filtering problem several years ago and the biologists were able to advise the geochemists on how to meet it.)

The problem of "dating" geological samples has moved substantially nearer to a complete solution—from very recent to very old material. The Gladwin tree-ring measurements, combined with isotopic ratio of carbon atoms of weight 12 and 13, and of radioactive carbon 14, give the ages for "youthful" specimens (under 20,000 years old). The measurements of traces of helium in rocks now give ages from 20,000 years upward, while the familiar lead-uranium ratio takes care of the upper scale to the 4-billion year "limit." All of these techniques are in use here with facilities which



X-rays from the Caltech synchrotron are the most energetic ever produced.

allow each to be pushed to the utmost in sensitivity and precision.

Physics. It was in the summer of 1952 that the new synchrotron went into operation, accelerating electrons to energies of over a half-billion electron volts. During the past year the operation of the machine has been steadily and very greatly improved, so that a large and reliable electron beam is now always available.

The X-rays from the machine are the most energetic ever produced and have been used to study the creation of mesons in hydrogen. As seems to happen so often in modern physics, this seemingly simple process turns out to be more complex, and hence more interesting, than had been predicted. The results will thus supply new information about the nature of the hydrogen nucleus—the proton—and also about the nature of gamma rays and of mesons.

In the new cosmic-ray laboratory Carl Anderson and his colleagues were dealing with energies which made the man-made synchrotron energies look puny indeed. At these cosmic-ray energies many kinds of subatomic particles are created which "live" only one-hundred-millionth of a second or less, and then decay into other particles.

These processes are most complex, but the Caltech group has been most productive in observing and interpreting them. The neutral V-particle is now quite well established as a particle which is heavier than a proton, but which decays into a proton plus a negative pi-meson.

Now Anderson and his colleagues find a *charged* particle which is heavier than a proton, decaying into a proton plus a neutral meson. There are also neutral V-mesons (which are lighter than protons), which decay into two pi-mesons, and there are tau-mesons which decay into *three* pi-mesons.

These complexities of the subatomic world are not at all understood from the point of view of nuclear theory. It seems likely that a radical new advance in theoretical physics will have to take place before understanding can come. But the theorists need still more experimental evidence before their new theories can be formulated. It is an exciting period in nuclear physics, with information accumulating more rapidly than comprehension.

Jet Propulsion. At Caltech there are two research units devoted to problems in jet propulsion. The Guggenheim Jet Propulsion Center is on the campus and is devoted to basic theoretical and experimental studies and to the training of students. It is financed by a continuing grant from the Daniel and Florence Guggenheim Foundation.

The Jet Propulsion Laboratory, located five miles off the campus, is financed principally through a contract with the Ordnance Corps of the U. S. Army. Part of the function of the laboratory is to develop and to engineer guided missiles needed by the Army. This work cannot be publicly discussed, of course, though it has been announced that the Army's huge "Corporal" rocket is a J.P.L. product. At the same time J.P.L. carries on a large program of fundamental research on fuels, thermodynamics, cooling, and combustion; electronic guidance and control; and other areas.

Of particular interest is the possibility of replacing liquid by solid propellants in guided rockets. It is evident that in continuously operating *aircraft* jet engines, a liquid fuel is the only practical type that can be handled. The air furnishes the oxidant. On the other hand, in a small artillery rocket a solid propellant is most practical. Here the thrust is needed for only a brief time to bring the missile up to speed.

For longer range *guided* missiles, however, liquid propellants again have been used because they can be more accurately controlled, *e.g.*, the fuel supply can be shut off promptly when the desired speed has been attained. The burning of a solid stick of fuel cannot be quenched. However, two large tanks of liquid fuel and oxidant with all the pipes and valves and pressure equipment involved provide a most complex array of apparatus to be installed in an expendable vehicle. This is a chief reason that long-range rockets are expensive. If solid fuels could be used, a major advance will have been made. Clearly this possibility is not an immediate one, but further research is of great importance.

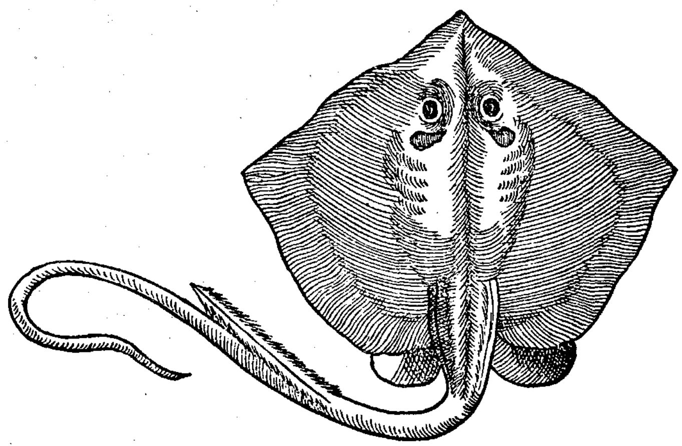
Chemistry. The work of the Division of Chemistry and Chemical Engineering continued to be both extensive and productive—and hence impossible to summarize. More light has been shed on the nature and behavior of enzymes, of certain materials that induce cancer in animals, of others that cause hemorrhages in tumors, of still others that prevent malaria.

Further progress has been made in the study of various types of hemoglobin in human blood, especially types that cause several diseases of the anemia type. A promising substitute for blood plasma, oxypolygelatin, has been perfected to a point where extensive clinical tests may be made. A new theory of ferro-magnetism has been developed. Electron-diffraction studies have revealed data on the structure of many types of molecules; other studies revealed the crystal structures of complex alloys.

Steady progress was made in fixing the structure of certain protein molecules, following the major advances made last year by Drs. Pauling and Corey. And further measurements were made on the properties of the various constituents of petroleum under conditions of high pressure and temperature found in deep oil reservoirs. There is surely no more dynamic center of chemical research in the world.

Biology. Members of the Division of Biology engaged in a variety of research activities during the year. These included an extension of new tissue culture methods of virus study to poliomyelities; investigations of protein synthesis; probings into the inner workings of the nervous systems of animals; determinations of the biological effects of high energy radiation; and looking into the mechanisms by which plants grow, flower and fruit.

Early print (1553) of a stingray. The spine is drawn disproportionately large.



THE STINGRAY

He has a retiring personality but he's a formidable looking fish all the same—and if you tread on him you're not likely to forget it

by FINDLAY RUSSELL

IN A SEVEN-MONTH PERIOD, from April to November, 1952, California lifeguard stations from Santa Monica to San Diego reported approximately 390 cases of stingray "attacks." Another 84 victims, in areas unattended by the beach services, were treated by physicians. It is not unreasonable to assume that some 50 additional victims received no medical attention from either of these sources, but recovered from their wounds without particular incident.

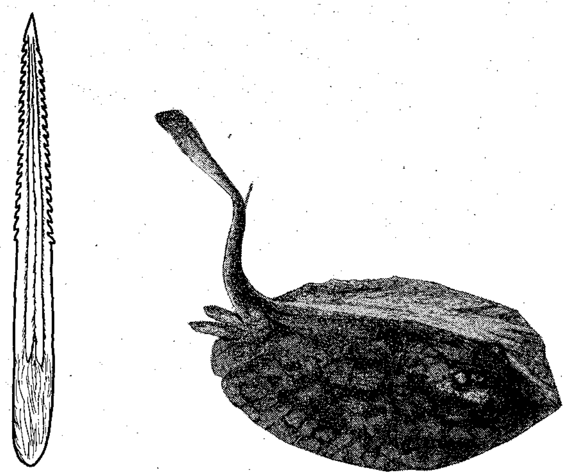
Small wonder that the stingray commands healthy respect from the fisherman and the bather.

Known to the ancients, the stingray has become one of the feared denizens of the deep. In spite of a rather retiring personality, he has often been indicted for crimes beyond the wildest imagination. What self-respecting stingray, for instance, would attack a tree? Yet Pliny, who lived from A. D. 23 to 79, credited the ray Pastinaca with the ability to "fix its spine in the root of a tree so that the tree withereth and dieth away."

Nor do the ray's accomplishments seem to be limited to trees. This curious aboriginal story comes from the native tribes of Tasmania.

"Two women were bathing; it was near a rocky shore where mussels were plentiful. The women were sulky, they were sad; their husbands were faithless, they had gone with two girls. The women were lonely; they were swimming in the water, they were diving for crayfish. A stingray lay concealed in the hollow of a rock. The stingray was large, he had a very long spear; from his hole he spied the women; he saw them dive; he pierced them with his spear . . . he killed them, he carried them away. Awhile they were gone out of sight. The stingray returned; he came close to shore, he lay in still water, near the sandy beach; with him were the women, they were fast on his spear . . . they were dead!

"The two black men fought the stingray; they slew him with their spears; they killed him; the women were dead! The two men made a fire . . . a fire of wood.



The sting, or caudal spine, of the round stingray at the left may be barely visible (it is halfway down the tail), but it is treacherous nevertheless—as the detailed drawing of it shows.

On either side they laid a woman; the fire was between: the women were dead! The two black men sought some ants, some large blue ants. They placed them on the bosoms of the women. Severely, intensely were they bitten. The women revived . . . they lived once more."

All in all, the rays have enjoyed a rather remarkable history. So have their stings. Ulysses was said to have been slain by the spine of a large stingray. A tribal war in the Malay States was once decided when two chieftains "gave battle armed only with ray stings." The Indians of several South American tribes, as well as some Polynesians, have used stingray spines on their spears and arrows for hundreds of years. But perhaps the strangest of all uses into which this structure has been pressed is that employed by an enterprising Australian who grinds, polishes, and sells the stings for toothpicks.

The bewildering array of stingrays that inhabit the seas of the world might confuse the most thorough of ichthyologists. Some, like the giant stingray of Australia (Bathytoshia), weigh more than 700 pounds, while others, like the round stingray (Urobatis halleri), so common to the waters off southern California, rarely reach a length in excess of 20 inches. Between these two extremes are many dozens of species which, in or out of their habitats, are justly respected by their land-dwelling neighbors.

The stingray, while a most formidable looking fish, is not usually considered to be a belligerent one. He probably never utilizes his sting except in self-defense, either against those animals which feed upon him or those unfortunate humans who walk upon him. There is no evidence to support the assumption that these fish use their spines offensively in obtaining food or attacking other fishes. The greatest danger in studying the larger rays in their natural habitat is swimming within range of the pectoral fins. The force behind these massive muscles of propulsion is sufficient to injure a man seriously. Cameramen have occasionally had their cases smashed by the broad fins of these sea monsters.

In the waters off California are four species said to be common to this region. They are the round stingray, the diamond stingray (Dasyatis dipterurus), the butterfly stingray (Gymnura marmorata), and the bat stingray (Holorhinus californicus). The bat stingray, largest of the California species, may reach a weight in excess of 200 pounds.

These fish are most commonly encountered in the late summer or early fall when, in large numbers, they move into the bays and sloughs. A population count taken on September 1, 1953 in Alamitos Bay, near Long Beach, California, revealed that there were over 50 of these fish for each of 10 areas of 100 square feet. They are, of course, more sparsely distributed along the surf, even though this area reports the greater number of "attacks." Fortunately, stingrays fear humans as fervently as humans fear stingrays. This mutual concern probably keeps the accident statistics from becoming alarming.

The species most likely to be encountered by the bather and the fisherman along the southern California coast is the rather small round stingray. This unbenevolent little creature, lying half-buried on the sandy bottom in the surf, or the mud flats of the bay, is often stepped upon by the unwary bather. The mere touch of a foot to the dorsal surface of the fish is sufficient stimulation for the animal to thrust his tail and sting forward into the foot or leg of his victim.

The sting or caudal spine of the stingray is a very treacherous-looking weapon. An 11-inch ray possesses a spine of approximately 1½ inches; a 200-pound stingray packs a weapon of 10 inches. Irrespective of its length, it can be driven into its victim with great force and accuracy. It is not uncommon to read of wounds 1½ inches long, perpetrated by a sting less than ¼ inch wide.

Large stingrays may inflict serious and occasionally fatal injuries. One investigator tells of a fisherman who was stung by a ten-foot stingray off Australia. This animal struck with such force that he drove his sting through the lower third of the man's leg, between the tibia and the fibula, leaving a wound 7 inches long on the lateral aspect of the leg, and 4 inches long on the medial side. Another investigator reports an incident in which a young woman was wounded fatally when a stingray drove its spine through her heart.

The sting is located on the dorsal surface of the fish's tail. It is a calcified structure bilaterally serrated along the last half or so of its length. The teeth are directed cephalically, and thus are responsible for the lacerating effect of the spine as it is withdrawn from the victim's flesh.

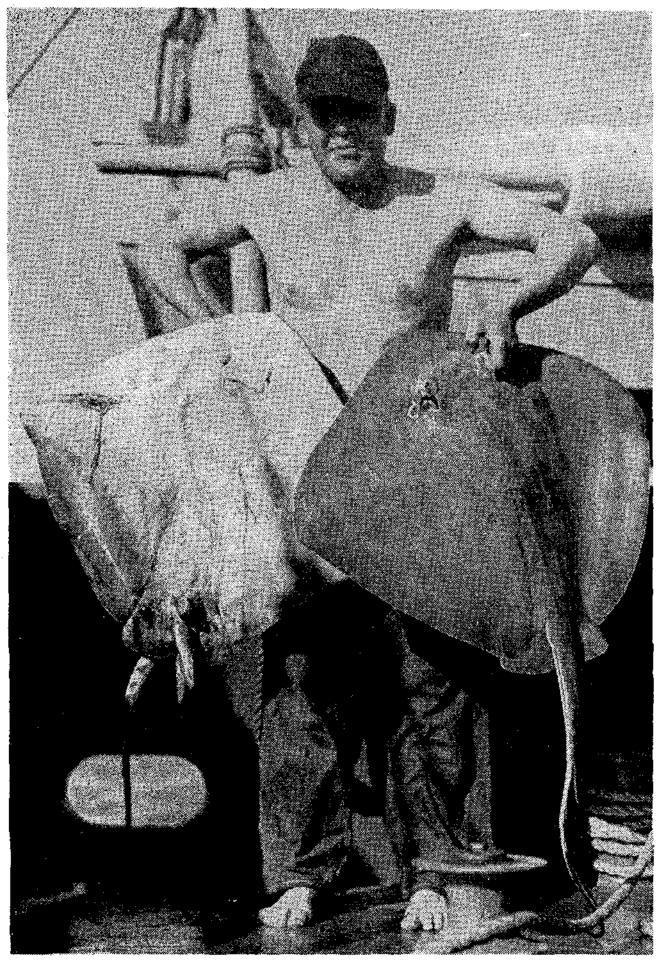
When the spine is driven into the victim, the pressure exerted by the involved tissues is sufficient to tear the integumentary sheath from the sting, and to express venom from a group of toxin-producing cells and their supporting structures. The fish usually retracts his sting, though occasionally it becomes detached or broken in the wound.

Until a decade or so ago there was considerable question in the minds of some investigators regarding the presence of a venom-producing organ within the caudal structures of this fish. It is now generally agreed that along the ventral surface of the sting, in two lateral grooves, lie certain specialized secretory cells which produce a toxin that is more directly responsible for the symptoms experienced by the victim than is the mechanical injury caused by the sting.

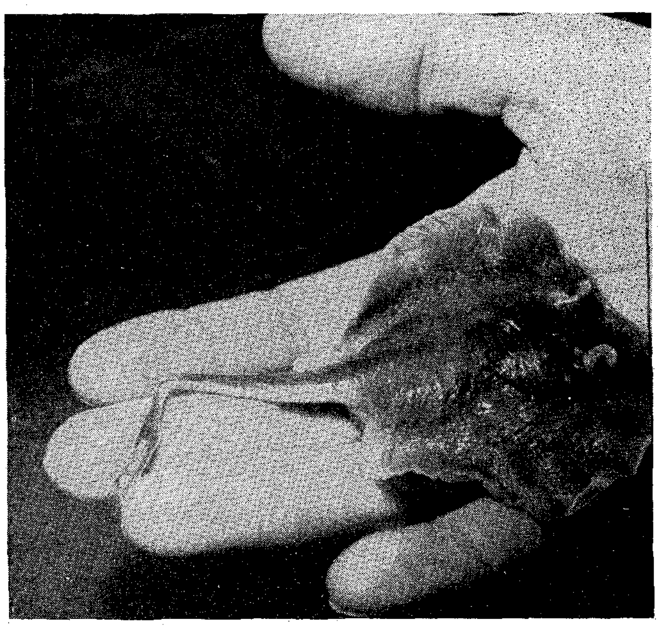
In spite of the serious damage that may be done by the fish's sting, the changes effected by the toxin may be even more dangerous. The venom from a 1½ inch sting, when injected intravenously, is sufficient to kill a rabbit within several minutes. While a fatality is fortunately rare, men have no doubt died from the effects of this toxin.

In 1952, at Caltech, an investigation was begun into the effects of the venom on the various components of the cardiovascular system. The study offered many problems from the beginning—the foremost of which was the taking of these unfriendly little creatures.

Unaccustomed as these fish are to being obliging, they have now become the victims of a system. A specially designed beach seine was constructed through the efforts of Captain Steve Smith and Professor G. E. MacGinitie of the Caltech Marine Laboratory. This 50-foot seine is set in 15 to 20 feet of water about 200 feet from shore. It is pulled across the bottom and onto the beach by a team of four men.



Diamond stingrays collected by University of California researchers. As diamond stingrays go, these are standard —not outsized—specimens.

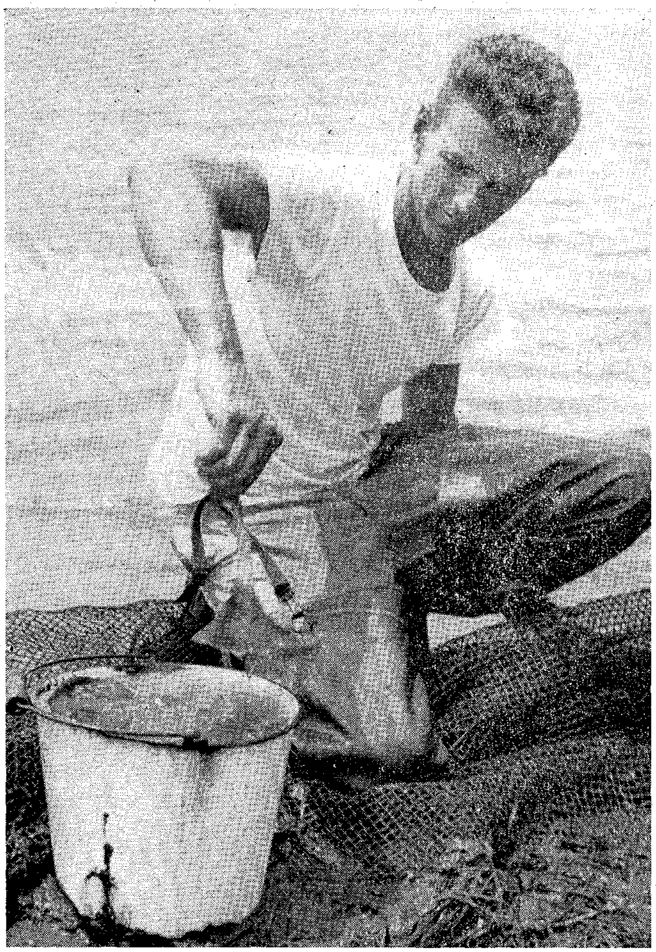


Diamond stingray is one of four species said to be common to the waters off California. A newborn ray can be held in the palm of a man's hand.

The fishes within this area are thus brought into shallow water, where the rays are removed and the rest of the species returned to the deeper water. The stings are severed from the rays and immediately refrigerated at –20° C. The venom is extracted from the tissues of the lateral grooves just prior to its injection in the experimental preparation.

Utilizing the intact animal, after a method proposed by Dr. A. Van Harreveld, Professor of Physiology at Caltech, it is possible to demonstrate that the venom has a deleterious effect on the cardiovascular system. Studies with the isolated preparations further confirmed these changes. In small doses the toxin causes dilation of the small blood vessels. This change is followed by a period of vasoconstriction which overshadows the dilative effect of the toxin. A similar type of response takes place in the larger vessels.

With greater, and usually lethal, dosages the venom causes cardiac dilatation and failure. While this study



Dr. Findlay Russell handles a round stingray with care

has given us considerable insight into the mode of action of the poison, there is much yet to be learned of the effects of the venom.

From the observations in the experimental preparations it has become possible to establish a more rational approach to the treatment of the stingray victim. While the physician may occasionally have to be called upon to render medical aid for the complications caused by the venom, in the greater number of cases the victim may treat himself.

It is wise when wading in areas known to be inhabited by stingrays to shuffle one's feet while walking to and from the beach. In collecting rays, we have used this precaution, and have only once suffered the displeasure of having to treat one of our seiners. We also wear rubber boots, but this precaution is purely psychological; a boot is no measure of safety to be placed between one's anatomy and a stingray.

When one is stung by a stingray he should irrigate the wound immediately with the cold salt water at hand. Not only may much of the toxin be washed from the wound by the simple mechanics of this operation, but the cold water acts as both a vasoconstrictor and a mild anesthetic agent.

A constriction band may be applied above the stab site. When the wound has been thoroughly irrigated and no evidence of the sting's epithelial sheath can be seen, the extremity may be submerged in hot water. The water should be maintained at as high a temperature as the victim can tolerate without injury, for 30 minutes to an hour. The addition of various anesthetic and antiseptic agents to the hot water is optional.

Following the soaking procedure, the wound should be covered with a sterile antiseptic dressing. In those cases where the injury has been severe, or where systemic complaints are registered, it is advised that the victim be seen by a physician immediately.

Further studies of the venom's influence on the blood cells, nervous tissues, and the pacemaker of the heart are now being conducted at the Huntington Institute of Medical Research in Pasadena. Support for the cardiovascular investigations was provided through the Bank of America-Giannini Research Foundation.

In the late summer and early fall stingrays move into California's bays and sloughs in large numbers. Right—a typical fall catch near Balboa.

THE CALTECH ALUMNI

II. Religion and Politics

TODAY, MORE THAN EVER BEFORE, the technically trained man is the fair-haired boy—of business, industry and government. Dr. Samuel A. Goudsmit, chairman of the Physics Department at Brookhaven and editor of the *Physical Review,* comments on this trend as follows:

"Some of us [physicists] are in industry, designing electronic equipment, and some of us are attached to the American embassy staffs in England, France and Germany. Colleagues of mine who never even bothered to vote before Hiroshima now sit at the elbows of our United Nations representatives when the subject of atomic energy is on the agenda, and others, who were ill at ease lecturing before a few seminar students, now address large audiences on the fate that threatens the world if atomic energy is not internationally controlled. From timid pedagogue to eloquent Jeremiah—all in the space of a few short years."

Other scientists are equally active in non-scientific affairs. In a somewhat similar way, the same thing is true for engineers. Many engineers are now going into positions of management and administration, becoming executives, or members of the boards of directors of large companies. A recent Columbia University survey reports that "40 percent of industrial management is engineer-trained, replacing both the lawyer and the banker in top industrial posts." As the foregoing implies, neither the scientist nor the engineer is sticking to his last. He is an active participant in non-scientific and non-technological activities.

It is not difficult to identify some of the important influences contributing to this heyday of the scientist and engineer. First of all, modern society, in its technological development, has become so complicated and elaborate that only those with highly developed skills and knowledge in science and engineering can make significant contributions to further progress. Furthermore, every well-trained scientist and engineer has had a long and arduous training in the logic of scientific method and experimental proof. The resultant ability to think vigorously and objectively is an invaluable asset in practically any situation in life, and both industry and business, as well as government, are rapidly becoming aware of this fact.

These remarks seem particularly applicable to the Caltech alumni—scientists and engineers who have proved particularly adept at getting special citations, awards and honors for outstanding professional and technical accomplishment. It seems safe to assume that these same Caltech alumni will have an important influence in determining the future goals and policies of American industry and American government; as technically trained people, they will undoubtedly perform in an outstanding manner, but they will be functioning as people, not as machines.

What about their non-technical attributes? What about their personal opinions? their prejudices? What are their views on religion, politics, government? These aspects of a person's sophistication and wisdom are no less, if not more, important than his technical proficiency—especially when they concern a group potentially as influential in the life of America as are the Caltech alumni. These are the questions we will consider in this and the next article on the Caltech alumni survey.

The Caltech alumni are predominantly Protestant (84 percent) in their religious affiliations. However, times are changing as far as religious affiliations among U. S. college graduates are concerned, and this fact is reflected in the Caltech figures.

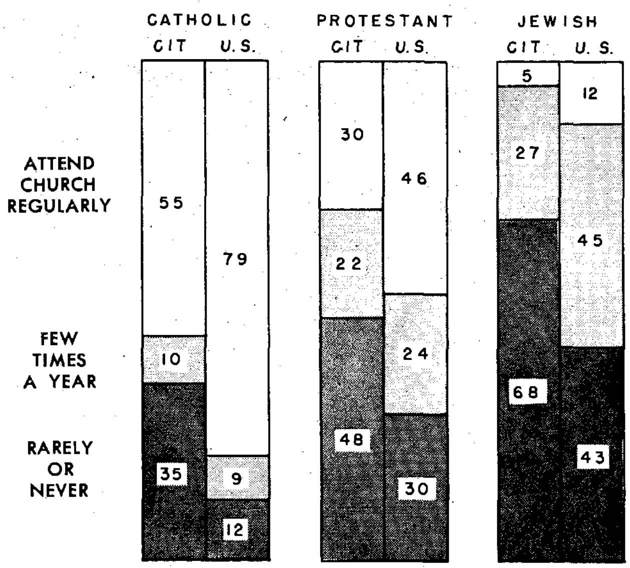
If we compare C. I. T. graduates over 50 with those under 30, we find the percentage of Protestants dropping from 96 to 81, while the percentage of Catholics increases from 3 to 10, and of Jews from 1 to 9.

If we compare these differences with the comparable figures for the U. S. graduate (from *They Went to College,* by Havemann and West), then it appears that there is a much larger percentage of Protestants and a much smaller percentage of Catholics among the Caltech alumni than among U. S. graduates in general.

		Under 30		Over 50	
	CIT	CIT	U.S.	CIT	U.S.
Protestants	84%	81%	69%	96%	87%
Catholics	7	10	25	3	10
Jews	5	9	6	1	2
Other	4				

This preponderance of affiliation with the Protestant church is of considerable importance for us, as we shall see in the next article in this series that the Protestants

GRADUATES AS CHURCHGOERS



are the most conservative of the three religious groups here under discussion. In the light of the youthfulness of our alumni, the relatively large percentages of Jews and Catholics in this younger group suggest that members of these two religious groups are entering the fields of science and engineering in increasing numbers.

While the religious affiliations of a group provide some indication of its religious views and preferences, we still need some indication of the degree to which it actively participates in religious affairs. In this context the figures on church attendance should be of considerable interest.

We find that only 29 percent of the Caltech alumni attend church regularly. Fifty percent attend rarely or not at all. If we break these figures down according to religious affiliation, and compare them with those for U. S. graduates, it appears that the Caltech alumni are much less active in their church attendance, regardless of religious affiliation.

The chart above shows this difference very clearly. Only among the Catholics do a majority attend church regularly, and even this majority is considerably less than the percentage of Catholics who attend church regularly among all U. S. graduates. Apparently the scientist and engineer are much less religious than the average college graduate. At least they are much less active in their church attendance.

Are they irreligious, or just too busy to attend church? This is a difficult question, and we don't presume to have the answer at the present time. However, our graduates were asked to agree or disagree with the statement, "Religion has little to offer intelligent, scientific people today." Two-thirds of the alumni disagreed; one-third either agreed or had no opinion.

If we look at how disagreement with this statement was distributed among the three religious groups, it appears that religion has little to offer two-thirds of the Jewish and one-third of the Protestant graduates. Even a quarter of the Catholics seem to feel that religion has little to offer them.

When these percentages are compared with the percentages for the U. S. graduates, the Caltech alumni are consistently lower.

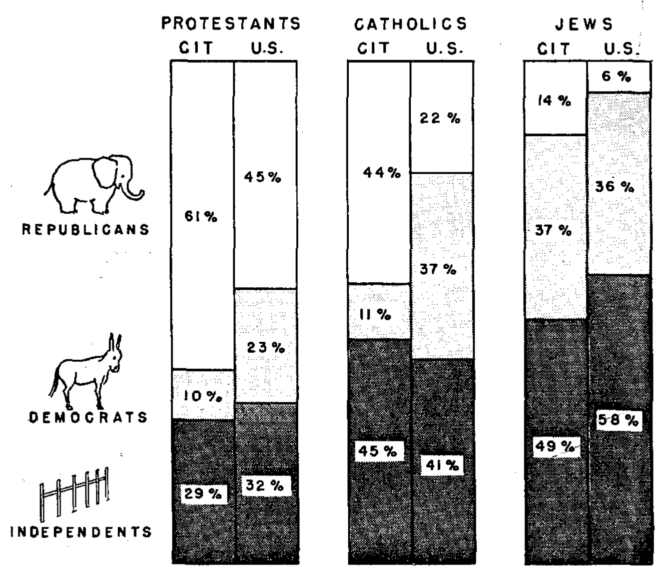
Disagreed with statement	CIT	U.S.
Protestants	66%	84%
Catholics	76	91
Jews	38	56

The chart below illustrates the interesting political differences among these three religious groups. The Protestants, who make up the vast majority of the Caltech alumni, are largely Republican. On the other hand, our Jewish graduates are predominantly Independent. The Catholics fall in between these two groups. These percentages are similar to those found among U. S. graduates, except that in all affiliations the C.I.T. graduates are more heavily Republican.

We also took a look at college grades, college finances, and post college civic activities for these three religious groups to see if there might be interesting differences. As the following figures show, there is relatively little difference among them. The Jewish alumni seem to be better at grade-getting, and the Protestants seem a bit more active in civic affairs, but the differences are not very startling.

Grades mostly A's	CIT	U.S.
Protestants	22%	15%
Catholics	20	14
Jews	35	15
Earned more than half of own way		
Protestants	36%	29%
Catholics	38	29
Jews	32	29
Five or more civic activities, in cities		
Protestants	36	
Catholics	23	
Jews	21	

POLITICAL PARTIES AND RELIGION



We might anticipate a future article at this point and add that there do not seem to be significant differences in income among C. I. T. graduates that can be attributed to religious affiliation. In fact, we might make the broad generalization that, in the fields of science and engineering, religious affiliation is of little significance, either while the student is getting his education or afterwards, when he is working in his professional field.

When Havemann and West reported on the U. S. college graduate, they stressed the very significant finding that although their survey had been preceded by 15 years of the New Deal and the supremacy of the Democratic party, they found there were still more Republicans than Democrats among their graduates—38 percent versus 23 percent. The authors stressed the point that, contrary to the accepted mythology, the college graduate is not a "radical" who would like to initiate new forms of government, but is in fact even less unconventional than the New Deal Democrat. Their results indicated that U. S. college graduates are essentially conservative Republicans.

It was good enough for father

The Caltech alumni are no exception to this observation; in fact, our alumni are even more Republican (56 percent) than are U. S. college graduates in general (38 percent). A partial explanation of this high percentage of Republican party affiliation probably lies in the often observed fact that sons tend to adopt the political party preferences of their fathers. This apparently is what has happened here, because while equal percentages of U. S. and C. I. T. graduates have the same political affiliation as their fathers, 67 percent of the fathers of C. I. T. alumni were Republican, while only 56 percent of the fathers of U. S. graduates belonged to this party.

Fathers' political affiliation	CIT	U.S.
Republican	67%	56%
Democratic	33	44
Alumni political affiliation		
Same as father's	58	58
Different party	14	10
Independents	28	32
Alumni party affiliation		
Republican	56	38
Democratic	12	23
Independent	32	38
Other party	.1	.4

A sizable portion of the Caltech alumni (32 percent) list themselves as Independent in their party affiliation. That is, one out of three will vote as he sees fit, regardless of party labels. This independence was revealed in several ways. The questionnaires were circulated in the fall of '52, immediately before the Republican landslide, yet even at that time 2 percent of the Caltech Republicans were planning to vote for the Democratic candidate, and 64 percent of the Democrats were planning to vote for the Republican candidate.

Also, in response to the opinion item, "When the public is really concerned about an issue, its judgment is usually correct and unassailable, no matter how complex the issue," 77 percent of our alumni disagreed. They are seemingly not prepared to accept the truth of a majority opinion, lock, stock, and barrel, just because it is the opinion of the majority. However, this independence of thought is not carried to the point of social irresponsibility. In checking the statement, "What one does with his life is not very important, except to oneself," 91 percent disagreed.

This matter of political independence seems to be connected with important personal traits and attitudes, rather than just representing a political and ideological vacuum. For instance, take the matter of grades. Now, any Caltech professor would agree that the high grades in courses should be given for independent thought and study, for analysis and synthesis of complex interrelationships, for the ability to take into account all important variables.

If this is how you get As, then this may be how you become an Independent in politics, because there is a steadily decreasing percentage of college graduates who are political Independents as you go from those who got mostly As to those who got mostly Cs.

Independent political affiliation	CIT	U.S.
Of those who got mostly As	38%	42%
Of those who got mostly Bs	30	35
Of those who got mostly Cs	27	31

Independents—and arteries

Political independence also decreases as the arteries harden. As one gains status and prestige, economic and professional security, and a strong stake in the status quo, the lure of change and innovation dims. As this process goes on, political independence decreases and party affiliation increases, particularly affiliation with the Republican party. The figures below clearly indicate these progressive changes.

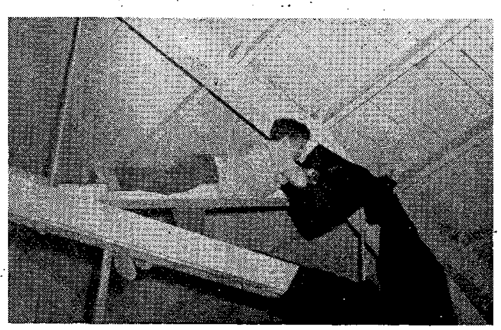
Years after	Independents		Democrats	Republicans
graduation	CIT	U.S.	CIT	CIT
1 to 10	36%	45%	15%	49%
10 to 20	32	41	12	56
20 to 30	24	37	8	67
More than 30	19	30	7	74

There will be more on this matter of the independence of thought among Caltech alumni, as it appears to be an important characteristic and occurs in many diverse ways.

This is the second in a series of articles discussing various aspects of the questionnaire survey of alumni which was conducted last year. Next month Dr. Weir, Associate Professor of Psychology, and the man responsible for the survey, will discuss alumni opinions and attitudes.

INTERHOUSE DANCE

It comes but once a year— which is probably just as well



It's only a one-night stand, but it takes more like a thousand and one nights' work to get ready for the annual Interhouse Dance—as witness a few of the feverish preparations pictured on this page.

"*But that's what I keep trying to make you understand —that the pi-meson disintegrates into a mu-meson and a neutrino.*"

IF THE SIZE OF the crowd was any indication, the annual Interhouse Dance in the student houses and Throop Club last month was a resounding success.

As usual, the decorations remained the outstanding attraction during the earlier part of the evening.

Blacker managed to cram the pirate ship from Peter Pan into its court. With the lines of a modern garbage scow, the primeval pirate vessel took three weeks to build, but performed disappointingly during the festivities when the deck—intended as an extra dance floor—collapsed into the lagoon with 75 people on it. Fortunately, not a toe was dampened, but Blackerites were disgusted with the Los Angeles company that rented them the scaffolding which was supposed to hold up the deck. Characters from Walt Disney's Peter Pan, surrounded with greenery, decorated the lounge.

At Dabney's Desert Oasis couples dodged hanging "tents" while negotiating the dance floor. In the mummy's crypt a bloody-looking punch flowed out of nowhere into a pool. The court was transformed into a dune-ridden desert with large quantities of sand—which is *still* being ground into the wooden floors in the houses.

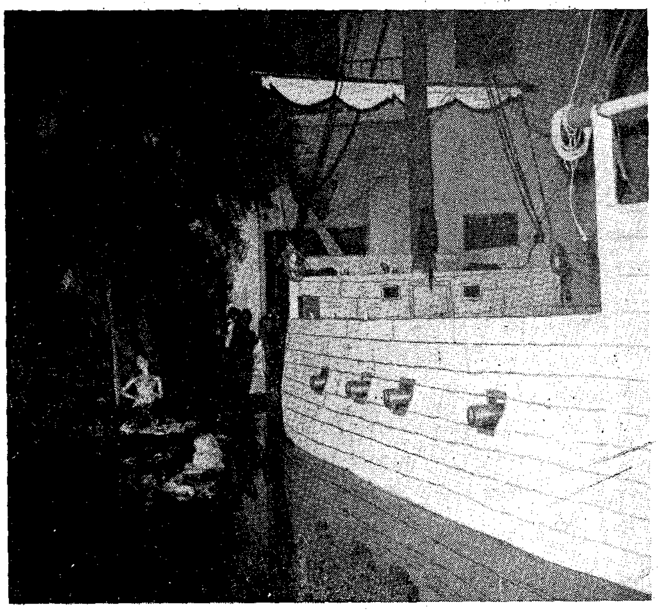
Fleming's Tropical Paradise was accessible only through narrow tunnels of particularly scratchy palm leaves, which impeded the flow of two-way traffic. Brilliant stars flashed in the ceiling all evening, reflected in the false wall of mirrors at the north end of the lounge. The mirrors, of course, appeared to make the room much larger, and as a result everyone tried to crowd in.

The Cheshire Cat grinned evilly from his perch in the Ricketts lounge, and, although the Mad Hatter and the rest of Lewis Carroll's friends were present, Alice was not to be seen. The Jabberwocky flapped around grotesquely in a cavern.

Over in Throop Club the stony silence of Egypt's pyramids was broken by the Eddie Charles band. Most Techmen and their dates filed silently by the mummies and skulls in the side crypts, or dropped in exhaustion into the chairs to be found in this macabre setting.

The hangover from the dance has been obvious to all recent visitors to Tech. Piles of leaves, wood, sand, stones, telephone poles, chicken wire, cardboard and miscellaneous trash decorated the campus far into November.

—*Jim Crosby '53*



Captain Hook's pirate ship, moored in an artificial lagoon in the Blacker House patio, was fitted out with rum kegs, a live cannon, a telephone-pole mast, and—until it collapsed early in the evening—a dance floor.

THE MONTH

Success

THE 200-INCH PALOMAR telescope is now a thoroughgoing success. That's the official word from Dr. Ira S. Bowen, director of the Mount Wilson and Palomar Observatories. It comes as a result of recent tests of the seeing-power of the Hale telescope, which prove that its performance is up to the most optimistic hopes that were held for it in its planning period.

The telescope's performance was checked by Dr. William A. Baum, staff member of the Mount Wilson and Palomar Observatories, using a photon-counting photometer, a light-measuring device so sensitive that it could measure the light of a candle 15,000 miles from the earth. The photometer, developed by Dr. Baum, counts individual photons (the smallest packets of light) reflected from the telescope mirror. The photon pulses are amplified, separated from extraneous pulses, and counted electronically, at a maximum rate of 6,000 a second.

Dr. Baum's measurements indicate that the telescope has photographed stars and nebulae which are at least 6,300,000 times dimmer than the dimmest stars visible to the naked eye.

Electrical Engineer

DR. LESTER M. FIELD of Stanford University, who has been at Caltech as a visiting professor since last January, has now been appointed professor of electrical engineering here. His appointment becomes effective next January 1.

At Caltech Dr. Field has set up an electron tube and microwave laboratory, with support from private industry and the Office of Naval Research, and is continuing his research on microwave amplification and interaction processes. Increased understanding of these problems is expected to lead to new forms of vacuum tubes, ultimately useful for such things as microwave relay systems and television amplifiers as well as for the generation of very high frequencies for chemical and physical research.

A native of Chicago, Dr. Field is 35 years old. He graduated from Purdue University in 1939 and received the Ph.D. degree in electrical engineering from Stanford in 1944. For the next two years he worked at the Bell Telephone Laboratories in the field of magnetron development and electron dynamics and, with Dr. J. R. Pierce (Caltech '33, M.S. '34, Ph.D. '36) developed the first practical traveling-wave tubes. Some of his work at the Bell Laboratories during the war was directed toward devices for detection and location of enemy aircraft.

He joined the Stanford faculty in 1946 and four years later became its youngest full professor, at the age of 32.

The professional fraternity, Eta Kappa Nu, selected him as one of three outstanding young electrical engineers in the United States in 1949. He was cited for "his important contributions to the microwave electron tube art and his organization and direction of an outstanding research laboratory (at Stanford) in this field." Last year he was elected a fellow of the Institute of Radio Engineers in recognition of his "many technical contributions to the electron tube art."

Hixon Professor

DR. ROGER W. SPERRY comes to Caltech next month as Hixon professor of psychology.

He has been active for many years in the fields of neurology and psychology and comes to Caltech from the University of Chicago and the National Institutes of Health, Bethesda, Maryland. He joined the faculty at Chicago in 1946 as assistant professor of neuroanatomy and since 1952 has held a joint appointment as research associate in psychology there and as chief of the section on development neurology at the National Institute of Neurological Diseases and Blindness.

Professor Sperry studied at Oberlin College and the University of Chicago. He recently received one of the

AT CALTECH

first distinguishd alumni citations granted by Oberlin, which awarded him the B.A. degree in 1935 and the M.A. in psychology in 1937. The citation reads:

"In less than a score of years Roger Sperry has worked his way to the heart of some of the most complex problems in neurophysiology. With quiet and patient persistence he has developed delicate skills of surgery, planned and executed careful measurements of behavior that have shed light where light was needed."

His major investigations have been in the fields of the developmental patterning of brain pathways, the neural basis of perception and memory, and functional recovery following lesions of the central nervous system, as well as re-education following peripheral nerve regeneration, muscle transplantation, and eye rotation.

After Chicago awarded him the Ph.D. degree in zoology in 1941, he spent a year as a National Research Council fellow in biology at Harvard University. He then worked as a research associate at the Yerkes Laboratories of Primate Biology, Orange Park, Florida, for four years before joining the Chicago faculty. During the war he served as consultant to a government research project on the surgical repair of nerve injuries. He also conducted research at the Lerner Marine Laboratory in Bimini, British West Indies, and the Bermuda Biological Station.

The Hixon professorship, awarded for the first time to Dr. Sperry, is provided by the Hixon Fund established in 1938 by a grant to Caltech from the estate of Frank P. Hixon to support scientific endeavor which offers promise of increased understanding of human behavior.

History of Science

THE AIRESEARCH Manufacturing Company, a division of the Garrett Corporation, Los Angeles, has established a $56,000 fund for the support of teaching and research in the history of science at the Institute. The fund will make possible two innovations at Caltech: a general course in the history of science, and a research project in the history of flight under pressurized conditions.

Dr. Rodman W. Paul, professor of history, will direct the three-year program which the new fund will support.

Dr. Thomas M. Smith, newly-appointed assistant professor of the history of science, will conduct the study and write the history as well as teach the new course when it is introduced next year. He comes to Caltech from the History of Science Department at the University of Wisconsin, where he has been completing his work for the Ph.D. degree. A 1946 graduate of the University of California at Los Angeles, he has long been interested in the history of science and aviation and has served as a technical writer in the aircraft industry.

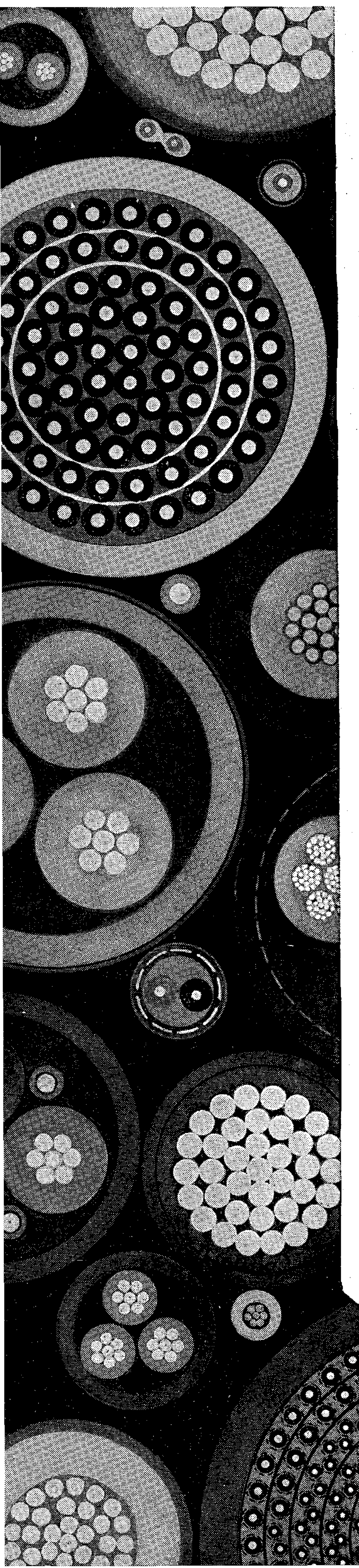
The study of the history of pressurized flight is being made because of the desire of President J. C. Garrett of the Garrett Corporation to make available a scholarly analysis of this important phase of recent aeronautical development. The history will cover all phases of the development of pressurized flight and will not be limited to the contributions of any one company.

AUFS

ON JANUARY 11 Edwin S. Munger comes to Caltech to report to the students, faculty and friends of the Institute on current developments in Africa. He will be on campus until January 20.

From January 25 to February 23 Boyd R. Compton will arrive here to report on Indonesia. Al Ravenholt will be here from February 8-17, reporting on the Far East. And from February 22 to March 3 E. A. Bayne will be on campus, reporting on Iran.

All four men are representatives of the American Universities Field Staff, the organization set up in 1951 by Caltech and seven other educational institutions in this country to send qualified young men out as their correspondents in foreign areas. In addition to sending back regular reports to the sponsoring colleges and universities, each of these men returns home every two years to visit the campus of each of the sponsoring institutions to report in person on current conditions, problems, and personalities in the area he is studying.



NO. 4 IN A SERIES

The Importance of

Coverings and Sheaths for

THE TERM "COVERINGS", as applied to insulated electrical wires and cables, refers to a relatively continuous homogenous layer or layers of impervious and inert material, applied over an insulated conductor or conductor assembly for the purpose of protecting such conductors from moisture, chemical attack and mechanical damage. Coverings may be colored to indicate circuit identification. Chemical attack refers to damage to the insulation resulting from acid, alkalies and other chemicals in the atmosphere or the ducts or soil in which the cables may be installed. Mechanical damage may result from the abraiding, compressing, cutting and tearing forces to which the insulation may be subjected during installation and service.

Coverings may be made of metallic or non-metallic materials. Metallic coverings may be, (1) a continuous metal tube over the insulated conductor, usually made of lead and known as a lead sheath, (2) metal tapes applied spirally about the insulated conductor and referred to as an armor or a shield, depending on the purpose for which it is used, or, (3) metal wires applied spirally either in one direction or in the form of a braid, and again known as an armor or a shield. Armor is a covering applied primarily for mechanical protection or to add strength while a shield is applied to protect the insulation from electrical stresses or for safety purposes. Non-metallic coverings may consist of, (1) a continuous layer of vulcanized rubber or rubber-like material, generally neoprene, or a thermoplastic material, called a jacket, (2) spirally applied, moisture-resistant fibrous yarn, usually cotton or jute, (3) moisture-resistant fibrous tapes, or, (4) moisture-resistant fibrous braids. Combinations of one or more of these may be used as explained later.

The kind and number of coverings used is determined largely by the size of the conductor or cable, the type of insulation on the conductor and the installation conditions. The following is a brief outline of the types of coverings required for the more important types of insulations and installation conditions.

INSTALLATION in DRY CONDUITS and DUCTS

Single-conductor rubber and varnished-cambric insulated cables require a covering over the insulation consisting of a moisture-resistant cotton braid on the small sizes and a double braid or tape and braid on the large sizes for protection against mechanical damage. On 600 volt cables for installation in buildings this covering must be flame-resistant, and is usually colored for circuit identification. A thin layer of neoprene may replace such fibrous coverings on rubber-insulated cables. Paper-insulated cables require a lead sheath for retention of the impregnant and for mechanical protection. Single-conductor polyvinyl chloride insulated cables usually require no coverings since they are generally considered resistant to flame and chemical and mechanical damage.

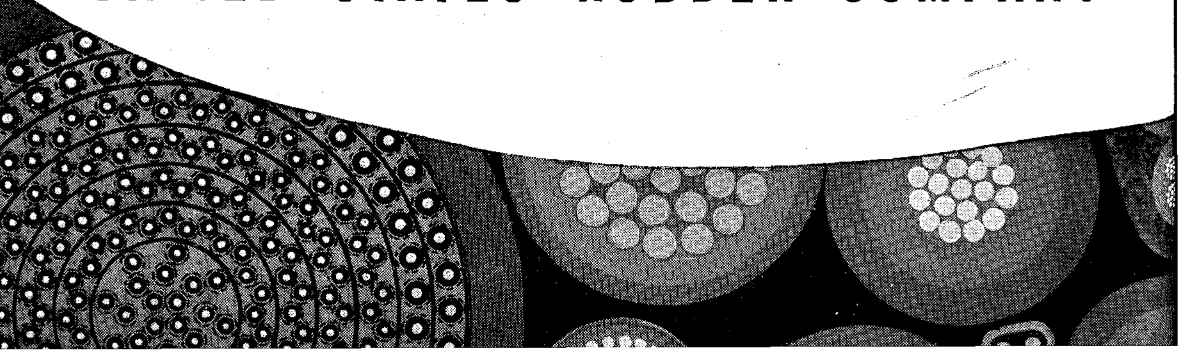
Multiple-conductor cables which consist of two or more single conductors assembled as a unit are protected by an outer covering. The individual conductors of multiple-conductor rubber insulated cables are generally protected by a single fibrous covering. The outer covering of multiple-conductor cables usually consists of a tape and moisture-resistant cotton braid on rubber and varnished-cambric insulated cables. A neoprene jacket may replace the outer braid on rubber-insulated cables. A polyvinyl chloride jacket is generally used on polyvinyl chloride insulated multiple-conductor cables. Multiple-conductor paper-insulated cables have a lead sheath over the assembled insulated conductors.

INSTALLATION in WET CONDUITS and DUCTS

The coverings described for use in dry locations on both single- and multiple-conductor cables are suitable for use in wet locations except that a lead sheath is required over varnished cambric and non-moisture-resistant rubber and polyvinyl chloride insulations.

Moisture-resistant rubber insulation requires mechanical protection in the form of a fibrous covering or coverings or a neoprene jacket. A neoprene jacket is preferred because of its greater resistance to deterioration in wet locations. Moisture-resistant polyvinyl chloride may be

UNITED STATES RUBBER COMPANY



nsulated wires and cables

used without a covering on single-conductor cables.

AERIAL INSTALLATIONS

The types of coverings described for use in wet locations are generally suitable for aerial installations but greater thicknesses of non-metallic coverings, particularly for single-conductor cables, are required. Fibrous coverings for aerial use are usually made of moisture-resistant jute, sisal or loom-woven cotton of large size. Neoprene jackets on single-conductor cables for aerial installations are about 50 per cent greater in thickness than those used for duct installations. These thicker covers provide the additional mechanical protection required for aerial installations. Neoprene jackets are generally preferred over fibrous or rubber jackets because of their greater resistance to weathering. Lead-sheathed cables with the same sheath thickness as used for duct installations are suitable for aerial installations. A lead alloy containing small amounts of antimony or tin is used instead of pure lead to reduce failures due to crystallization.

DIRECT BURIAL

For direct-burial installations, rubber, rubber-like or thermoplastic jackets and lead sheaths are generally used. The jacket or sheath thicknesses are the same as those used for aerial installations. Lead sheaths require protection against mechanical damage. This usually consists of two servings of moisture-resistant jute yarn immediately over the lead followed by two steel tapes over which are applied two servings of moisture-resistant jute.

SUBMARINE and VERTICAL CABLES

Submarine cables require protection against mechanical damage and additional strength over that provided by the conductors to prevent them from being broken by dragging anchors or other objects. Vertical cables frequently require greater strength for their support than that provided by the conductors. This additional strength and mechanical protection is usually provided by a serving of steel wires which completely covers the surface of the cable. This is known as a wire armor. A bedding consisting of two moisture-resistant jute servings is provided between the non-metallic jacket or lead sheath and the armor wires.

PORTABLE INSTALLATIONS

Cables for portable installations such as those used on dredges, shovels and mining equipment must be flexible and their sheaths must be resistant to abrasion, cutting and tearing. Tough wear-and-weather-resistant rubber or rubber-like jackets are therefore used. Such jackets are generally made in two layers with a reinforcing braid of high-strength cotton yarn between them. The jacket thicknesses for such cables are generally greater for a given size of cable than those of cables for non-portable installations.

SHIELDING

Shields consist of one or more conducting layers on insulated electric power cables, the purpose of which is to confine the dielectric field to the insulation on the individual conductors. The two most important functions of shields are, (1) to protect the insulation against harmful electrical stresses and discharges at its surfaces, and, (2) to reduce hazards of shock.

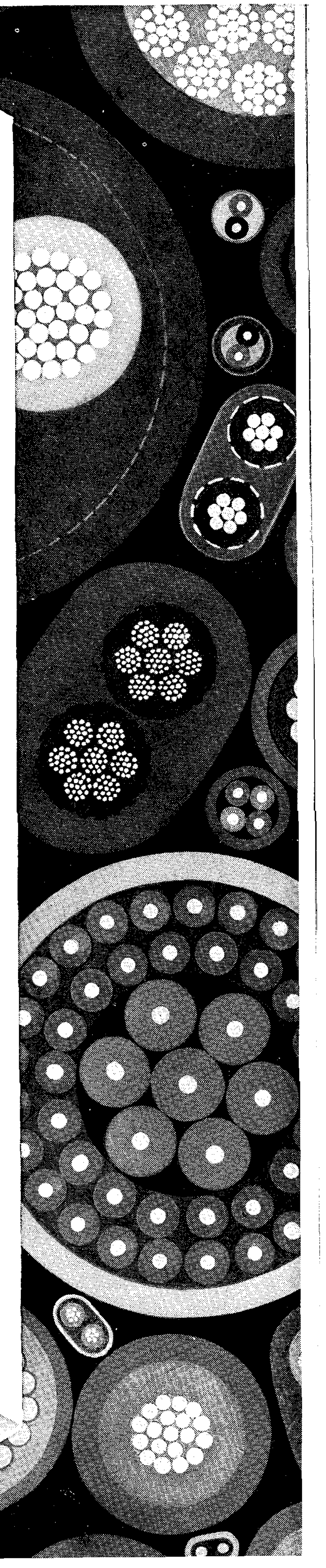
Since harmful electrical stresses can occur at both the internal and external surfaces of an insulation, particularly on stranded conductors, at high voltages, it is necessary to provide shields at both surfaces. Internal shielding in the form of a semi-conducting fibrous material is generally used immediately over the conductor for operating voltages above 2000. External shielding usually consists of a semi-conducting fibrous layer immediately over the insulation over which is applied a layer of metallic material. External shields are generally used at voltages above 3000 for non-metallic jacket cables and above 10,000 for lead-sheathed cables.

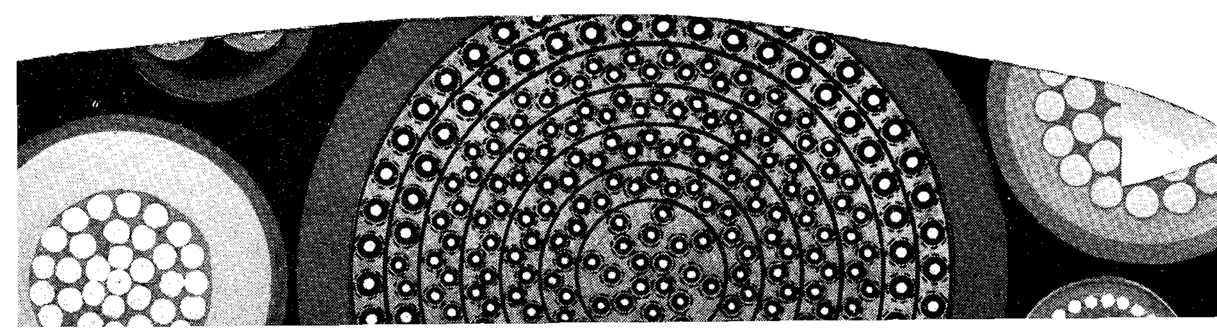
Metallic shields are made of non-magnetic materials such as aluminum or copper and are applied as tapes on cables for non-portable installations and as braids for portable cables. External shields must be grounded at all joints and terminals.

For reprints of these pages write to address below.

Electrical Wire and Cable Department

Rockefeller Center • New York 20, N. Y.





UNDERGRADUATE SCHOLARSHIPS AT CALTECH

by L. WINCHESTER JONES

Director of Undergraduate Scholarships

WEBSTER'S COLLEGIATE Dictionary defines scholarship as 1) the character or qualities of a scholar, or 2) a foundation for the aid or support of a scholar. To most people, then, the word suggests a reward or prize for outstanding scholastic achievement and, therefore, an honor. For many years, through the twenties and early thirties, scholarships at the California Institute were looked upon in this light and were awarded as prizes to a few of those in approximately the top ten percent of their respective classes who were given Honor Standing.

During the thirties an important change occurred in the general attitude toward the awarding of scholarships. These were hard times and families found it difficult to send their children through four years of higher education. Between the two world wars, however, both industry and government had come to regard a college education as a prerequisite for employment or promotion in an ever-increasing number of jobs, with the result that college training appeared to be a necessity to many who—prior to 1918—would have considered such training a luxury beyond their needs and resources.

The answer was, of course, the tremendous growth of the state universities, but the private colleges too were wise enough to know that those most deserving of, and best able to profit by, a collegiate education were not confined to the wealthy. They set out, therefore, to raise additional scholarship funds. Many of them, including the California Institute, in their desire to secure the best students, regardless of economic background, decided to award scholarships involving tuition or cash primarily on the basis of financial need rather than scholastic superiority.

This does not mean that scholarships are given to inferior students. There are too many good students with financial need, and too few scholarship funds to create any such risk. But it does mean that a good student will not receive cash or its equivalent simply because he is good. If he has no need, he will receive an appropriate honor and the cash will go to someone who does have the need, and who has also demonstrated that he is worthy of this help.

This change in basic policy has brought with it many problems. Foremost is that of determining financial need. But there is also the matter of the public's reaction to this change. As I have indicated, most people think of a scholarship as an honor and do not readily accept the substitution of some other term such as Honor Standing.

There is also the competition among colleges for the better students. Since World War II the habit of making multiple applications for admission has become widespread. It is safe to assume that two-thirds of those who apply to the California Institute have likewise applied to at least two other colleges. No one can criticize this practice, in view of the fact that an applicant's chances of admission here are about one in five, but it does create a situation in which colleges often find themselves competing for many of their top applicants. In such a situation the award of a scholarship, or of a larger scholarship, will often turn the scale.

It is good to know that there is competition for brains as well as for brawn, but this competition naturally makes matters difficult for those who try to adhere to the principle of financial need in awarding scholarships—especially in view of the wide difference of interpretation that can be given to this rather indefinite term.

With the foregoing as a background we can now go into the machinery by which the California Institute awards scholarships, and the ways in which we are attempting to cope with the resulting problems. The administration of undergraduate scholarships is the responsibility of a faculty committee known as the Committee on Undergraduate Scholarships and Honors.

The actual selection of scholarship holders in the sophomore, junior and senior years is made by a subcommittee composed of the Chairman of the main committee, the Dean of Freshmen, the Dean of Students, the Director of Undergraduate Scholarships, and one other member of the main committee. However, awards are not considered final until they are approved by the main committee.

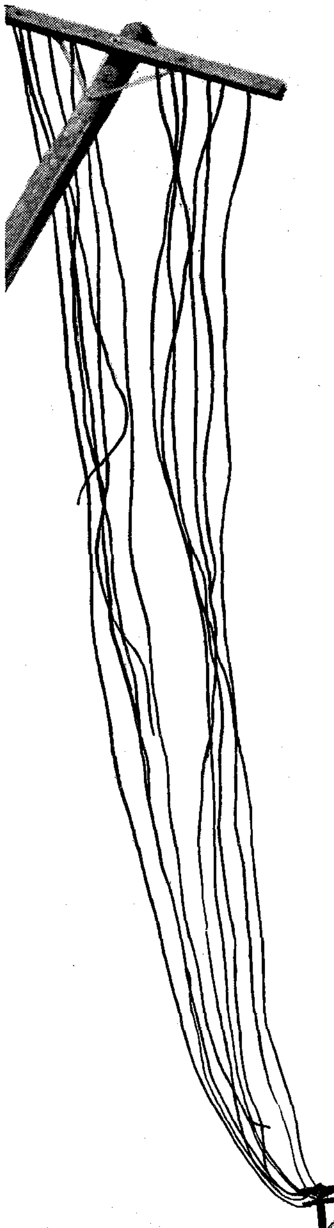
Scholarships are awarded to entering freshmen by the Freshman Admission Committee, acting in this regard under authority delegated by the Committee on Undergraduate Scholarships and Honors. The same arrangement holds for transfer scholarships, the recipients of which are selected by the Upperclass Admissions Committee.

In order to obtain a scholarship a freshman or transfer applicant must fill out a form which calls for rather detailed information on his and his family's financial resources. The form must be on file in the Admissions Office not later than March 1 for freshmen and April 1 for transfers. Scholarship applications are available at the time freshmen are interviewed, and the interviewer thus has an opportunity to go over the information in person with the applicant.

A student in residence at the Institute may apply for

2000 HOMELESS...LINES DOWN.

URGENT...REPAIR QUICKLY.



Gale winds ripped through Alabama and Georgia last spring, destroying 500 homes, leaving 2000 homeless, killing and injuring 382.

Thousands of telephones were out of order—hundreds of poles damaged and destroyed. Communications had to be restored quickly. They were! Here's how:

1. Engineering teams rushed to the stricken area. In hours, they determined material and men needed to restore service.
2. Based on these reports, equipment—as far off as Chicago and New York—began rolling toward the area.
3. Telephone crews arrived from as far away as Atlanta and Birmingham—engineering and accounting forces, construction, cable testing and repair teams.
4. Red Cross, hospital and other essential installations were rushed.
5. The public was informed of progress by daily newspaper and radio releases.

Result: in 3 days, Columbus, Georgia—which suffered 10 million dollars property damage—had half its out-of-order telephones working and Long Distance service nearly normal. In another 3 days substantially all service had been restored.

Planning and co-ordination among many telephone people with a variety of skills made this quick recovery possible. It illustrates vividly the teamwork typical of Bell System men and women.

There's room on this team for a wide range of college graduates—business and liberal arts, as well as engineering. Plan for your future by getting details now about job opportunities in the Bell System. Your Placement Officer has them.

BELL TELEPHONE SYSTEM

scholarship assistance—usually called a grant in aid—if he stood in the top half of his class at the end of the preceding academic year. Until the fall of 1953 only the top quarter was eligible, but additional need and the knowledge that a number of potentially outstanding graduates do not rank in the top twenty-five percent have made it necessary to extend the eligibility, even though this has placed a serious strain on the funds available.

During the summer all students in the top half of their respective classes are notified that they may apply for grants in aid if they need assistance. The letter of notification points out that funds are limited and that application should not be made unless there is a genuine need. As far as the committee has been able to ascertain, the undergraduates, with few exceptions, have adhered admirably to the spirit of this request. Application forms from students in residence must be filed within a few days after registration for the fall term, when full information is available on summer vacation earnings. Each applicant for a grant is interviewed by a member of the subcommittee, and when these interviews are completed the subcommittee meets and tries to arrange the fairest possible distribution of the available funds.

Juding financial need

There can be no hard and fast rules for judging relative financial needs among any group of students. Family resources and family obligations, such as number of dependents, furnish a starting point, but almost every case presents a different problem. The Committee on Undergraduate Scholarships and Honors has, however, set down certain basic criteria.

The first of these is that if a student is to receive aid he should make a reasonable contribution of his own time and effort in earning money unless there are excellent reasons why he is unable to do so. The Committee therefore sets up a figure—usually around $600, though it may vary in individual cases—which it is believed a student should earn in a twelve-month period. This amount is counted among his assets in determining need.

A reasonable contribution from the family, depending on income and number of dependents, is likewise expected. The Committee feels that its responsibility is to make it possible for undergraduates to obtain the bachelor's degree; therefore, in considering savings and other non-income items, it makes no allowance for the applicant's further education in graduate school.

The Committee does not feel that it is warranted in extending help to students who marry after entering the Institute beyond the amount which might be given had the student remained single. Those who enter after marriage are considered to the extent possible on the basis of the cost of supporting their families.

Finally, the Committee believes that seniors, with only a year to go before it is possible for them to enter full-time employment, should be asked to use the Institute's loan funds, which are generous in their interest rates and terms of repayment.

Guided by these basic principles, the subcommittee tries to determine the difference in each individual case between available resources and necessary expenditures and, in so far as possible, to make up the difference. Up to the present time, however, the Committee has had to limit its aid to a maximum of full tuition ($600) because of a lack of sufficient funds.

The only exception to this practice occurs in the case of students who, to the greatest extent, fulfill the conditions set up by donors of certain special scholarships which amount to more than full tuition. Those with the highest grade-point averages for the preceding year receive some preference, but basically it is financial need which determines the size of the award.

The Committee does not claim that its judgments are infallible. The determination of individual need is difficult. There are many indefinite and cloudy situations, but the alternative to awards based on need appears to be an allocation of funds according strictly to grade-point average—the old theory of a prize or honor, under which a number found themselves with more money than they needed, and a larger number with less than the minimum necessary to go on.

There are, however, more problems connected with this kind of scholarship award policy than the determination of financial need. The reaction of the public must be considered, and our public consists not only of the applicants and their families but of the secondary schools which these applicants have attended, and on which we rely for students in the future.

It has already been pointed out that secondary school graduates, and more especially their parents, often look upon cash or tuition scholarships as honors. We have lost good students, sons of well-to-do parents, simply because they and their families felt that Caltech did not value them as highly as did some other college which had given them a scholarship—even though, as far as we could determine, no financial need existed, and even though they did receive Honors at Entrance.

This attitude can also prevail among secondary school principals and other administrative officers. One way of impressing a community with the quality of the school which it is supporting is to advertise at commencement, or in other ways, the number—and even the amount in dollars—of college scholarships which the members of the graduating class have received. Fortunately, this practice is not yet widespread, but it appears to be increasing.

Scholarships and honors

For colleges which award largely on the basis of need, another embarrassment arises. Student X, with an outstanding record but no need, is given honors but no scholarship. Student Y from the same school, with a record somewhat inferior to that of X but with a real financial problem, is given a scholarship. Yet many times it is student Y who makes the headlines in the

local newspaper, along with the dollar amounts that have been offered him. It is for this reason that the California Institute never publishes awards of scholarships, but only Honors at Entrance and, in the case of students in residence, Honor Standing.

The idea that money is the most appropriate award for excellence is firmly rooted in this country, and it will not be easy to uproot it. Several attempts are, however, being made. Among these is the uniform scholarship application blank for entering students, being used this year by twelve West Coast private colleges, including Caltech.

Each college has a set of these blanks, with its own name in large type at the top of the first page, and some special information on its own scholarships and rules governing application on the fourth and last page. All the rest of the blank is the same for all the colleges, including, on the first page, a careful statement of the difference between Honors at Entrance, which are rewards for excellence but carry no stipend, and Scholarship Grants, which are to aid the needy and are not considered as honors.

If available scholarship funds are to aid the largest number of worthy applicants it is essential that the public—parents, students, and educators—be persuaded that merit does not always and necessarily have to be paid off in cash. The uniform scholarship application is only one step, but an important one, in this process of education.

A healthy airing of this problem is going on in other parts of the country, and it is to be hoped that this will lead to other cooperative endeavors to lessen the confusion and the abuses which always tend to exist wherever money is being given away.

What Caltech spends on scholarships

The amount of money spent each year on undergraduate scholarships at the California Institute is a considerable sum. The following table gives the figures for the current academic year and provides a comparison with previous years.

	1948-49	1949-50	1951-52	1953-54
Freshmen only	$ 6,500	$12,150	$23,150	$30,250
Total undergraduate (including freshmen)	19,575	32,250	47,950	81,000

Out of a total of 582 undergraduates, 158 were given grants for 1953-54, making an average grant of $512.

Two things stand out in these figures. The first is that freshmen receive by far the largest proportion of the total. For one thing, freshmen are likely to have earned less during the summer before admission than they will later, and they are strongly advised not to hold jobs during the first year. For another, many freshmen applicants and their families must have the assurance of some aid before they feel that they can risk a start at a college which charges $600 tuition. Once through the first year, most of these men manage to continue, even though they may not receive subsequent scholarship help.

The second noteworthy fact is the large and steady increase in the total amount of money awarded and the increased need which this reflects. This is brought about partly by the decrease in the number of government-supported veterans in the last few years, but largely by the steadily rising cost of living.

Where the money comes from

The sources from which these funds are drawn can be divided into three categories.

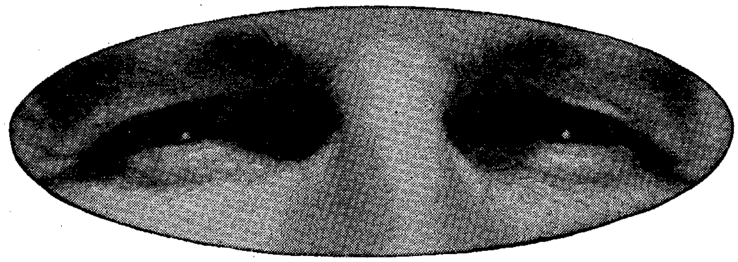
1) Endowment funds given to the Institute for undergraduate scholarships and included in its portfolio of investments, the income only to be used. In 1953 $32,450 was spent from this source.
2) Special funds given year by year by foundations, corporations, and individuals, the entire amount of the gift to be awarded in the year in which it is given. In 1953, $41,950 was spent from this source.
3) Funds from the Institute's general operating budget allocated each year for scholarships. In 1953, $6,600 was spent from this source.

From the foregoing it may appear that the Institute is pretty well off for scholarship funds, but two facts need to be pointed out. The first is that for several years we have spent more from Category 1—endowment funds—than the capital amount of these funds has produced in income. We have been drawing on resources accumulated from 1943 to 1946, when three-quarters of our undergraduates were in the V-12 program completely supported by the Navy, and during the two or three years thereafter, when many students drew all they needed under the G. I. Bill.

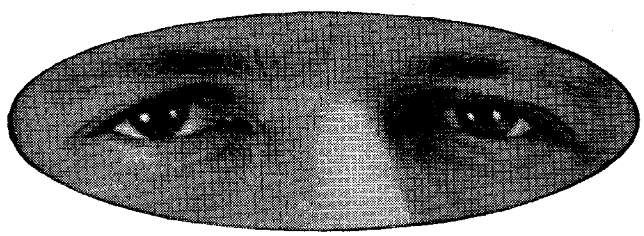
The second fact to note is that over half of our present income—that designated as special funds donated annually—may be temporary in nature. Even corporation scholarships now established on a nation-wide basis are subject to the influence of changing tax laws and the continuing approval of boards of directors and stockholders. Many of the gifts in this category, while most welcome, may be of an even less substantial nature if one looks very far into the future. We are, therefore, in the position of a man who is living beyond his income by drawing on savings, and relying on the generosity of friends who may at any time find it necessary to withdraw their support.

Equally important is the fact that all of our scholarships for more than full tuition—and all those which can be awarded for the full four years rather than for the freshman year only—are included in Category 2—the special funds over which we have no control beyond year to year or, at the most, four-year commitments. While it is safe to assume that we will never engage in competitive bidding for applicants who are simply holding out for the highest offer, it is essential that we have funds to give those top students who really want to come here, but who cannot do so without the assurance of

WHAT GOOD WOULD YOU EXPECT



STEEL MEN TO SEE



IN PLASTIC PIPE?

● Is it reasonable for men who make steel to recognize that plastic pipe can do things steel cannot?

Certainly they're quick to see steel do many things plastics can't.

Republic Steel produces plastic pipe. But Republic also lists among its products titanium sheet, aluminum windows and powdered iron. Each has qualities that outdo steel on some jobs.

Republic Steel Corporation is not only iron ore mines and blast furnaces. It is men earning a living by providing other men materials for them to use in earning their livings. It is men providing pipe where pipe is needed —seamless steel pipe; welded steel pipe (three types), and plastic pipe. Republic Steel's production of plastic pipe augments Republic's 3-STEP SERVICE FOR STEEL USERS:

1. **to make more and better kinds of steel than any one else:**
2. **so that we can recommend the precisely exact steel for your job:**
3. **then to share with you our unexcelled knowledge of how to fabricate steel in order that you can get the best results for your product.**

We see steel as the world's most versatile material—but certainly not the be-all and end-all for every job. This realistic attitude toward our main product is one reason why you can depend upon our recommendations.

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WORLD'S WIDEST RANGE OF STEELS AND STEEL PRODUCTS

some support often beyond a tuition scholarship. A prospective student in this situation knows that competition at Caltech is keen, and each year a number of our best applicants feel that they must attend a second-choice college in fairness to the family budget, rather than enter here on a one-year scholarship and take a chance on a renewal.

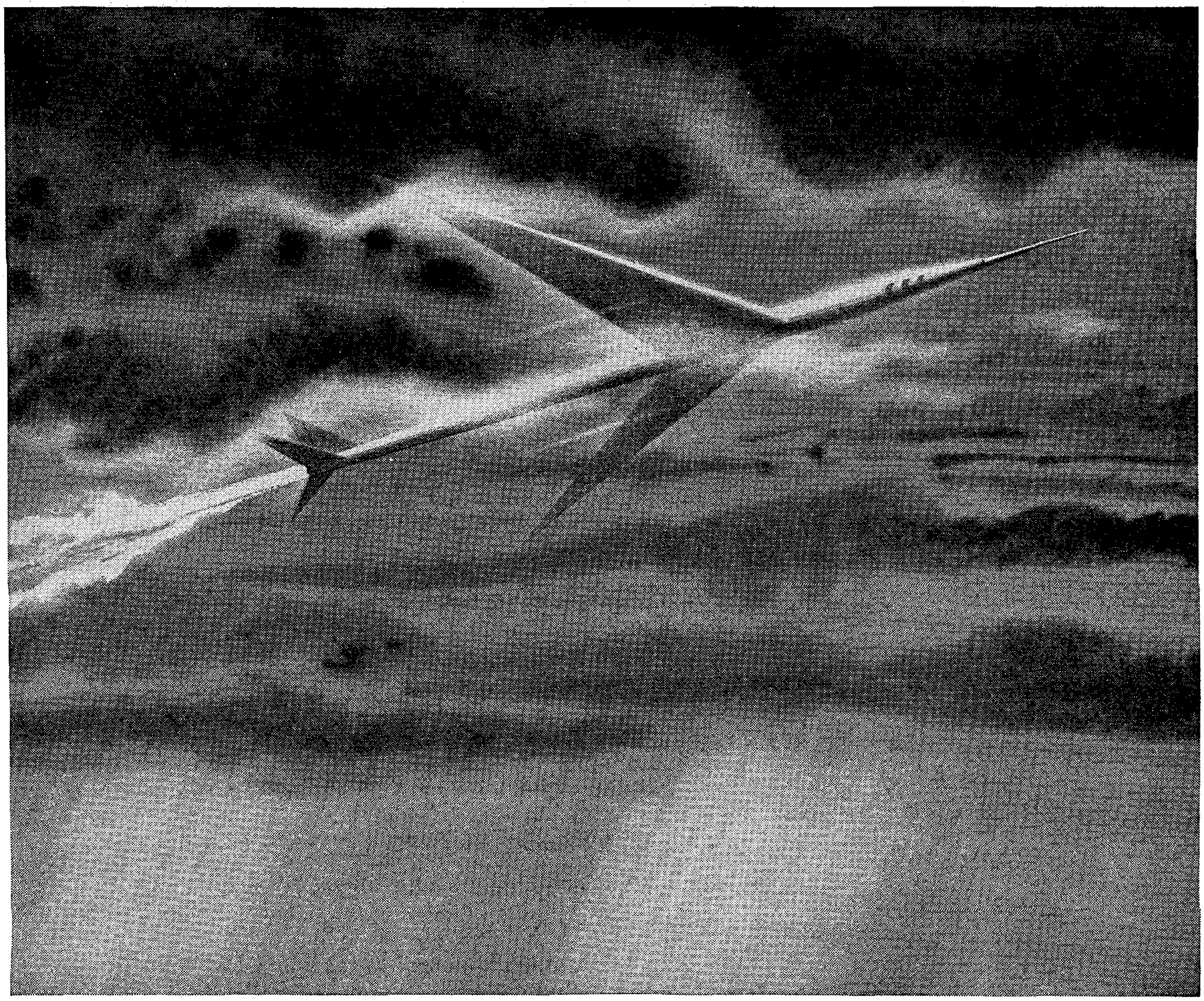
In this connection, the figures on cancellations after admission has been granted are of interest. In 1953 there were 98 such cancellations, more than half of them for financial reasons. A number of those who withdrew their applications did not give definite reasons, but it is a safe assumption that finances dictated the choice for many of these as well.

In the case of 36 of these cancellations we know that the applicant made every effort to attend Caltech, but in the end had to decide on a state university, or on a college which offered either a larger scholarship, or a scholarship which extended over four years. Many of this latter group were among our top applicants. We had given them scholarships to the extent of available funds, but not to the extent of the need that existed. Had half of these men entered in place of an equal number who, in our estimation, stood below them, we would have today an even better freshman class, and eventually an even better group of graduates.

While the number of cancellations this year was higher than usual, the percent of those withdrawing for financial reasons has always been large. Added to this is the fact that it is by no means certain that the California Institute will be able to keep its tuition as low as the present $600 rate. An increase will mean that more people will need help, and the amount of this help in dollars will have to be increased for each person.

If, then, the California Institute is to continue to enroll the kind of student for which it is seeking, and be independent to the greatest possible extent of the financial resources of the applicants in making its selection of the best, it must be able not only to maintain its present level of scholarship assistance but to expand this level to meet increased need and increased costs of obtaining an education.

The most useful funds for this purpose are those which are given to the Institute in the form of principal, the interest from which may be used without special restrictions. Quite properly and understandably, individual donors wish to give scholarships under certain conditions—such as rank in class, year in college, or major field of study. Such gifts we welcome, but where several have substantially the same restrictions, a situation can arise in which there are not enough good candi-



dates who precisely meet the requirements, while on the other hand there are very deserving students who cannot get assistance they need because they happen to be in the wrong class or the wrong option.

Nothing in this article should be taken to imply that the Institute does not welcome, and receive with real gratitude, annual gifts to be used in their entirety during the current period, under such restrictions, within certain limits, as the donor may wish. The Institute will not accept scholarships which exclude applicants on the grounds of race, creed, or color, or which require any agreement concerning future employment. Aside from this restriction, almost anything goes. On the other hand, a long-range scholarship policy which fits need to worthiness in the greatest possible number of cases should have behind it a substantial bulwark of endowment funds over which the college authorities have full control in meeting the requirements which exist at any given time. At present, we do not possess such an endowment for scholarship purposes.

The job of the undergraduate school at the California Institute is to enroll and to graduate creative people who will also be an influence for good in the communities in which they will eventually settle down. These people cannot be selected exclusively from families which can afford to pay all of the $1600 a year it now takes to attend here if a boy lives in the Student Houses. This figure, which includes personal expenses for clothing, laundry, entertainment, etc., is about a minimum. Nor will the most creative or the best citizens always be found among the top ten or twenty percent academically. A scholarship program so limited that it can care only for those who attain these rarefied heights will miss many a man who, while earning perfectly respectable but not outstanding grades, has profited greatly by engaging in a number of worthwhile extra-curricular activities and has, therefore, also made a valuable contribution to undergraduate life.

In order to select and enroll the best applicants, and to enable many of them to develop properly during their undergraduate years by having time to spend on something besides studying and earning a living, we must have an adequate scholarship endowment. If this endowment is to be of the greatest value, those responsible for scholarship awards must be able to use the income in any way which best fits the current need. In spite of the generosity of many friends our funds are far from adequate at present. It follows then that if we are to keep Caltech at the top of the heap in terms of the quality of its graduates, we must do all we can to increase these funds.

ALUMNI NEWS

Alumni Scholarships

IN SIX YEARS the Caltech alumni, through the Caltech Alumni Fund, have provided the Institute with sufficient funds for the construction of a swimming pool and facilities. We can all take pride in this accomplishment —the raising of over $167,000 for a much needed goal.

As announced previously, the bequest of the late Scott Brown was designated by the Trustees of the Institute for a gymnasium. The combined athletic facility, consisting of the Alumni Pool and the Scott Brown Gymnasium, will be located in Tournament Park. Construction is scheduled to begin early in 1954.

The Alumni Association directors have taken this generous response over the past six years to be an indication of an ability and genuine willingness on the part of the alumni to be of service to Caltech. In the year 1952-53 a total of 1,172 alumni contributed. Considering the relative newness of the Fund, this is a striking demonstration of support. The Caltech Alumni Fund has shown itself to be an instrument for effective and continuing aid on the part of Tech alumni.

Scholarships have been chosen as the next goal. The new objective of the Alumni Fund is the establishment of an endowment to provide for undergraduate scholarships. These will be four-year full-tuition grants, to be known as Alumni Scholarships, and they will be awarded by the Institute on the same basis as the Institute's own scholarships. With the raising of $75,000, four scholarships can be granted, such that each undergraduate class will have one Alumni Scholar.

As Dean Jones points out elsewhere in this issue, the Institute has a real need for scholarship aid. Private educational institutions such as Caltech are experiencing increasing difficulty in finding the financial means needed to maintain a top-notch educational program. In state universities the tuition is very nominal. Hence, for the private schools to attract high-caliber students of limited financial means, the offering of tuition assistance is a requisite, and this places an additional burden on those institutions. The Alumni Fund, in providing for scholarships, is thus capable of giving true service to the Institute and to education.

Those alumni who have been recipients of scholarships in the past can well appreciate the importance of such a program. Alumni Scholarships will be granted only to students who have a definite need for assistance and whose education at Tech would otherwise be impossible or seriously impaired.

While the solicitation for the Fund does not begin until next February, it is possible to take advantage of the expected reduction in 1954 income tax rates by making an early contribution before January 1. Checks should be made to the Caltech Alumni Fund.

—*Robert R. Bennett & A. Allen Ray*
Directors in Charge of the Alumni Fund

PERSONALS

1924

Robert S. Ridgeway, mechanical supervisor of the producing department of the Standard Oil Company of California, is leaving soon for Saudi Arabia to start a new gas injection plant, which is to repressure the oil field in that area. He will be absent about four months on this work and will then have a month's vacation in Egypt, Italy, and other parts of Europe.

1925

Robert H. Dalton, M.S. '26, Ph.D. '28, of the Corning Glass Company, received a John Price Wetherill medal of the Franklin Institute for his discovery, with Dr. S. Donald Stookey, of a revolutionary photosensitive glass process. Born in Christ Church, New Zealand, Bob was a teaching fellow at CIT from 1925 to 1928, and a Ramsay fellow at Oxford University from 1929 to 1930. He's been a research chemist with Corning Glass since 1930, and has been granted two patents in conjunction with the photosensitive glass process.

Paul H. Emmett, Ph.D., senior fellow of the Mellon Institute for Industrial Research, won the 1953 Pittsburgh Award of the American Chemical Society's Pittsburgh Section. Cited for distinguished service to chemistry and to the community as a research scientist, lecturer, educator and inspiration to younger chemists, Paul will receive the award, an engraved bronze plaque, at a dinner in the University Club of Pittsburgh on December 17. He first joined the Mellon Institute staff on a petroleum refining fellowship in 1944. Prior to this he was professor and head of the department of chemical engineering at Johns Hopkins. During World War II he was a division chief in the atom bomb project at Columbia University, and is internationally recognized for his extensive research on the adsorption of gases and on the use of catalysts. The award citation particularly notes his contribution to the now famous Brunauer-Emmett-Teller method for determining surface areas.

1926

Fray Hardwick, M.S. '27, is with National Union Radio in the development and research group in Orange, New Jersey.

1927

Gustaf W. Hammar, Ph.D., is head of a research department at the Eastman Kodak Company in Rochester, New York. After many years as head of the physics department at the University of Idaho, Gustaf joined the Eastman Kodak Company in 1946. His four children are now either married or in college. He says he hasn't had a chance to see Tech since he left in August of 1926.

1929

Duane Roller, Ph.D., has resigned as assistant director of Hughes Research and Development Laboratories to become chairman of the editorial board of the AAAS, and editor of the two journals, *Science* and *Scientific Monthly.*

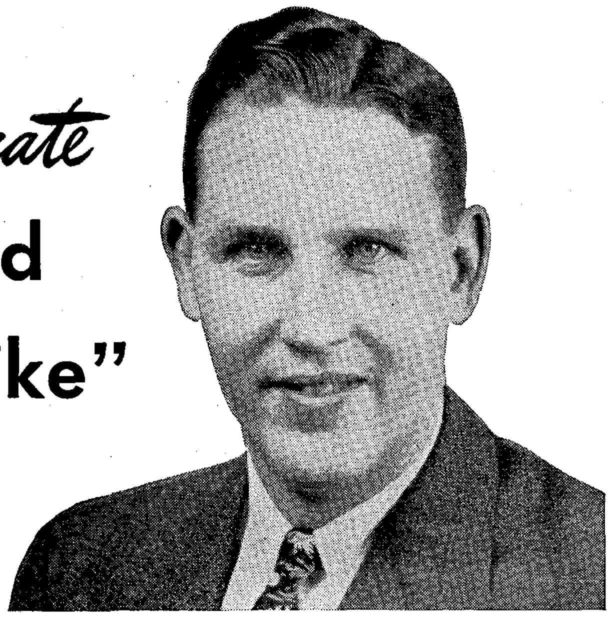
Richard G. Rofelty has been in Japan since April as chief engineer for the Guy F. Atkinson Company. The Company has a contract with the Electric Power Development Company of Japan to furnish technical assistance in the construction of the Sakuma Dam Project, which when completed will be the highest in the Orient.

Roy F. Slocum, M.S., died in Los Angeles on November 2 of a heart infection. Roy became an electrical engineer for Electrical Research Products, Inc. immediately upon graduation and worked there for 22 years. He is survived by his wife, Elna, and four sons: Don, age 20, Jerry, age 17, Melvin, age 14, and Kenny, age 11.

1930

Chester F. Carlson was awarded the Edward Longstreth medal by the Franklin

"Allis-Chalmers Graduate Training Course Helped Me Find the Work I Like"



says HUGH C. SELLS,
Syracuse University, BS—1942
and now Manager, Knoxville District Office

"I guess I was like many graduating engineers. I didn't really know what I wanted to do. When the Allis-Chalmers representative visited the campus, and described their Graduate Training Course, it sounded like the type of postgraduate training I really needed.

"What appealed to me then—and still does—is the broadness of the program. Here is a company filling a unique spot in industry. It makes important, specialized equipment for almost any industry you can name."

Wide Choice of Activity

"It's like a big department store for industry. But that isn't all! In addition, it offers a wide choice of activity within each of these many product groups . . . whether it be sales, design, research or production.

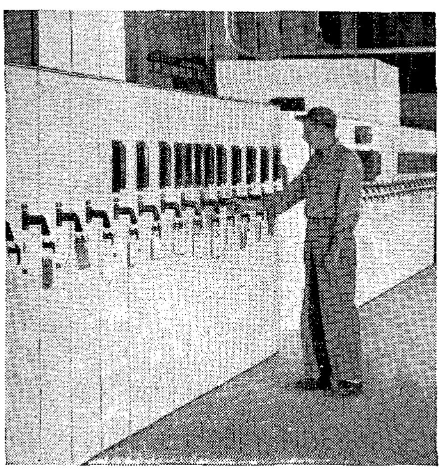
"After getting the broad look at industry the program offers, my interest began centering on Service and Erection of large equipment. This led me into many departments of the company, and I learned about everything from steam turbines to sifters for flour mills."

Valuable Background

"The transition from service to sales was natural. The background of service and erection work proved very valuable.

"So you see, whether you think you know what you want to do or not, the Allis-Chalmers Graduate Training Course is so flexible, so broad in its scope, you have a real chance to find yourself. Best of all, you don't have to waste time doing it."

ELECTRONICS—Modern way to dry sand cores is with Allis-Chalmers *Foundromatic* Sand Core dryer. Revolutionary new process dries cores in minutes instead of hours.



POWER—Neat, compact and safe switchgear installation is big improvement over open framework and knife switches in older installations.

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

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

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

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

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

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

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

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

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Institute, Philadelphia, for the invention of xerography. Chester is consultant to the Haloid Company, Rochester, New York, on his xerography process, which, has enjoyed rapid growth. Haloid, in cooperation with the G. E. X-ray division, is now in the process of introducing xero-radiography for the X-ray inspection of castings.

1931

Robert B. Jacobs, Ph.D. '34, is technical director of the engineering research department of Standard Oil Company of Indiana. Bob's family consists of his wife, Mary Elizabeth, and two sons—Chris, age 11 and Fred, age 7. The Jacobs are building a new home in Homewood, Illinois.

1932

Bryant Fitch has been promoted to director of research at the Dorr Company in Westport, Conn. Bryant joined the Dorr Company in 1946 and became assistant director of research in 1950.

1934

Nephi A. Christiansen, Ph.D. '39, is director of the School of Civil Engineering at Cornell University. He is also continuing as chairman this year of the graduate studies division of the A.S.E.E. and has accepted the chairmanship of the Upper New York Section of the A.S.E.E. for 1953-54.

Cmdr. George W. Van Osdol was recalled to active duty with the Navy in June, 1952, and is now on military leave of absence from Pacific Tel. & Tel. He expects to be back in California by July.

James W. McRae, M.S., Ph.D. '37, is the new president of the Sandia Corporation in Albuquerque, New Mexico. Jim had been with the Bell Telephone Laboratories since 1937, and became director of electronics and television research there in 1947. In 1949 he became director of apparatus development and then director of transmission development. In 1951 he was appointed vice-president in charge of the systems development organization. Jim is also president of the Institute of Radio Engineers for the year 1953. He and his wife have four children: Carol, 14; Beth, 12; Jimmy, 8; and Johnny, 6

1935

Robert M. Stanley, president of Stanley Aviation Corporation in Buffalo, New York, writes that they have just broken ground in Denver for a new manufacturing plant. Located on the Denver airport, the plant will have better than 50,000 square feet of space and will be capable of employing 500 people. Including the Buffalo plant, this will raise Stanley's total manufacturing space to 135,000 square feet.

Glenn Chan, M.S., passed away on August 2, 1953, according to a note received by the Alumni Office from his sister. No further details were given.

Arthur T. Ippen, M.S., Ph.D. '36, recently won the Karl Emil Hilgard Prize for a paper on "Mechanics of Supercritical Flow." Art is professor of hydraulics and in charge of the hydrodynamics laboratory at MIT. He taught at Lehigh University before being appointed an associate professor at MIT in 1945. Widely known for his research and professional activities in the field of fluid mechanics, hydraulic engineering and hydraulic machinery, Art was in charge of the planning for the new hydrodynamics laboratory at MIT, which was dedicated in 1951.

Lind B. Davenport has been elected president of the Southern California Chapter of the American Society of Heating and Ventilating Engineers. This is the only society that owns and operates its own laboratory, located in Cleveland, for research on problems of interest in heating, ventilating and air conditioning. He is also president of the Air Conditioning Supply Company, factory representatives for various companies.

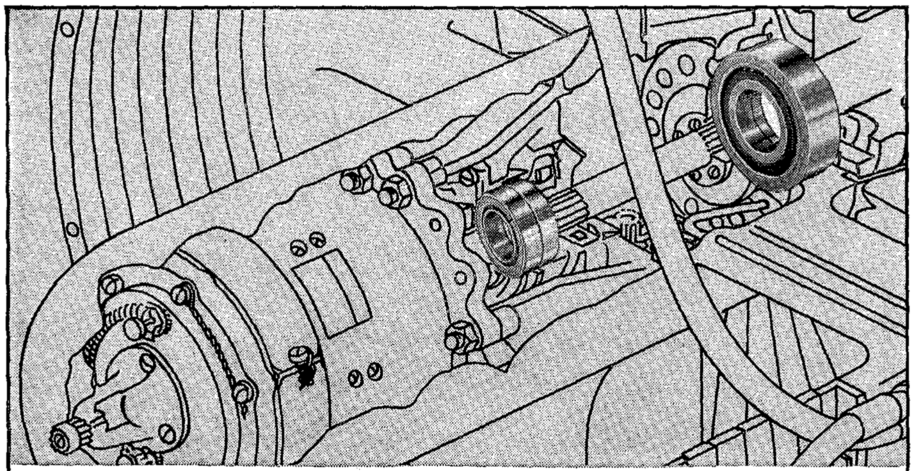
1937

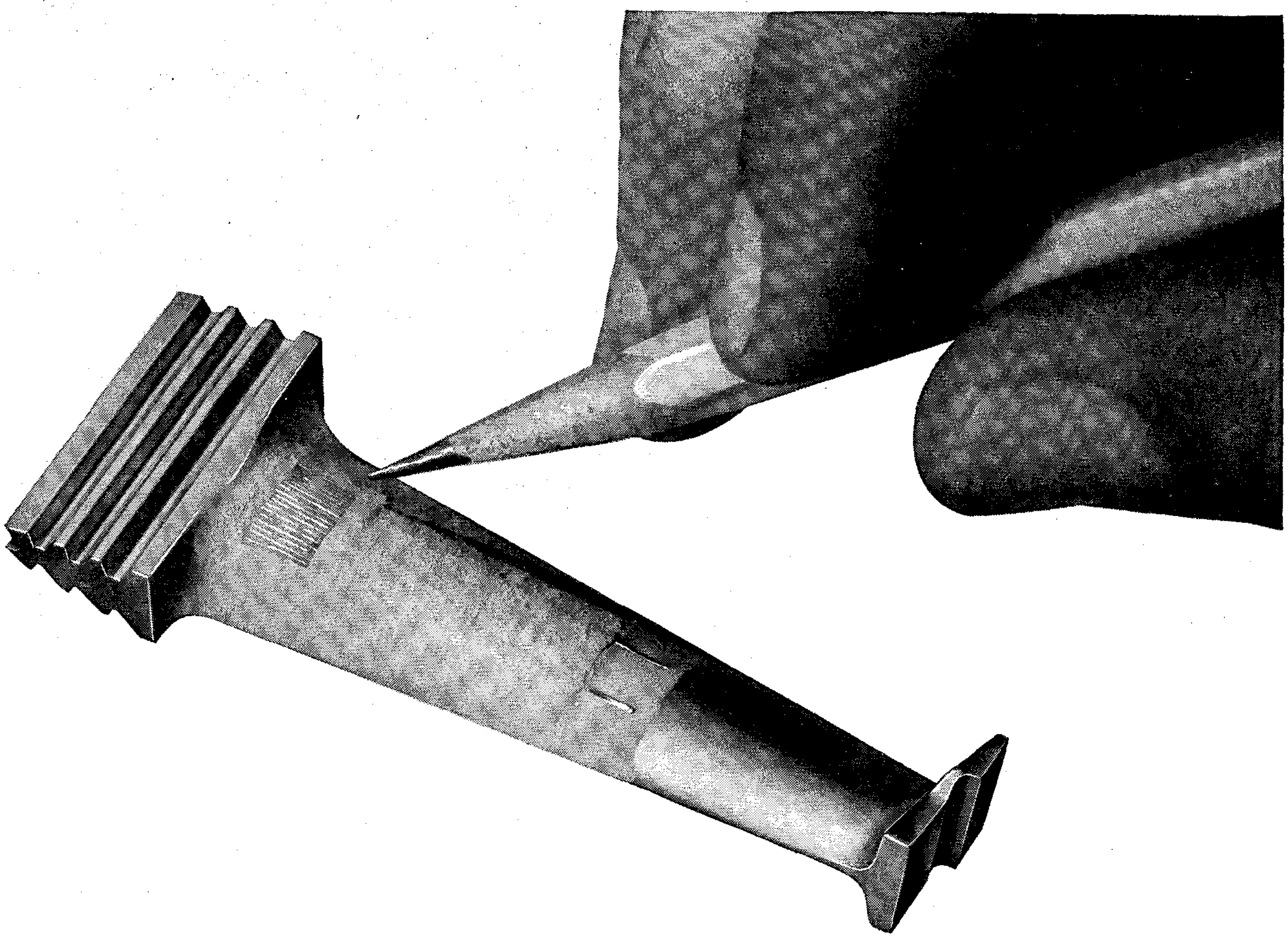
Robert C. McMaster, M.S., Ph.D. '44, formerly supervisor of the Electrical Engineering Division at the Battelle Memorial Institute in Columbus, Ohio, has now been made an Assistant Coordination Director there. One of his first jobs in connection with the new appointment is to serve as Acting Chief of a new division devoted to Information Systems Engineering.

"One of our great hopes," he writes, "is to create a large mechanized technical library, and to provide information service to industry. This library would involve the use of mechanized systems for searching and selecting documents containing information desired by the users. In this connection, we have been pioneering the development of new coding, including the concepts of generic semantic factors, and the development of machines suited for random searching within such factors for the desired literature. We are rapidly building a skilled staff to carry out this development, which we think will eventually be of large proportions."

1938

Bruce C. Elliott is head of the newly-formed Axelson Market Research Department at the Pressed Steel Car Company, Inc. in Los Angeles. Bruce has been with the Axelson Aircraft Sales Division since 1949. In his new position he will be in charge of research activities for aircraft,





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Even at temperatures of 1500° — speeds of 12,000 rpm — this tiny wire grid reports to our engineers on the strains in jet turbine blades. It gives them accurate measurements for calculating stresses caused by resonance and flutter.

This basic information, in turn, permits the design of blades that combine the optimum aerodynamic characteristics with structural integrity.

Strain gages are not new. But our engineers had to advance the art considerably to get readings at these high speeds and temperatures. It required the development of improved cements, instrumentation, slip rings . . . new application techniques and calibration curves.

Nothing can be left to chance in the design of aircraft engines for supersonic flight. Thus we use — and frequently improve on — every advanced technique and engineering tool. This straight-forward approach to engineering problems is one of the reasons many outstanding engineering graduates decide on a career at Pratt & Whitney Aircraft.

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PERSONALS . . . CONTINUED

petroleum equipment, lathe and foundry divisions.

1939

Josiah Smith, M.S. '40, A.E. '48, was married to Eleanor Nagy on September 4. Eleanor was former Supervisor of the Office Services Department at the Cooperative Wind Tunnel, and Josiah is Assistant Director of CWT.

T. R. Matthew was detached from duty as supply officer on the *U.S.S. Sicily* last December when she returned to San Diego from Korea. He is now in charge of the power plant branch, stock control division, of the Aviation Supply Office in Philadelphia. This branch buys and distributes all aircraft-engine and propeller spare parts for the Navy. Tyler and his wife, Virginia, are happily settled in a new home in Moorestown, New Jersey.

Lawrence G. Borgeson, M.S. '40, has been promoted from western area manager of the RCA Service Company, Inc., with offices in Hollywood, to manager of the technical field administration at the company's home office in Camden, New Jersey.

Charles H. Townes, Ph.D., now has four daughters, the last one having been added in the summer of 1952. He's been executive officer of the Columbia University physics department since 1952, and is a deacon of the Riverside Church in New York and a councillor of the New York Academy of Science. Last September he attended the International Conference on Theoretical Physics in Japan.

1940

Leo Brewer, professor of chemistry at the University of California at Berkeley, is due to speak before a meeting of the Metals Branch of the American Institute of Mining and Metallurgical Engineers, Southern California Section, in Los Angeles on December 10. The subject: "Molecular States at 3000° C." Leo has been on the University of California faculty since 1946. From 1943-46 he worked for the Manhattan District project.

Robert L. Wells, M.S., has been appointed assistant manager of engineering for the Aviation Gas Turbine Division of the Westinghouse Electric Corporation in South Philadelphia, Pa. Bob entered the Westinghouse graduate student course in 1940 and joined the Aviation Gas Turbine Division in 1945, where his most recent position was manager of engine design.

1942

Robert J. Clark, M.S. '43, is now in the Washington office of North American Aviation, Inc. He will spend most of his time at the U. S. Navy's Bureau of Aeronautics.

Col. Edward W. Maschmeyer, M.S., professor of air science and tactics of Purdue University ROTC, died November 6 after undergoing surgery for a brain tumor. He was 44. A native of Indianapolis, Ed served as a private pilot to Paul V. McNutt when he was Governor of Indiana, and also served McNutt when he went to the Philippine Islands as High Commissioner. Ed was in the Air Force Reserve and in the regular Air Force during World War II and during the Korean conflict. He is survived by his wife, Frances, and three daughters—Suzanne, Margo and Nancy.

1946

Morton M. Astrahan, M.S., received his Ph.D. from Northwestern in 1949 and has since been employed by I.B.M. on design and construction of digital electronic computers, as a project engineer. He was organizer and first chairman of the IRE Professional Group on Electronic Computers. In September, 1951, he married Joann Schwartz and now has a son, Melvin, born in October, 1952.

1947

Chadwick S. Dauwalter is still employed by North American Aviation in the propulsion section of the aerophysics laboratory, but his current assignment is at the Edwards Air Force Base Experimental Rocket Engine Test Station, where he heads the North American data analysis group.

1948

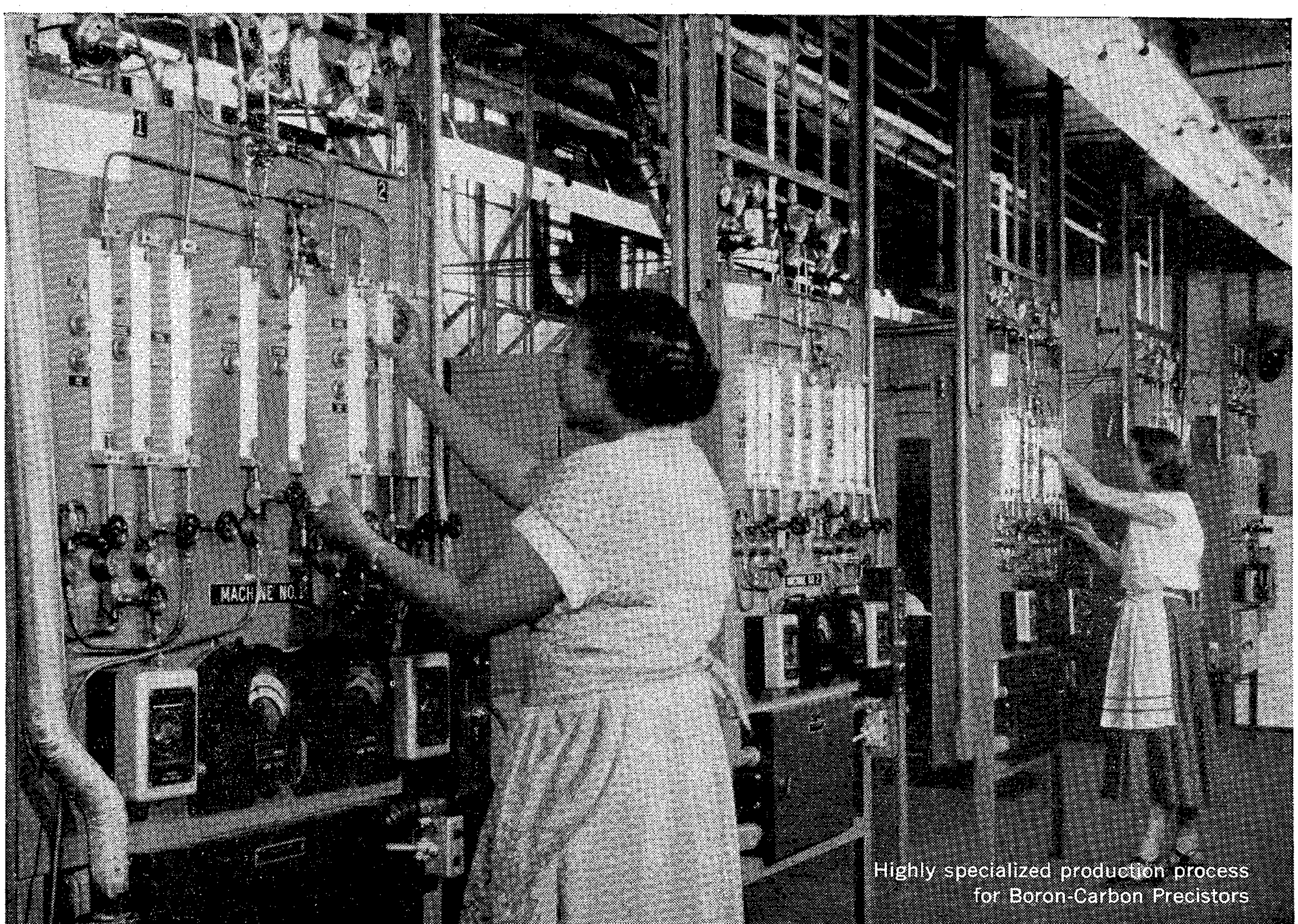
Griffith C. Barlow received his M.D. from the U.S.C. School of Medicine and completed his internship at the L.A. County General Hospital last June. He started his residency in pediatrics at L.A. Children's Hospital in September. Last January, Griffith married Mary Jane Davey of Sierra Madre, who is also an M.D. They're living in Eagle Rock.

William E. Smyth was married last April to Shirley MacDonald of Pelham Manor, N. Y. The Smyths are now living in Mount Vernon, N. Y. Until November, 1952, Bill was a corporal in the Army, with the 4th Mobile Radio Broadcasting Company overseas. He's now employed by the National Broadcasting Company of New York as a TV engineer.

Donald P. Wilkinson is a mechanical engineer with the Propulsion Research Corporation in Inglewood. The Wilkinsons now have two sons—Ronald James, 3 years old, and Robert Donald, born last January.

Frank F. Scheck writes that he, *John Brockman,* Ph.D. '48, and *Bill Harland* '44, relived the atrocities committed in Fleming's Alley 3 over ten years ago, when Bill was in New York on business recently. Their respective wives were quite properly horrified by these revelations of their dark past.

Bill lives in Montreal and is building hydro electric plants; John propagates miraculous bugs for Lederle Labs in Pearl River, New York; and Frank has been in patent law as an associate of Pennie,



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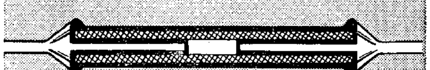

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IRC Filament Type BT Resistors

IRC Type DC Deposited Carbon Resistors

IRC Type MV High Voltage Resistors

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Edmonds, Morton, Barrows and Taylor in New York since finishing Columbia Law School in 1951. Frank mentions seeing *Bruce Worcester* '48 and B. J. when they were in New York recently. He's now at Wright Field working for Hughes.

Donald R. Morrison has joined the training group at Atlas Powder Company's research laboratory in Wilmington, Delaware. Before coming to Atlas, a manufacturer of commercial explosives and industrial chemicals, Don was a chemical engineer with the Union Oil Company of California.

M. Blouke Carus and his wife announced the arrival of a baby boy on June 24. On September 4 they left for Europe to visit his wife's parents and returned to the U. S. on November 1.

William N. Harris, M.S. '50, is now working for E. I. DuPont at its Savannah River Plant in South Carolina.

Herman S. Dichter, M.S., is now working at Bulova Research and Development Laboratories in New York. On December 7, 1952, he married Dolores Goldman of Buffalo, New York.

Robert D. Dalton, Jr., M.S., has gone into partnership with his father in structural engineering in Oakland, Calif.

1950

Alex Stolony, M.S., is studying for his Ph.D. in physics at New York University. He says he's finished all his course and exam requirements, and is now working on a thesis at the Brookhaven National Laboratory at Upton, Long Island, N.Y. It's on neutron cross sections, using the Brookhaven "fast chopper."

1951

Capt. Frederic W. Hartwig, M.S., Engr. '52, is in Walter Reed Hospital, Ward 1, Washington, D.C., recovering from polio.

Robert W. Madden has been working on instrumentation for high-speed aircraft for the past two years at the I.B.M. Vestal Laboratory in Vestal, New York. Since the work is classified, all he can say is that it involves the use of large-scale digital computers to test the validity of analog computer design, and that he finds it very interesting.

Eugene Sevin, M.S., is a research engineer in the structural research section at the Armour Research Foundation in Chicago, Illinois. Gene was married in June, 1951, and has a daughter, born last May.

1952

Paul D. Arthur, Ph.D., and his wife, Mary Alice, will be in Baghdad, Iraq, for the 1953-54 school term. Paul received a Fulbright Award and is with the U. S. Educational Foundation as an engineering instructor. Since last April the Arthurs have been in England, France, Switzerland, Belgium, Holland, Luxembourg, Yugoslavia, Austria, Italy, Greece, Turkey, Syria, Lebanon and Iraq.

1953

Carl A. Rambow received the national Daniel W. Mead prize for 1953 for his essay on engineering ethics, written during his senior year at Caltech. The prize is awarded annually to a member of one of the 133 student chapters of the A.S.C.E. and consists of a certificate and a $25 cash award. Carl is now serving in the U. S. Navy.

Al Haber, working for his M.S. in biology at the University of Wisconsin, writes that "the University is really a paradise—except for the fact that grad students have to work as hard here as they do at Tech."

Lt. Col. Benton Elliott, Engr., is at present the Marine Corps guided missile liaison officer at White Sands Proving Ground in New Mexico.

scale, the technical difficulties, and the monetary cost of the project have been underestimated by perhaps an order of magnitude.

They agree that in the natural course of events space flight will be attempted but that some motivation other than scholarly curiosity will be needed to accomplish it in the brief period of a decade or two. In this respect space travel differs from the development of the A-bomb, which was motivated by no less than the desire for survival.

This reviewer enjoyed the book and felt a strong sense of identification and "escape" while reading it. It should certainly turn a profit for its publisher. However, though most of what it says is correct, or at least possible, what is left unsaid is also important. For example, on page 54, a discussion as to how a ship could return to its orbital base in the event of a guidance failure on takeoff glosses over a multitude of difficulties and has a certain fairy-tale atmosphere of unreality. This same attitude of dedicated optimism permeates much of the book. It is not likely, however, that such a carefully written and stimulating book will in the long run do anything but good for the cause of rocketry.

ATOMIC WEAPONS IN LAND COMBAT
by Col. G. C. Reinhardt and Lt. Col. W. R. Kintner
Military Publishing Co., Harrisburg, Pa. $3.95

Reviewed by George K. Tanham
Assistant Professor of History

Atomic Weapons in Land Combat, the first book to appear on tactics for ground forces armed with atomic weapons, is full of new tactics for the land forces.

The authors feel that atomic weapons, while extremely powerful, and thus part of the natural technological development from the simple rifle, are in no sense absolute weapons.

The key to their use, as they see it, is pithily stated: "No stockpile (in the near future) can stand the drain of attempting to destroy a major foe with unexploited explosions."

For use on the offense, they feel it is best to hit the enemy at his strongest point because of the great destructive power of atomic weapons, and then at once rush exploiting troops through the breach.

In the defense, the commander must by some means make the enemy mass, without concentrating his own forces too much, then use his atomic weapons, and finally, in an active and mobile defense, exploit the weakness created.

The need for better trained troops who have had intensive instruction on the effects of atomic explosions and careful psychological preparation is rightly stressed. The colonels state: "A division unprepared for an atomic blast could be rendered unfit for combat for months by a strike which would not cripple a well-trained division."

The final chapter considers the difficulties of command in an atomic war, but also ranges over a variety of other subjects. It does stress some stark facts which—atomic weapons or no—the United States must recognize; that we cannot afford the "logistical prolificacy" we enjoyed in World War II and that, being numerically inferior, we will have greater manpower problems than ever faced before.

In this book the authors merely explore the possibilities of the use of atomic weapons on land and warn where the dangers lie in conducting warfare along conventional lines. This approach is understandable, but the development of more positive and constructive ideas would have started more thinking about the necessary tactics, which is what the authors hoped for. The book is, however, a helpful antidote to the idea that atomic weapons are absolute weapons, and a good starting point for a discussion of tactics in an atomic war.

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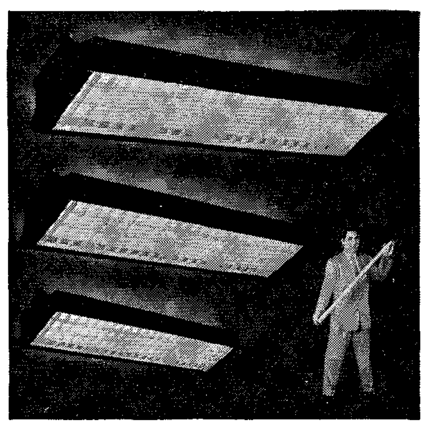

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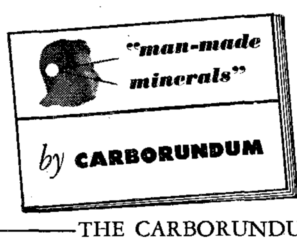

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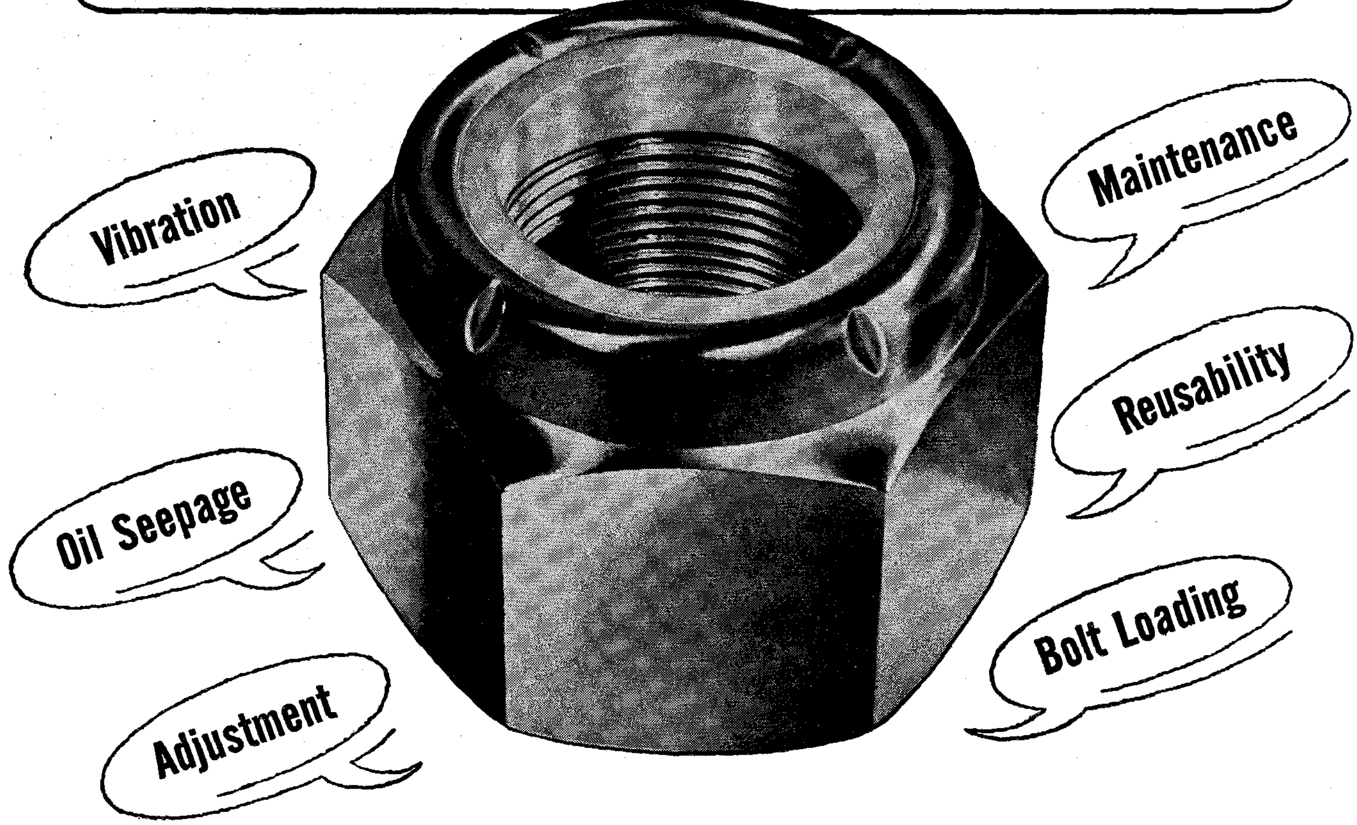

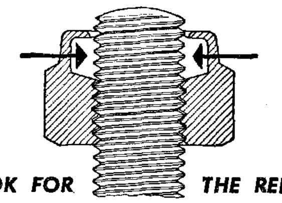

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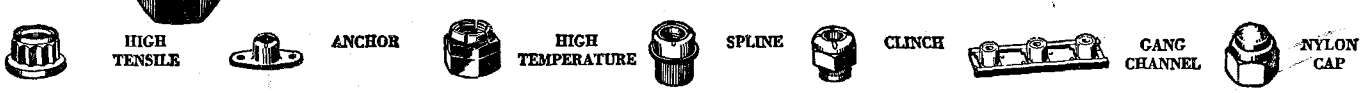

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CALTECH CALENDAR

December, 1953

ALUMNI ACTIVITIES

January 13	Dinner Meeting
February 6	Dinner Dance Oakmont Country Club
March 17	Dinner Meeting
April 3	Alumni Seminar Day
June 9	Annual Meeting
June 26	Annual Picnic

CALTECH ATHLETIC SCHEDULE

BASKETBALL

December 3, 4, 5
Redlands Tournament

December 11, 7:30 p.m.
Occidental at Glendale High

January 9, 8:00 p.m.
Cal Poly at Covina High

CROSS COUNTRY

December 5, 10:00 a.m.
Conference at Caltech

SOCCER

December 5, 2:00 p.m.
UCLA at UCLA

DEMONSTRATION LECTURES

Friday Evenings
7:30 p.m.—201 Bridge

Dec. 4—"New Devices and Modern Concepts in Very High Frequency Electricity," by Professor Lester M. Field

Dec. 11—"Opinions of Employees and Management," by Professor Robert D. Gray

DINNER MEETING

Caltech
Alumni Association

January 13, 1954

Carolina Pines
Restaurant
7315 Melrose Ave.
Los Angeles

Social Hour—6:00
Dinner—6:30
Cost—$3.25

Speakers:

Mr. Frank Rush—
"Conditions in Austria and Europe Behind the Iron Curtain"

Dr. John Weir—
"The Alumni Survey"

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