ENGINEERING AND SCIENCE

OCTOBER / 1950

Engineering Building . . . page 17

PUBLISHED AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

Compact industrial television system—developed at RCA Laboratories—lets us see the unseeable in safety!

Eye-witness reports from a fiery furnace!

Something's gone wrong in a big blast furnace, and heat is too high for engineers to approach. Focus the Vidicon camera of an RCA Industrial Television System on the flames and the fiery furnace can be studied in comfort on a television receiver.

This is only one suggested use, for RCA's compact industrial television system is as flexible as its user's ingenuity. "Eye" of the tiny camera—small enough to be held in one hand—is the sensitive Vidicon tube. The only other equipment needed is the Vidicon camera's suitcase-size control cabinet, which operates anywhere on ordinary household current.

The Vidicon camera could be lowered under water where divers might be endangered—or stand watch on atomic reactions, secure from radiations. And it is practical to arrange the RCA Industrial Television system so that observers can see a *3-dimensional picture* . . . real as life!

* * *

See the latest wonders of radio, television, and electronics in action at RCA Exhibition Hall, 36 West 49th St., N. Y. Admission is free. Radio Corporation of America, Radio City, New York.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey. **Also many opportunities for Mechanical and Chemical Engineers and Physicists.**

RADIO CORPORATION of AMERICA

World Leader in Radio — First in Television

Photo by USAF Air Materiel Command

Glass face that can take a bath of fire

The man you see here can wade into the hottest part of a gasoline or oil fire and stay to put it out.

He is wearing the latest in fire-fighting dress, developed by the Engineering Division Laboratories at Wright-Patterson Air Force Base, in Dayton, Ohio.

Designing the suit—to protect the wearer against heat up to 2000° Fahrenheit—was a tough enough problem for Air Force scientists. But once they had solved this by using layers of glass fabric, nylon, and metal foil, the problem presented by the visor for the fire-fighting suit was yet to be worked out.

Was there a material transparent enough to let the fire fighter see, yet fire-resistant and fire-repellent enough to let him face up to a 2000° Fahrenheit blaze?

That question was put to Corning Glass Works, and the answer was a fire fighter's face made of Corning's Vycor Brand 96% silica glass.

Two thin panels of 96% silica glass—the Corning glass that can be heated till it glows and then plunged into ice water without breaking—are used to make the visor. And their inner surfaces are coated with thin, transparent films of gold.

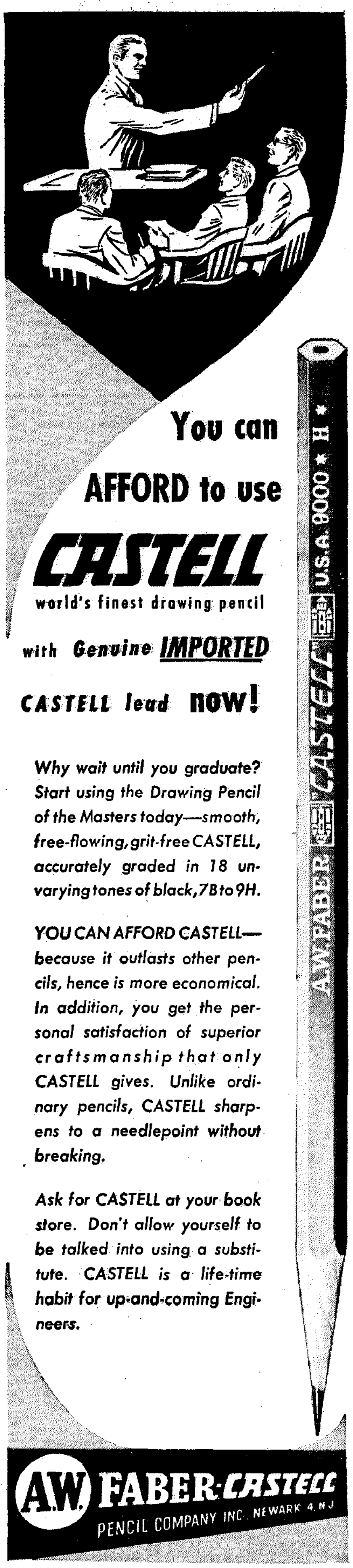
This glass transmits cool, visible light, allowing the fire fighter to see. The gold film blocks the hot, invisible rays by reflecting them outward. A small dead-air space between the glass panels prevents conduction of heat through the glass from the hot, burning gases.

We hope this special use for Corning's 96% silica glass will remind you that today—because of Corning research—you can use glass in many ways that you may never have thought of before.

Throughout industry, Corning means research in glass—research which has made glass a material of practically limitless uses. That's a good thing to remember when you've finished college and started working. Then, as you plan new products or processes, we invite you to call on Corning before the blueprint stage. *Corning Glass Works, Corning, New York.*

CORNING

means research in glass



BOOKS

THE WATER SEEKERS
by Remi A. Nadeau
Doubleday, N.Y., $3.00

Reviewed by Franklin Thomas
Professor of Civil Engineering

FORTUNATELY THERE ARE deliberative agencies and courts which have jurisdiction over rights to water in the arid West. Controversies over where limited quantities of water shall be used and by whom become very acute.

Mr. Remi A. Nadeau, fifth generation descendant of an early Californian, graduate of Stanford, and a resident of Santa Monica, has produced a fascinating narrative of crucial events and plans which have largely determined the destiny of important areas in the Southwest. The author recounts the activities of individuals and happenings related to the origin and consummation of the Owens River Aqueduct and the various projects using Colorado River water to exemplify the tensions and conflicting interests which arise.

The book is an important and factual record based upon very extensive research covering an extensive bibliography which the author lists as an additional benefit for his readers.

Anyone who spends time interestingly in a perusal of this book will have increased appreciation for the water which flows freely for his comfort and convenience.

THE PHILOSOPHY OF MATHEMATICS
by Edward A. Maziarz, C.P.P.S., M.S., Ph.D.
Philosophical Library, N.Y., $6.00

Reviewed by E. T. Bell
Professor of Mathematics

FOR ABOUT 2400 YEARS philosophers from Pythagoras to Kant tried to tell mathematicians what mathematics is really about. Then, in 1854, George Boole published his *Laws of Thought*, the effective beginning of symbolic logic. By 1895, with the work of the Italian School of symbolic logic, it at last became possible to state the basic problems of the so-called philosophy of mathematics in a clear and unambiguous form. In the succeeding half century the English, German, and American schools of symbolic logic created subtle and penetrating techniques for investigating the foundations of mathematics. The outcome was a vast literature that no philosopher could understand.

In an endeavor to bring the mathematicians and the philosophers within shouting distance of one another, Dr. Maziarz proposes in Part II of his book a return to pure metaphysics as practiced in the Middle Ages. Part I is a summary, with hundreds of references and excerpts wrenched from their contexts, of the efforts of mathematicians to understand their subject. To the reviewer it seems that the summary is slanted toward the author's scholastic bias evident in Part II. The mathematician who hopes for illumination from this part will have to understand numerous passages such as the following on page 195: "Quantity is analogously divided by metaphysicians into transcendental and predicamental. They point out that *transcendental* quantity, a field of metaphysical inquiry, is used to signify the amount of perfection or entiative being which a thing possesses. (The author here refers to Saint Thomas Aquinas, *In V Metaphysicorum*, Lect. 15, nn. 954-976.) The being of a giraffe, for example, is intrinsically greater than the being of a stone. Transcendental quantity, as based on the substantial or accidental perfection of a being—on its amount or plenitude of perfection—is spoken of as virtual quantity, while that based on a consideration of a plurality of such things is spoken of as transcendental quantity or transcendental number."

Not having a copy of the *Metaphysicorum* at hand, the reviewer is predicamentally unable at the moment to decide whether pi (3.1415926...) is a transcendental number or a giraffe.

INTERNAL BALLISTICS OF SOLID-FUEL ROCKETS
by R. N. Wimpress
McGraw-Hill, N.Y., $4.50

FIRST OF A TWO-VOLUME series on rockets from the California Institute of Technology, this book carries the subtitle: Military Rockets Using Dry-Processed Double-Base Propellant As Fuel. It has been compiled by R. N. Wimpress, now associated with Industrial Engineers, Inc., and a former member of the Propellants Group of the rocket development organization working under Contract

CONTINUED ON PAGE 4

BIGNESS

COMES IN HANDY!

In Peace — In War!

ON December 7, 1941, the Japs launched their "surprise attack" on Pearl Harbor . . .

On June 25, 1950, the Reds launched *theirs* on South Korea . . .

And today, as in 1941, 1942 and 1943, it is the enemy's turn to be surprised—

At the ready strength of our competitive free-enterprise industries . . . at the speed of *their productive mobilization!*

Socony-Vacuum, one of America's big companies, geared to peacetime competition under the U. S. business system, has been steadily growing stronger —looking ahead, plowing back—building for future needs.

And today in Petroleum this bigness is coming in "handy"—*vitally* handy as our nation goes on a war footing.

For example, Socony-Vacuum's worldwide producing facilities have more than doubled—and refining capacity has increased nearly 50% since 1942—big build-up year of World War II.

Today, Socony-Vacuum has pledged its all-out efforts to meet our military and civilian needs. We believe the free system which has enabled us to become a big company, which makes our nation the greatest in the world—is worth serving and protecting to the limit of our resources and abilities.

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SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:

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SOCONY-VACUUM

BIGNESS SERVES AMERICA—PROTECTS AMERICA!

BOOKS CONTINUED FROM PAGE 2

OEMsr-418 between the California Institute and the Office of Scientific Research and Development.

The material presented here is based almost entirely upon the activities of the group who worked with rockets at Caltech during 1941-45, and Dr. Bruce H. Sage, Professor of Chemical Engineering at the Institute, and one of the supervisors of the Propellants Group, contributes an introduction to the volume which points up the achievements of some of the Institute personnel who worked on the project.

The information in this book has been available up to now only in unpublished reports.

VIRUSES 1950
Edited by M. Delbruck

Division of Biology, California Institute of Technology, $2.50

VIRUSES 1950 consists of the proceedings of the conference held at the Institute last spring (E & S, April '50), which brought together for the first time scientists working on the three great groups of viruses—those which attack animals, plants and bacteria. The book has been edited by Dr. Max Delbruck, Professor of Biology at the Institute, who warns readers in a foreword not to expect to find a comprehensive coverage of all virus problems here. He does not add, however, that this is as close to a comprehensive coverage of virus problems as any interested reader will yet find — and as such, invaluable.

SECRET
by Michael Amrine
Houghton Mifflin, Boston, $3.00

Reviewed by E. T. Bell
Professor of Mathematics

MANY READERS OF THIS MAGAZINE will be personally familiar with one phase or another of the situation Amrine describes in his novel. The hero, Halverson, a specialist in the applications of radiation to cancer, early got sucked into the atomic bomb project. When the war ended he returned to his own research, only to become embroiled in the futile attempt to get atomic energy under civilian control.

Amrine knows what he is talking about here, as he was publications director of the Federation of American Scientists. If he himself did not provide a Roman holiday for the Senate committee, he evidently knew somebody who did. Likewise for Halverson's tangles with the military and the F.B.I. Finally, under various pressures, moral and otherwise, Halverson is sucked in again, this time for army research on a Super-killer. There the story leaves him, with both feet in the quicksands from which there is no escape.

It is clear that Amrine does not particularly care for colonels, generals, senators, and F.B.I. agents in their relations with science. This goes for some others, too. Even our benign eldest statesman is dismissed as one of "the grand and archaic Baruchs". But it was rather unkind to include Senator Rankin in the same sentence.

Readers looking for salvation will ask what is to be done about the situation if we don't like it. What does a pint-sized wrestler do when three hundred pounds of solid meat is sitting on his head?

ENGINEERING AND SCIENCE

IN THIS ISSUE

ON THE COVER

On the cover this month is a night shot of the newest building on campus—the Engineering Building, which adjoins the M.E. Building and faces the Aeronautics Building. It will probably have its formal dedication sometime in November; meanwhile, you'll find some details about it on page 19.

RADIOISOTOPES

Jerome Kohl, author of "Radioisotopes in Industry," which appears on page 7 of this issue, received his B.S. from Caltech in 1940. He's now a Chemical Engineer with Tracerlab, Inc. in Berkeley — which means he's in a good position to know about new uses of radioisotopes in industry, engineering and agriculture. You'll find some of this information in his comprehensive article.

Incidentally, Mr. Kohl sent in an A-1 bibliography for this article, which we weren't able to include in this issue. We have copies of the bibliography here in the office though. If you want one, give us a call or send us a card and we'll get it off to you promptly.

Continued on page 6

PICTURE CREDITS

Cover	Wm. V. Wright
p. 6	Wm. V. Wright
p. 10	Cal-Pictures
pps. 12-14	Wm. V. Wright
p. 17 (bottom)	L. A. County Museum
p. 18	Wm. V. Wright
p. 24	Maurice Terrell for Flair

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CONTENTS

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The Main Line

OCTOBER, 1950

A poet, name of Carman (appropriate for this railroad column, no?), once observed that October is a month that sets the gypsy blood astir. As far as we're concerned, that's all the justification needed for hying away on a fall vacation... via Southern Pacific, naturally.

However, if you find yourself in need of "convincers" for someone of dully practical turn of mind, consider this quartet of reasons:

I. BEAUTY. Indian summer is the most delightful time of year along Southern Pacific lines all over the West. In the Sierra, leaves are turning to magnificent colors. On the coast, the ocean is still warm for swimming. In the valleys, the frost may be on the pumpkin at night, but there is laziness in the sunlit air all day.

II. ECONOMY. It isn't peak *winter* vacation season yet in places like Arizona's resort country—and the other romantic stretches of the Southwest along S.P.'s Sunset Route. The climate in the fall is mild and balmy. The summer heat is over. So go before the rush. Many resorts and guest ranches offer reduced rates for the next couple of months. Also, as it is past the *summer* season, you stand a good chance to get a special rate at summer resorts all over the West, too. Fall's the time for economy... but time is fleeting.

III. COMFORT. This time of year, you have more elbowroom in which to relax, and there is just as much (or even more) of nature to enjoy.

IV. RESERVATIONS. With the crush of summer vacation over, not only are resort and hotel accommodations more available, but your choice of space on our finest, fastest trains is also greater.

And... one final thing to keep in mind (as if we've given you the slightest chance to forget it during these past few months)...

S.P. has just added two new, sleek, smart streamliners to the family: the new Los Angeles-New Orleans *Sunset Limited,* and the new San Francisco-Portland overnight *Cascade.*

With the inauguration of these two trains—just a week apart, back in August—we climaxed a gigantic $35,000,000 passenger equipment modernization program that was set up even before the end of the war. Little by little, we've built up our fleet of speedliners ... new cars for the *City of San Francisco* and the *Overland,* a whole new *Golden State,* a brand-new *Shasta Daylight,* a new *Cascade,* a new *Sunset.* East or West on S.P. lines, you can go by streamliner... and you can see the whole Pacific Coast by our low-cost streamlined Daylights: two California *Daylights* between Los Angeles and San Francisco, and the *Shasta Daylight,* between San Francisco and Portland.

So now, whichever way your fancy takes you, there's an S.P. route with fine streamlined trains to speed you on your way. This year, make Indian summer a memorable one: go places... and go S.P.

Now, to another timely subject: namely, football. A peek at the Pacific Coast collegiate pigskin schedule reveals the following: November 4, Southern California plays Stanford at Palo Alto; November 11, U.C.L.A. plays California at Berkeley. So—with small fear of contradiction—we predict that hordes of Trojans and Bruins will be San Francisco-bound on those up-coming, successive week ends.

The punishment some people take on such week ends—needlessly—passeth understanding. They drive 400-odd miles non-stop, overturn San Francisco, then drive all the way back—arriving home looking and feeling like a fraternity pledge class at the end of an "informal initiation."

That's why, as alumni advisors, we say "Next Time, Try the Train"... relax, take it easy, let the engineer drive you.

S•P the friendly Southern Pacific

IN THIS ISSUE CONTINUED

Otto

MR. BONES

With the short article on page 18 about the life and hard work of Bill Otto, Sculptor and Preparator in the Geology Division, E & S begins what we hope will be a continuing series on the people who make up Caltech. In fact the only thing that can now stop this from being a continuing series is your boredom. Just let us know if this sets in.

CORONA

Of all the pictures we were sorry we couldn't crowd into the spread on the Marine Lab on pages 12 to 14, the one we were sorriest about is crowded in below—it's Dr. Beadle, head of the Division of Biology, with *his* collection of marine specimens.

Beadle

RADIOISOTOPES IN INDUSTRY

Radioisotopes have already revolutionized research in the biological sciences. Now they threaten to do the same in industry

by *JEROME KOHL*

TODAY, ONLY FOUR YEARS AFTER the first shipment of pile-produced radioactive materials from the Oak Ridge Laboratory of the Atomic Energy Commission, some 12,000 shipments of radioactive isotopes have gone out to more than 750 government, private and industrial laboratories for use in peacetime research.

More than 450 shipments of radioisotopes leave the Oak Ridge Laboratory each month. They go to all the countries of the world, for use in all the major fields of scientific investigation, and for applications in medicine, agriculture and industry as well.

The British physicist Frederick Soddy, in 1910, first applied the term isotope—from the Greek *isos* (same) and *topos* (place)—to substances with different atomic weights which nevertheless had identical chemical properties and occupied the same place in the periodic table of elements.

For example, carbon, as found naturally, consists of two isotopes of atomic weights of 12 and 13. Carbon-12 is stable and comprises 98.9% of all natural carbon. Carbon-13 is also stable and comprises the remaining 1.1%. Besides these two naturally occurring stable isotopes, radioisotopes of carbon can be produced with atomic weights of 10, 11, and 14. Carbon-10 has a half-life of 20 seconds (in other words, half the radioactive atoms will have disintegrated in that length of time). It emits a positron and becomes boron-10. Carbon-11 has a half-life of 20.5 minutes. It becomes boron-11 after emitting a positron. And the carbon-14, with a half-life of 5,100 years, forms nitrogen-14 with the emission of a beta particle.

Radioisotopes are useful because, while exhibiting the same chemical behavior as the stable isotopes of the same atomic number, they can be differentiated and located by their emitted radiation. In studying compounds formed during photosynthesis, for instance, carbon dioxide containing the radioactive carbon-14 is fed to plants. Products formed at varying times after introduction of the radioactive carbon dioxide are determined by analysis of the plant structure. Presence of the radioactive carbon-14 in any particular compound provides proof that it was formed from the radioactive carbon-14 and in the period following its administration.

Since radiations from individual atoms can be measured, radioisotopes make possible the detection of minute quantities of materials. For example, in friction tests, use of an activated sample permits determining the amount of metal transferred, even though this metal weighs under 10^{-10} grams. Radioactive sodium has been detected in amounts below 4×10^{-19} grams.

The radiations emitted by radioisotopes are in some cases extremely pentrating. Thus the tagged compound or object can be located at a distance or even through a steel wall. A burrowing animal, tagged with a small capsule containing a radioisotope of zinc or cobalt, can be followed as it moves beneath the ground. Go-devils, which are used for cleaning pipelines, can be tagged with a radioisotope permitting their location through the pipe wall.

Radioisotopes are also useful as sources of radiation. The alpha particles emitted by radioisotopes such as bismuth-210, ionize air and can be used for static dissipation. Beta particles, such as are emitted by strontium-90, are used in thickness gauges; in this application, the attenuation of these beta particles by the material to be measured provides an indication of its weight per unit area. Gamma rays, such as are emitted by cobalt-60, are used for treatment of cancer and for industrial radiography.

Progress in the use of radioisotopes was slow until the chain-reacting piles were constructed during the recent war. For workers in the 1920's only the naturally occurring radioisotopes were available.

The development of the cyclotron in the mid-30's made it possible to produce radioisotopes of many of the elements—but at enormous expense and on an infinitesimal scale. The uranium chain-reactors, since the war, have increased the available supply of radioisotopes by a factor of several thousand over those available from natural sources, cyclotrons and other accelerators. They have also greatly reduced the cost of radioactive materials. A single millicurie of carbon-14 produced in a cyclotron would cost $1,000,000; the same amount produced in the Oak Ridge Reactor is sold for $50.

There are now more than 700 known radioisotopes. More than 100 of these are available from the United States Atomic Energy Commission. But most of the interest and the applications have centered on the nine elements listed in the table below.

Pile Production of Radioisotopes

In a pile, radioisotopes are produced by two basic phenomena: (1) the fission of the uranium fuel; and (2) the absorption of neutrons by non-fissionable elements.

When uranium fissions, it breaks into radioactive fragments called fission products. These products range in atomic number from element-30 to element-64. In processing fuel that has been removed from the reactor, certain of the fission products are recovered either as elements or in groups.

While nuclear fission results in the production of many radioactive elements, the neutron capture reaction is the principal isotope producer. Normally, in the Oak Ridge pile, target materials for the capture reaction are inserted in ¾"-diameter x 3" long aluminum cylinders. These cylinders are then placed in a graphite block or "stringer," which is pushed into the interior of the pile and irradiated by neutrons for a given period. The target material can comprise an element or compound or even a fabricated article, such as a piston ring or corrosion specimen. When a fabricated article is irradiated, the activity is produced directly within the article. This makes the production of equipment or specimens from radioactive components unnecessary.

In the neutron capture or (n,gamma) reaction, a neutron is absorbed by a target atom and a gamma photon is emitted. This reaction produces radioisotopes which are isotopic with the target element. Thus, irradiation of stable sodium-23 results in the production by the (n,gamma) reaction of radioactive sodium-24.

Less common neutron absorption reactions are the transmutation reactions, such as the (n,proton) or (n,alpha). In the first of these, a neutron is absorbed by a target atom and a proton ejected. In the second, a neutron is absorbed and an alpha particle ejected. Both of these transmutation reactions result in the production of radioisotopes which are chemically different from the target atoms. In this case, the radioactive atoms can be separated as a carrier-free product. The (n,p) reaction in the pile results in good yields of carbon-14, phosphorus-32, and sulfur-35, and small yields of iron-59. The (n,alpha) reaction produces hydrogen-3 and argon-37.

The Atomic Energy Commission has set up certain prerequisites for the procurement of radioisotopes. The

COMMONLY USED RADIOISOTOPES

Isotope	No. of Shipments from Oak Ridge to 6-30-50	Half-Life		Energy of Emitted Radiation in MEV		Cost of Minimum Shipment
				Beta	Gamma	
IODINE-131	4,224	8	Days	.595 .687	.367 .080	$1.00/MC carrier free
PHOSPHORUS-32	3,810	14.3	Days	1.70	..	$1.10/MC C.F.
SODIUM-24	600	14.3	Hours	1.4	1.4	$12.00/15 MC
CARBON-14	586	5100	Years	0.15	..	$36.00/MC
SULFUR-35	270	87.1	Days	0.17	..	$2.40/MC as H_2SO_4 $6.00/MC as BaS
CALCIUM-45	192	180	Days	.25	..	$33.00/3.0 MC
POTASSIUM-42	195	12.4	Hours	2.0 3.6	1.4, 2.1 1.5	$12.00/125 MC
COBALT-60	183	5.3	Years	.3	1.16 1.30	$50.00/1st CURIE $5.00/Add'l CURIE
IRON-59	165	46.3	Days	.26 .46	1.1 1.3	$33.00/MC

NOTES: (1) MC = Millicurie. In this table defined as 3.7×10^7 disintegrations per second.
(2) Carrier Free = Represents pure radioisotope not diluted with stable isotope of the same chemical species.
(3) A handling charge of $10.00 is made for each shipment.

first, which covers equipment, requires that isotope users have available suitable counting and monitoring equipment, such as:

1 Scaler with Register and Timer	\$450 to \$750
1 Tube Mount	25 to 200
2 G-M Tubes	50 to 200
Calibrated Source	25 to 50
1 Laboratory Monitor (G-M Tube)	250 to 400
1 Portable Radiation Survey Meter (Ionization Chamber)	250 to 650
Lead Bricks and Containers	200 to 300
Minometers, Film Badges, Planchets	150 to 250
	\$1400 to \$2800

The second prerequisite covers training of technical personnel. The Atomic Energy Commission requires that a recipient of radioactive materials have obtained training and experience in their use in a laboratory employing radioisotopes, or have associated with him an individual so experienced. This training can be secured at the Oak Ridge Institute of Nuclear Studies in a 4-week training course, or by an intensive course at one of the commercial radiochemical laboratories.

Medical Applications

Medical workers have been in the forefront in using this new research tool—and 38% of the 1850 applications listed in the AEC's Summary of Isotope Distributions cover applications pertaining to medicine and biology.

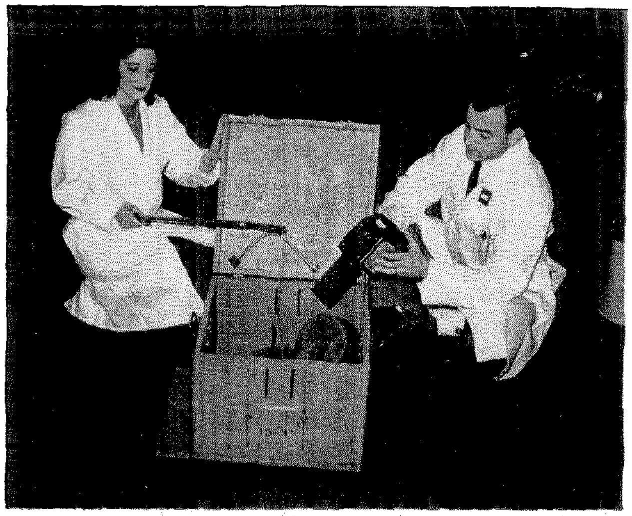
Phosphorus-32 is used to define brain tumors, utilizing the discovery that radioactive phosphorus concentrates in brain tumors in a ratio of 5 to 100 times the concentration in normal brain tissue. Iron-59 has been used to trace the distribution of iron through the organs and bodies of anemic rats in a fundamental attack on the causes of anemia. Iodine-131 is used in the treatment of certain thyroid disorders. Cobalt-60 is being used widely in place of radium for the treatment of cancer.

Industrial Applications

Industrial and engineering applications of radioisotopes are steadily increasing. The following examples cover some typical uses by industry and agriculture.

The feasibility of detecting radiation at a distance from the source has resulted in a number of interesting applications. At Cornell University D. R. Griffin, Professor of Zoology, has used radioactive materials in homing experiments with wild birds. The technique is to catch a bird at its nest, fasten a small capsule containing from 1 to 10 microcuries of zinc-65 to its leg (not enough to harm the bird), carry the bird a known distance from its nest, and release it. A radiation detection instrument hooked up to a clock or strip-chart recorder indicates the proximity of the bird and its time of arrival at the nest.

The Apis Engineering Company has used a similar technique for a different problem. It has tagged queen bees so as to cause the queen to operate swarming alarms. Activation of the alarm closes the hive exits and warns the bee-keeper. He can then guide the bees to a new hive.



Monitoring a shipment of barium-140 from Oak Ridge

The Physical Research Division of the Eli Lilly Company of Indianapolis, Indiana, reports that it is planning to tag ground moles with small quantities of radiocobalt in order to find out where they burrow, the distances they travel, and their general movement habits.

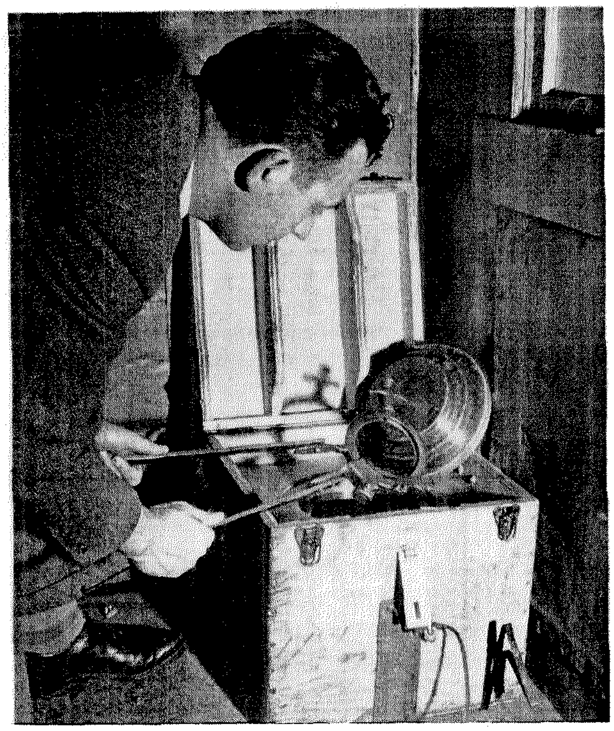
The feasibility of detecting very small quantities of a radioisotope makes it an ideal tool for cleansing action studies. J. C. Harris, R. E. Kamp, and W. N. Yanko incorporated carbon-14 in N,N-di-n-butyl stearamide, which is soluble in hydrocarbon oils. Test pans were dipped in oil containing the active compound and were then cleaned with various solvents, detergents, and rinses. The quantity of "soil" adhering to the metal following the cleaning cycle was determined by counting with a Geiger counter.

Calibration of the technique was obtained by counting a weighed amount of oil applied to a metal panel. The use of radioactive carbon permitted determination of quantities of "soil" below 2×10^{-7} grams per sq. cm., as compared with a maximum usual sensitivity by the gravimetric technique of 1×10^{-4} grams per sq. cm.

C. N. Birchenall and R. F. Mehl studied the rate of self-diffusion of iron in alpha and gamma iron by plating iron-59 on test specimens which were subjected to various heat treatments and then counted. Measurement of the rate of change of the surface count permitted calculation of diffusion rates.

In studying the rate of diffusion of silver in silver the General Electric Company has plated silver-110 on on the surface of a stable silver block, subjected the specimen to various heat treatments, and then shaved thin layers from the block for measurement of activity.

Calcium-45 has been used in the form of bicarbonate for studying the absorption and exchange of calcium during the washing of cotton swatches in the laboratory



Radioactive piston ring is removed from storage container for engine wear tests at California Research Corp.

of the General Aniline and Film Corporation. In the tests, actual conditions encountered in hard-water launderings were closely simulated. Labeled bicarbonate water corresponding to a hardness of 300 parts per million based on calcium carbonate was used. The calcium uptake was measured by placing the cotton swatches in a special sample holder, which exposed a definite area to a thin-window G-M tube. Calibration showed that calcium concentrations as low as 2 micrograms per gram of cotton can be detected readily in this manner.

Because the penetrating nature of gamma radiation permits its detection through pipe walls, barium-140 (a gamma emitter) has been used by Standard Oil of California to follow interfaces in oil pipelines. Ten millicuries of barium-140 were converted to an oil soluble barium soap and dissolved in a small quantity of oil. Aliquots containing 1 mc. each were injected into the pipeline at the time a stock change was made. Injection was accomplished by use of a compressed air cylinder. Travel of the interface was followed with a portable G-M counter. Location of this interface permitted tankage switching at the pipeline terminal at the optimum time. The technique also provided data on the degree of intermixing of materials pumped in the pipeline.

The ability to detect small quantities of a radioisotope permits its determination even when it is greatly diluted. S. Karrer, D. B. Cowie, and P. L. Betz took advantage of this dilution potential and injected sodium-24 as sodium chloride at a constant rate into the suction of a condenser water pump. Samples taken downstream from the condenser were analyzed for radioactivity content by use of a dip counter. The measured dilution, plus knowledge of the input rate of the activity, permitted calculation of the water circulation rate.

Even prior to the availability of the pile-produced radioisotopes, researchers at M. I. T. had been studying friction phenomena, using cyclotron-produced radioisotopes. In their early experiments, a copper-beryllium block was irradiated in the M. I. T. cyclotron, forming zinc-63 and copper-64. Test riders were then moved under controlled conditions over the activated surface and the quantity of transferred matter was determined by use of a Geiger counter. The effects of lubrication, load, and speed of movement were invesigated by this radioactive tracer method, which permitted detection of quantities of material as small as 10^{-10} grams.

In a more recent study, pile-produced radiochromium was plated on a piston ring. The ring was then installed in a test engine for study of wear under normal operating conditions. The distribution of transferred chromium was determined by autoradiographing the cylinder liner.

The pile irradiation technique has been used to study wear rate in an internal combustion test engine as a function of type of fuel, properties of lubricant, and jacket water temperature. The usual practice in conducting engine wear tests is to assemble the test engine with carefully weighed and measured components, operate the engine for a certain period, disassemble the engine for inspection and weighing of parts, reassemble, and continue. In some tests, the engine is disassembled several times during the run. The California Research Corporation used a piston ring which had been irradiated in the Oak Ridge pile to provide a continuous measurement of the rate of wear of the ring without requiring disassembling the engine. In the actual test, the rate of wear was measured by use of a dip counter immersed in the circulation lube oil. A correlation between counts per minute and weight of abraded material was obtained by counting a weighed amount of the metal.

Agricultural Applications

The ability to locate individual radioactive atoms and to differentiate these atoms from chemically similar stable atoms has resulted in a widespread use of radioisotopes for agricultural research. R. N. Colwell studied the drift of Coulter pine pollen by soaking the pollen in a water solution of Na_2HPO_4 using phosphorus-32. The rate of fall of the treated dry pollen proved to be the same as for that of untreated pollen. A calibration was obtained by counting a measured number of pollen. The labeled pollen was released in the field under conditions simulating its normal release from the tree. Later the pollen was collected along various radii from the point of release. Collections were made in petri dishes or by use of a vacuum cleaner. Use of photographic film in contact with the filters of the vacuum cleaner permitted locating individual radioactive pollen grains. In an experiment using 10 mc. of P-32 (which costs about $5.00), some 10 billion pollen grains were activated.

In a similar experiment by John C. Bugher and Marjorie Taylor, mosquitoes were grown in a medium containing phosphorus-32 and strontium-89. In field experiments, radioactive mosquitoes were released and catches made at a series of stations placed around the compass and at various distances from the release point. The experiments indicated that the mosquitoes were distributed largely by wind drift, rather than by their own flight.

Radioisotopes are ideally suited as tools for the investigations of fertilizers. Important plant nutrients, such as calcium, phosphorus, iron, postassium, copper, sodium, sulfur, and zinc are available as radioisotopes from the Atomic Energy Commission. These elements can be incorporated in fertilizers and applied to the soil to determine the effect on plant utilization of fertilizer composition or the method of application. Plant uptake of the activated fertilizer can be readily measured and can be distinguished from uptake of the same compound already present in the soil. The United States Department of Agriculture in Beltsville, Maryland, has studied a number of fertilizers in this manner.

X-ray gauges have been used for the past several years in steel mills for measurement of the total thickness of the steel. The gauges comprise an X-ray source and some type of radiation-measuring receiver.

For materials weighing under 1 gram per sq. cm. (0.050 inches of steel or 0.166 inches of aluminum), beta radiations such as are emitted by yttrium-90 and rhodium-106 can be used for thickness measurement. The Beta Gauge comprises a radioactive source, which is located under the material to be measured, and a receiver, such as an ionization chamber, which is mounted directly over the source. The material to be measured passes between the source and the receiver and acts as an absorber for the beta rays.

The Beta Gauge is truly a weight gauge, since the absorption of beta particles is a function of weight of absorber per unit area rather than thickness. Beta Gauges of the absorption type can be used for measuring the weight per unit area of materials such as paperboard, roofing felt, plastic sheet, or aluminum sheet.

Workers at California Research Corp. monitor a pipeline to detect presence of radioactive material

Thickness Applications

Where access is available to only one side of a sheet, or where very thin materials or coatings are to be measured, a backscattering technique can be used. When beta particles from a radioisotope impinge on a solid material, the direction of travel of a certain proportion of the impinging particles is changed. The magnitude of this effect is determined by the density of electrons in the solid material. Thus, the technique can be used to measure the thickness of a plastic sheet as it passes over a steel roll or the thickness of tin plate applied to steel sheet.

Another interesting thickness application is the measurement of water content of the snow pack by the use of radioactive materials. This work is being carried on as the Cooperative Snow Investigations of the United States Department of Commerce, Weather Bureau, financed by the United States Army Corps of Engineers. In this study, radioactive cobalt-60 is located on the ground, while the receiver is located on a post above the activity. Transmitting equipment is used to send data regarding the weight of the snow pack to a central laboratory.

Radium has been widely used since the First World War for radiography of castings and welds. Radium currently costs approximately $20,000 a curie; cobalt-60 is now available from the Atomic Energy Commission at $50.00 the first curie and $5.00 a curie thereafter. The gamma radiations emitted by the cobalt-60 are very similar in energy to those emitted by the much more expensive radium. In addition to having the price advantage, cobalt-60 is free from the health hazard resulting from the emission of gaseous radon by radium. Accurate radiography requires compact sources. Cobalt-60 is now available in the form of irradiated wire, with a specific activity in curies per cubic cm. greater than that available from the presently used radium compounds.

It is obviously impossible to detail the hundreds of uses of isotopes. This cross-section sampling, however, should give some indication of the sensitivity, versatility, performance and promise of this revolutionary new research tool.

Bringing up a specimen—or possibly even a dinner

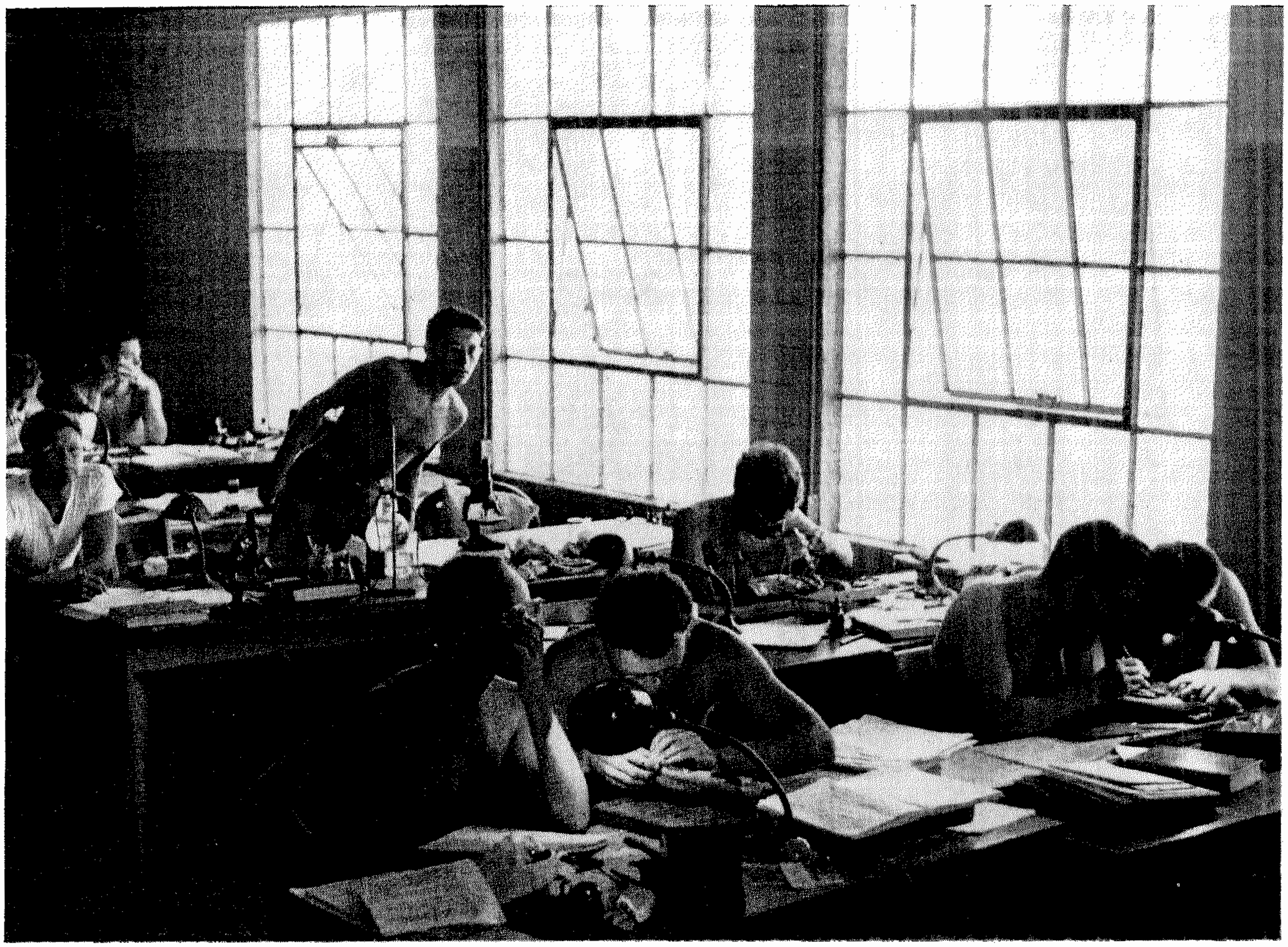
BIOLOGISTS HIT THE BEACH

Summer Session at the Marine Lab

BETWEEN THE SOPHOMORE and junior years, students taking the Biology option at Caltech find themselves in the not-unpleasant position of having to spend six summer weeks at the Kerckhoff Marine Biological Laboratory in Corona Del Mar. Though the chief purpose of this trip is the study of zoology—and, sure enough, a good deal of zoology gets studied—the fact remains that the Marine Lab is remarkably handy to the beach, the water and the sun.

What little spare time was left to the 18 students who took the Marine Lab course this summer was taken up by various reconstruction and renovation projects on the 23-year-old lab building. For their efforts the students received credit against their living expenses. They did their own marketing and cooking this year too, and managed to keep food costs down to less than $1 per day per man—possibly the most impressive accomplishment of the whole project.

On the dark side—a healthful and invigorating specimen-collecting trip at five (5) in the morning.



Above: In the lab itself informal dress was the rule.

Left: Most exotic collection technique at the lab involved the use of this Man-from-Mars underwater outfit.

Below: Specimens, kept in small aquaria in the lab, included nearly a hundred active, adolescent octopi.

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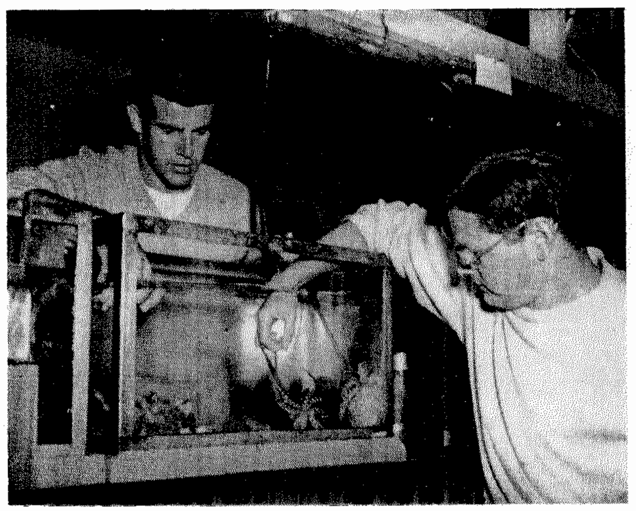
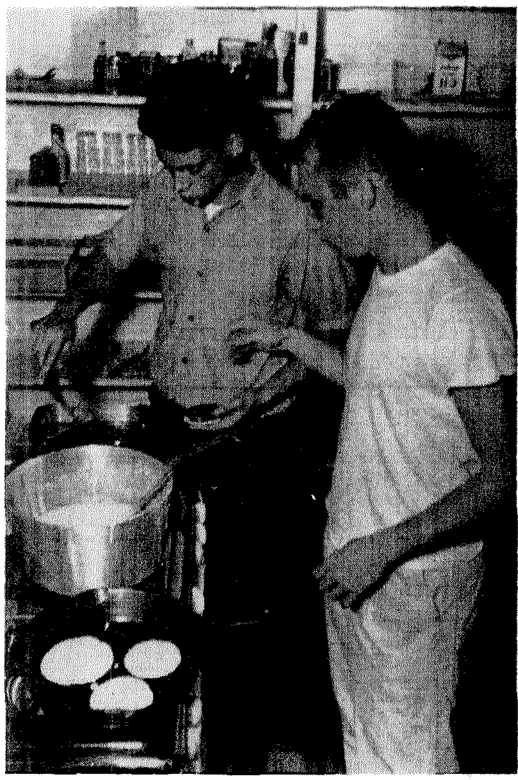
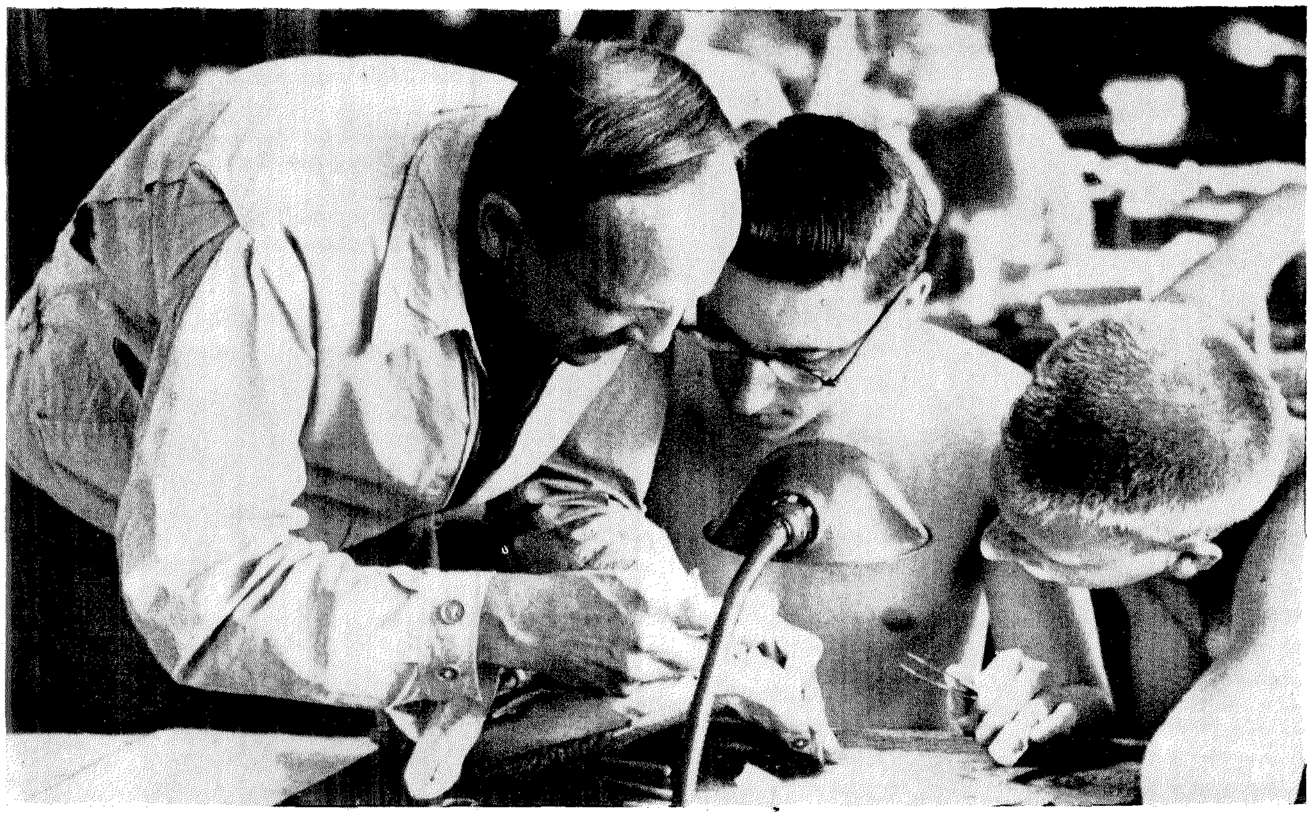




Student cooks worked in shifts

Meals were al fresco—and every man for himself



Stanford Professor Arthur C. Giese, instructor of the summer course, gets in on a difficult dissection problem.

CARICATURES OF MEN OF SCIENCE

by E. C. WATSON

Sir George Biddell Airy

LIKE A GOOD MANY OTHER Victorian men of science, George Biddell Airy (1801-1892), eminent British astronomer, did outstanding work in several fields. Particularly in his younger years, his contributions to mathematics and physics were as impressive as those in astronomy. His work on the theory of light, which in 1831 won him the Copley medal of the Royal Society, and his researches on the mean density of the earth were especially noteworthy.

The *Vanity Fair* caricature of Airy which is reproduced on this page appeared in the magazine on November 13, 1875, accompanied by the following account:

"We have among us in the various departments of Science some truly great men whose names will live in their work to many future ages; and of these is Sir George Airy. Born in Northumberland four-and-seventy years ago with a splendid intellect but to no inheritance, he has made of himself, by an unremitting course of labour of the most trying kind, what he is—one of the glories of his country.

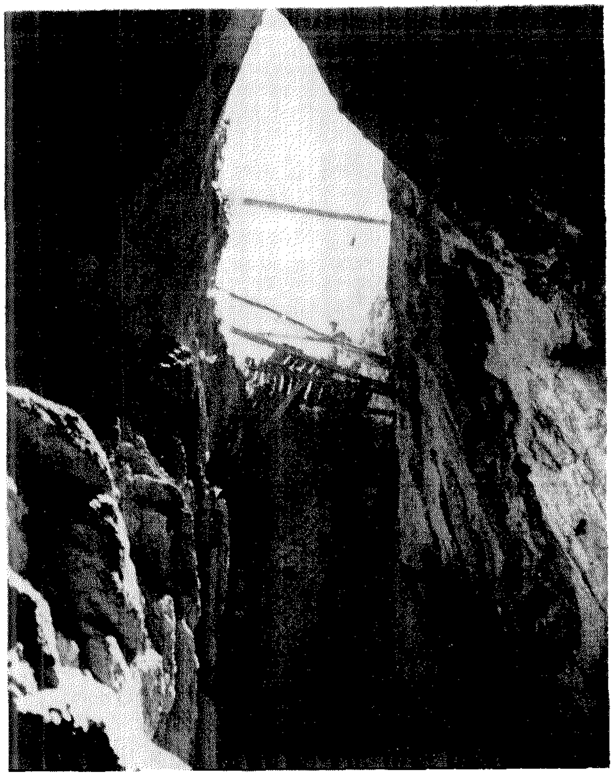
"Not without difficulty he succeeded at eighteen in entering Trinity College, Cambridge. He came out Senior Wrangler, was elected Lucasian Professor at twenty-five, and at once proceeded to deliver a most remarkable series of lectures on Experimental Philosophy, in which he fully developed for the first time the undulatory theory of Light.

"At twenty-seven he was elected Plumian Professor, and now he took charge of the Cambridge Observatory, and devoted himself with all his rare powers to astronomy. The best mathematician of his time, and with a natural turn besides for the more delicate forms of mechanics, he at once began to revolutionize all the astronomical calculations, and to perfect the observations by adapting to them every modern resource of the mechanical arts; and at thirty-four he was taken into official recognition by receiving in the post of Astronomer-Royal one of those few appointments which must even in these times be given solely for ability and aptitude.

"In this capacity he has served the State and the Science like the enthusiast that he is, nor could there be named a man who has done so much and such wearing work as he. He superintends the compilation of the Nautical Almanack, he is appealed to on all questions of boundary, he rates chronometers, and corrects compasses, and withal he finds time to organise expeditions, to start new theories in optics, and to contribute many papers to the public press.

"A sober, steady man, with an immense capacity for and delight in labour, his life has been spent where his work lies, on Greenwich Hill, and he is little known to Society; yet he is still young, he knows almost everything, and his accomplishments and simplicity render him the most charming of companions. It is remarkable proof of the estimation in which men of the highest worth are held in England, that at seventy Sir George was made a Companion and at two-and-seventy a Knight Commander of the Bath. Perhaps some day, when he has performed as great service to his country as Prince Leiningen and Sir John Pakington, he will be admitted with them to the honour of the Grand Cross, which will nevertheless make him no greater a man than he is."

One of a series of articles devoted to reproductions of prints, drawings and paintings of interest in the history of science—drawn from the famous collection of E. C. Watson, Professor of Physics and Dean of the Faculty at the California Institute.



San Josecito Cave—a 70-foot cleft in limestone

25,000-YEAR-OLD HORSE

The skeleton of an Ice Age horse makes a return trip to Mexico

by CHESTER STOCK

IN RECENT YEARS FIELD PARTIES of the Institute's Division of the Geological Sciences have been conducting a series of paleontological investigations in southern Nuevo Leon, Mexico (E & S, Sept. '43, Feb. '48). There, in the cave of San Josecito, they have uncovered deposits which probably furnish the most satisfactory information we have of the vertebrate life of the Ice Age in Mexico.

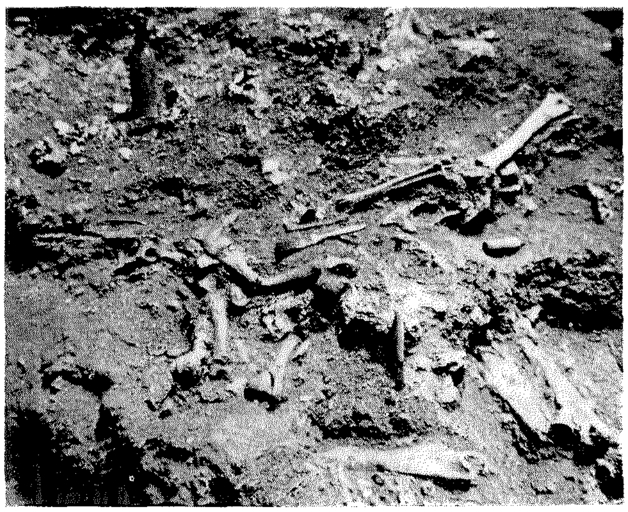
While the field work has continued, research has also progressed with individual members of the Pleistocene assemblage of mammals and birds from that locality.

The composite skeleton of the Mexican horse illustrated on page 17 was recently prepared and mounted in the laboratories of Caltech's Division of the Geological Sciences. In anticipation of presenting the paleontological material to the valuable collection of native fossil specimens on exhibit at the Instituto Geologico Nacional, a second horse skeleton, reconstructed at the California Institute, was taken by truck in early spring of this year to Mexico City.

This horse was chosen for special study and for presentation to the Mexican Institute for several reasons. First, it furnishes information on a group of animals that has played an important part in the history and economy of Mexico—and still does. Secondly, some forerunners of the living forms are already known, at least from later geological formations in Mexico. And finally, the available fossil material of this species of horse was sufficiently complete to permit the construction of an articulated skeleton illustrating its diagnostic skull and skeletal characters.

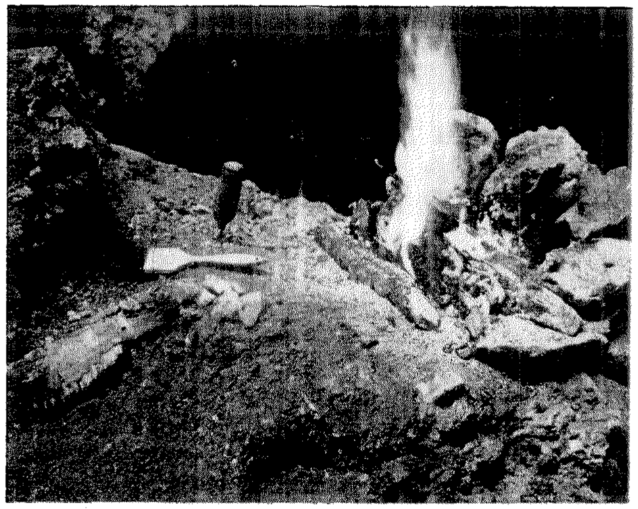
Until the discovery of the fossil specimens at San Josecito Cave, horses of the Pleistocene or Ice Age in Mexico were known only by fragmentary remains. The presence of several species had been recognized, but determination was limited to the characters indicated by isolated teeth or jaw fragments.

One of the earliest records was that made by the distinguished British comparative anatomist, Sir Richard Owen, who in 1869 described two halves of a palate with the cheek-teeth on either side which had been found



This picture of fossil specimens in San Josecito Cave gives some indication of the job of selection, sorting and working out of material that faces the paleontologist in the field.

After fossil bones have been worked out and cleaned, the next step is to dry them out near a fire. These are horse bones being dried out in San Josecito Cave.



in deposits exposed in the Valley of Mexico. To this type of horse he applied the name *Equus conversidens.* It would appear that some of the characters on which the mammal was once considered as distinct can no longer be relied upon, but in the large series of specimens referred to as *E. conversidens* the animal from San Josecito Cave appears to be most closely related to Owen's species from the Valley of Mexico.

It is now possible on the basis of the amount of fossil material available to give a full statement concerning the morphological structure that this creature possessed whereby it differed distinctly from other Pleistocene horses of North America.

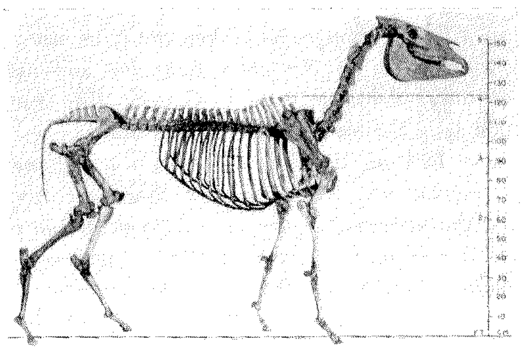
The picture below shows in side view a skeleton of the Mexican horse, permitting for the first time recognition of the size and proportions of the animal. In stage of evolution (as expressed, for example, in the structure of its feet and teeth) the Pleistocene horse is close to its modern descendant. The distinctness of the form, with reference to fossil horses known from other Pleistocene horizons in North America, can be appreciated by a comparison of the Mexican horse with that of the characteristic horse from the Pleistocene asphalt beds of Rancho La Brea, California, right, below. Not only is the Mexican horse considerably smaller, but the proportions of the skull and skeleton are different.

The San Josecito horse may be likened in general size to the living Mongolian wild horse and the African Burchell zebra. In certain details of the enamel pattern of the cheek-teeth (regarded by some students of fossil equines as significant from the standpoint of expressing zebrine relationships) the Mexican horse may be considered as resembling the zebras.

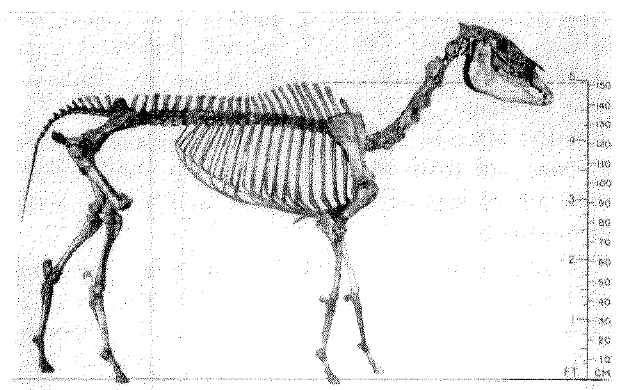
The very small hoofs are also like those of the zebra. However, on the basis of the proportions of its skeletal parts and of the skull the Mexican horse deviates from both *Equus burchelli* and *E. przewalskii.*

The direct association of the California Institute in the furtherance of the paleontological activities of the Mexican Geological Institute is an expression of the desire to cooperate in the study of common problems in the fields of education and science of special interest to Mexican and American students.

FOSSIL HORSES — FROM MEXICO AND CALIFORNIA'S RANCHO LA BREA



Skeleton in side view of a horse from the Pleistocene deposits of San Josecito Cave, Nuevo Leon, Mexico—known as *Equus conversidens leoni* Stock. Note the relation in size and differences in skeletal characters when compared with the Rancho La Brea specimen below.



Skeleton in side view of a characteristic horse from the Pleistocene asphalt deposits of Rancho La Brea, California—known as *Equus occidentalis* Leidy. Note the relative size of the animal with regard to that of the Mexican horse above.

BONE MAN

Some notes on the life and hard work of Bill Otto, Sculptor and Preparator in the Geology Division

WILLIAM V. OTTO is the man who did the actual reconstruction job on the skeleton of the prehistoric horse described on the preceding pages. In fact, he's responsible for the whole awesome assemblage of skeletons which are on display in the halls of the geology buildings—from the 29-foot prehistoric sea serpent down to the 2-foot horse.

The first thing everyone asks Bill Otto is how long it takes him to put a skeleton together. And one reason he hesitates in his answer is that he's never had time to see a job straight through since he's been here. He invariably keeps three or four things rolling at once. Right now, for example, he is (1) building a mount on which to assemble a skeleton of a giant ground sloth, (2) making casts of the brains of a mastodon and a prehistoric bear, (3) working out some prehistoric camel material from a huge mound of earth encased in a plaster cast and sent in by field workers in the Tehachapi Mountains.

Most of the material he works with is shipped in to him, though he occasionally goes out into the field himself. In the case of the Mexican horse, the material had been worked out from the surrounding earth, separated from bones belonging to other animals and thoroughly dried over fires before it was shipped to Bill Otto at the Institute. When he got it he cleaned it off and treated the brittle bones with plastics to harden them.

Then began the arduous and finicky job of selecting from this mass of material those bones which were in the best condition, and which would make the best-articulated skeleton. These were treated further, while the discarded ones were carefully filed away in one of the Geology Division's 500-odd cabinet drawers, which contain everything from shrews' claws to elephants' spinal columns.

Finally, after he had carefully planned the position the limbs and skull would take, Bill Otto settled down to the job of making a steel frame and mounting the skeleton on it.

The reconstruction of the Mexican horse was completed within a three-month period. Bill Otto, who is nothing if not methodical, can verify that by checking the ledger in which he keeps a careful record of how much time he spends on each project each day.

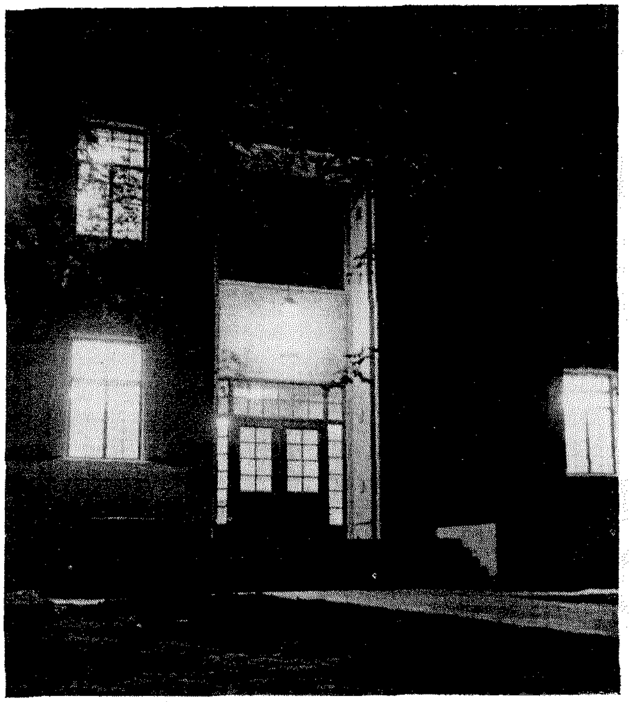
William V. Otto, Sculptor and Preparator in the Division of Geological Sciences, assembles a giant ground sloth

The second question everyone invariably asks Bill Otto is how he happened to get into this racket anyway. That's easily answered too.

He was born in Frankfurt, Germany, and came to this country when he was a boy. Out of school, he worked at various jobs but maintained a consuming interest in sculpture and woodcarving and finally decided to try to make a living at them. Though he was self-taught, his work was distinguished enough to be shown in the National Academy in 1941. It wasn't furnishing him with much of a living, though, and when the paleontologist Childs Frick—son of the great financier and art collector—encouraged him to come to Caltech, Bill Otto didn't hesitate long before he made up his mind.

Though he'd had no training in paleontology, and though his interest was artistic rather than scientific he found that the same techniques were used in preparatory work as in sculpture. As a sculptor he knew comparative anatomy, so, as a preparator, he merely extended his range of knowledge. As a result of this combination of skills Bill Otto is perhaps the most distinguished preparator in the country, and one to whom paleontologists constantly turn for help.

In his spare time he still works at sculpture, and constantly experiments in new mediums. Though all this means he has to maintain a pretty rigid schedule, he has always managed to find time to brew coffee for the rest of the members of the Geology Division, who file in twice a day to his lab, and hold a coffee clatch among the sloth bones there. As for Bill Otto himself, he hasn't much time for any of this; he just keeps working away on his ground sloth, bear brain, and camel remains.



THE SUMMER AT CALTECH

Engineering Building

As THE NEW SCHOOL year started, workmen were still putting the finishing touches on the new engineering building on campus—though the offices were all occupied and most of the laboratories in operation nevertheless.

A $500,000 structure, the new building adjoins—and extends—the present Mechanical Engineering building, making one continuous structure which is now called the Engineering Building. It is three stories high, with two basements and 34,000 sq. ft. of floor space.

In planning the building the general policy was to make it as nearly flexible as possible. It has no geegaws or arrangements for special gadgetry which might be unique today and outmoded tomorrow. Consequently it is a severely simple and eminently usable general-purpose building.

It houses Civil Engineering, Applied Mechanics (and those teaching advanced mathematics to engineering students). There are two general classrooms and four special classrooms for the use of graduate students. Several general research rooms provide much-needed space for graduate students and faculty members engaged in Institute research or that sponsored by outside agencies.

The sub-basement of the building is completely devoted to metallurgy and the materials problem. Lab space is also available for additional work on the properties and strength of materials, for work on corrosion, using radioactive tracers; and for the testing lab itself. Space has also been provided—and facilities new to the Institute—for research in concrete, complete with curing rooms with controlled temperature and humidity. There are improved facilities for soil mechanics work—both instruction and research. And there are new facilities for dynamics research and vibration work.

When the engineers, who had been pretty much scattered around the campus, packed up and headed for the Mecca of the new Engineering Building, they set off a chain reaction. The Electrical Engineering Department took over part of the space in Throop that had been vacated by Civil Engineering. The Institute Purchasing Office moved into another part of the old C.E. quarters. The Graduate Office moved into the old Purchasing Office in Throop. The Bookstore expanded into the space left by the Soil Mechanics Lab in Throop. Electrical Engineering set up its Servo-Mechanisms Lab in what had been the Testing Materials Lab in Throop. And E & S, not to be left behind, took over the engineers' eyrie in the Throop tower.

Present plans are to hold an open house in the new Engineering Building early in November.

Merrill Tunnel

ON AUGUST 31 THE INSTITUTE dedicated a new subsonic wind tunnel on the campus, officially known as the Merrill Tunnel, in honor of Albert A. Merrill, veteran Caltech instructor and a pioneer in the field of aeronautics.

The new tunnel was designed for a top speed of about 175 miles an hour. Approximately 110 feet long, it has a 32 by 45-inch test section, which can handle models with a wing span up to 40 inches. Power is supplied by a 75-horsepower electric motor with a three-bladed fan, and speed is attained through control of the pitch of the fan blades. The tunnel will have a balance system capable of handling six component forces.

This is the eighth wind tunnel on campus. These now range in size from a 2½-inch supersonic tunnel to a 10-foot one, and in speed from 175 miles an hour (the

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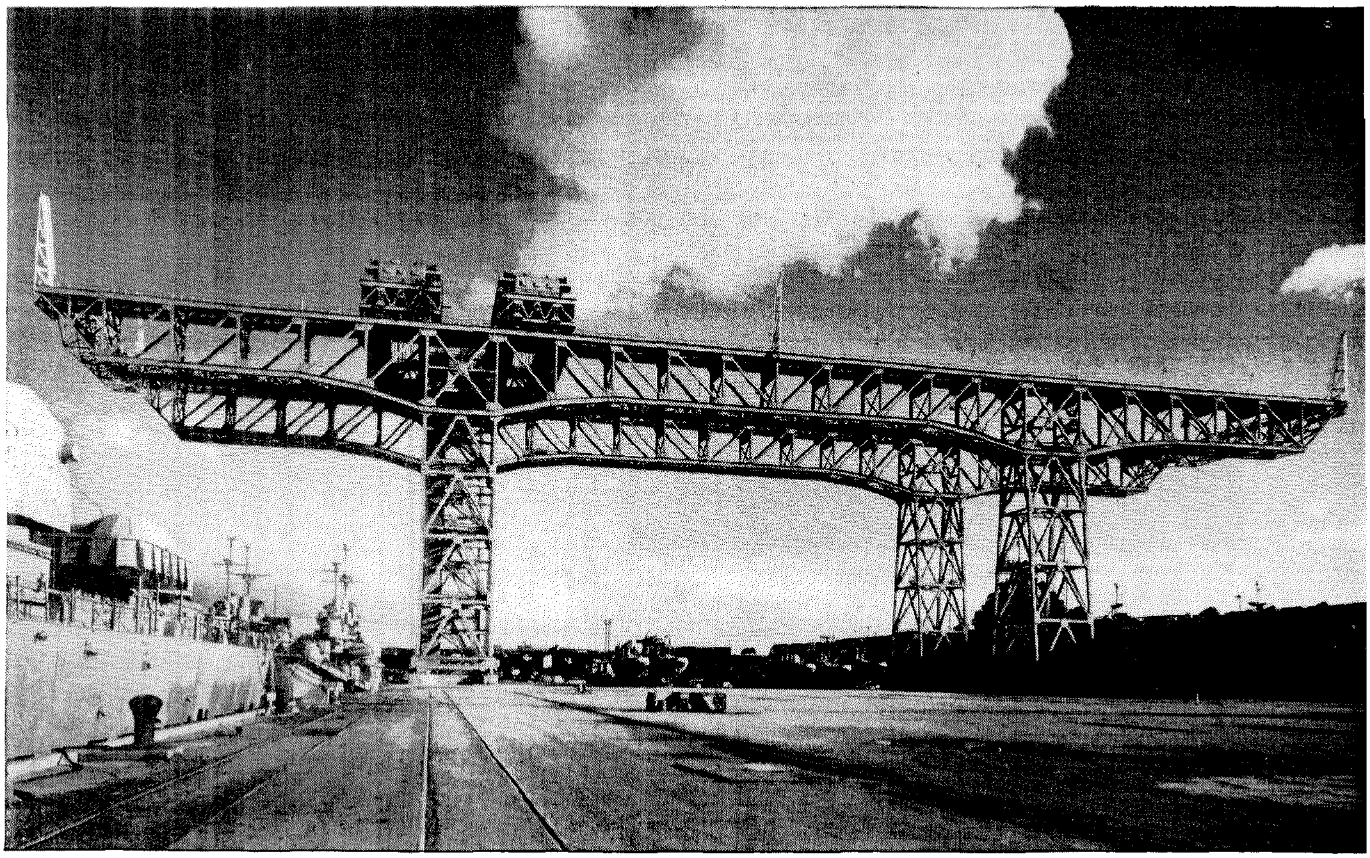
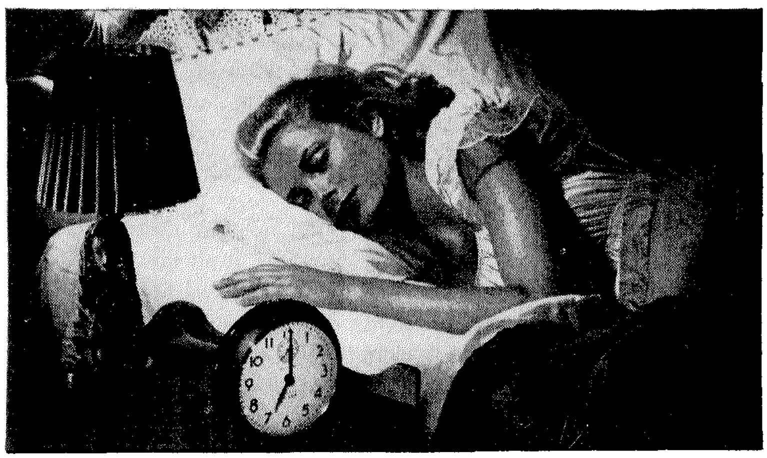
Only STEEL can do so many jobs



HOW TO LIFT A MILLION POUNDS. This crane runway, whose structural steel was fabricated and erected by United States Steel for the San Francisco Naval Shipyard, is 730 feet long, 209 feet high, extends 162½ feet over the water at each side. It can lift gun turrets and other huge sections weighing as much as 1,000,000 pounds.

THE SOFTEST THING YOU CAN SLEEP ON IS STEEL. For solid comfort, you can't beat mattresses that have inner springs of steel. Especially if the inner springs are made of U·S·S Premier Spring Wire, specially developed by United States Steel to give lasting resiliency and buoyancy to the inner springs of sleep equipment and upholstered furniture.

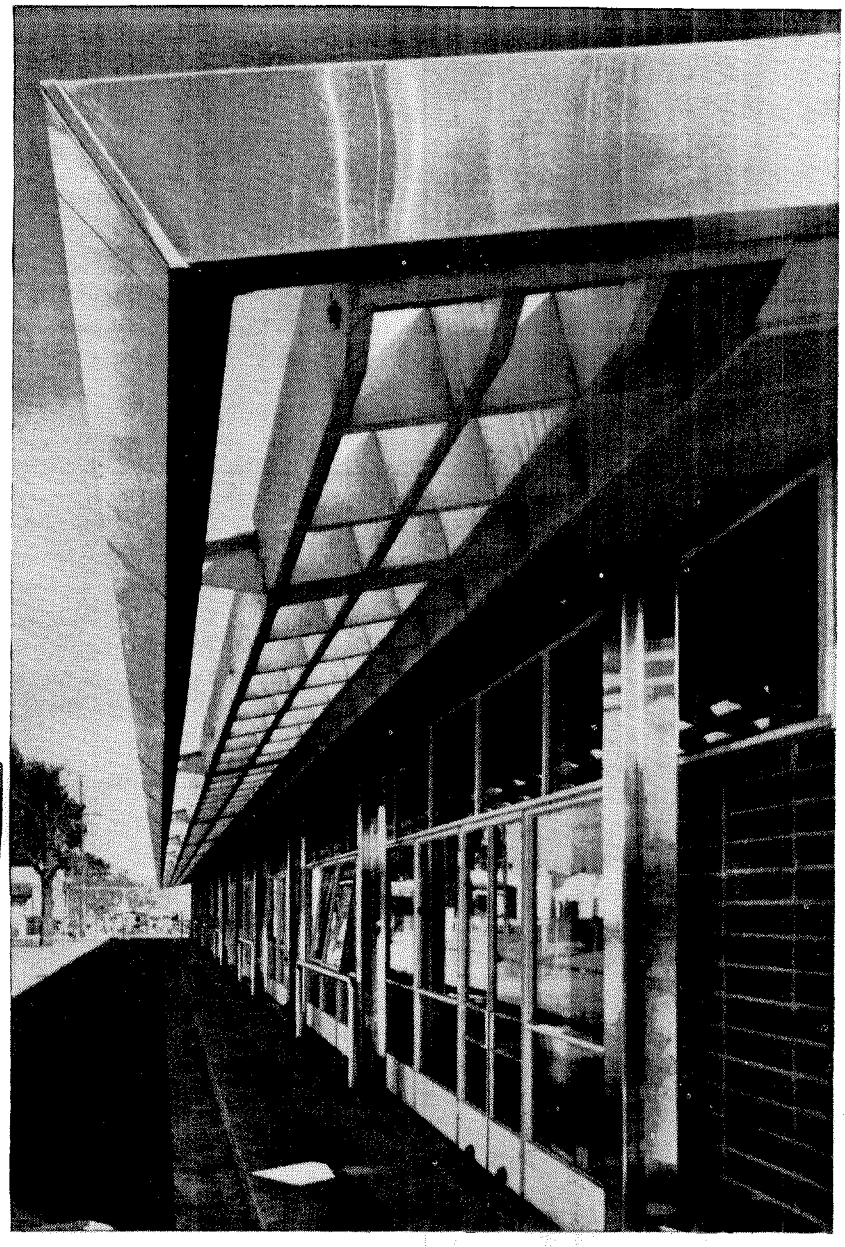


CLEANER THAN YOUR BEST CHINA. The inside of a food can is "surgically clean." Sterilized in processing, it is cleaner *and* safer than any dish. The Department of Agriculture reports, "It is just as safe to keep canned food in the can—if the can is kept cool—as it is to empty the food into another container." And, incidentally, did you know that "tin cans" are really about 99% *steel?*

AMERICAN BRIDGE COMPANY · AMERICAN STEEL & WIRE COMPANY · CARNEGIE-ILLINOIS STEEL CORPORATION · COLUMBIA STEEL COMPANY · H. C. FRICK COKE AND ASSOCIATED COMPANIES
OLIVER IRON MINING COMPANY · PITTSBURGH LIMESTONE CORPORATION · PITTSBURGH STEAMSHIP COMPANY
UNITED STATES STEEL PRODUCTS COMPANY · UNITED STATES STEEL SUPPLY COMPANY

so well...

NEW ICE CREAM IDEA. In certain parts of the country, you can now buy individually packaged single servings of ice cream. They're called "Diced Cream"... and they strike a new high in sanitation, economy and convenience. Diced Cream is made in machines fabricated largely from stainless steel—to assure maximum purity in the finished product.



STAINLESS STEEL GOES TO SCHOOL. What a change from the little red schoolhouse! This new school in California embodies the latest features in school construction, including the use of U·S·S Stainless Steel for architectural trim. The stainless trim resists atmospheric corrosion, harmonizes with the building design. United States Steel produces steel of all kinds for such buildings . . . continuing its number-one job of helping to build a better America.

Listen to . . . The Theatre Guild on the Air, presented every Sunday evening by United States Steel. National Broadcasting Company, coast-to-coast network. Consult your newspaper for time and station.

MANUFACTURED FROM USS STEEL UNITED STATES STEEL

. . . and this label is your guide to quality steel

UNITED STATES STEEL

Helping to Build a Better America

GENEVA STEEL COMPANY · GERRARD STEEL STRAPPING COMPANY · MICHIGAN LIMESTONE & CHEMICAL COMPANY · NATIONAL TUBE COMPANY · OIL WELL SUPPLY COMPANY
TENNESSEE COAL, IRON & RAILROAD COMPANY · UNITED STATES STEEL EXPORT COMPANY
UNIVERSAL ATLAS CEMENT COMPANY · VIRGINIA BRIDGE COMPANY

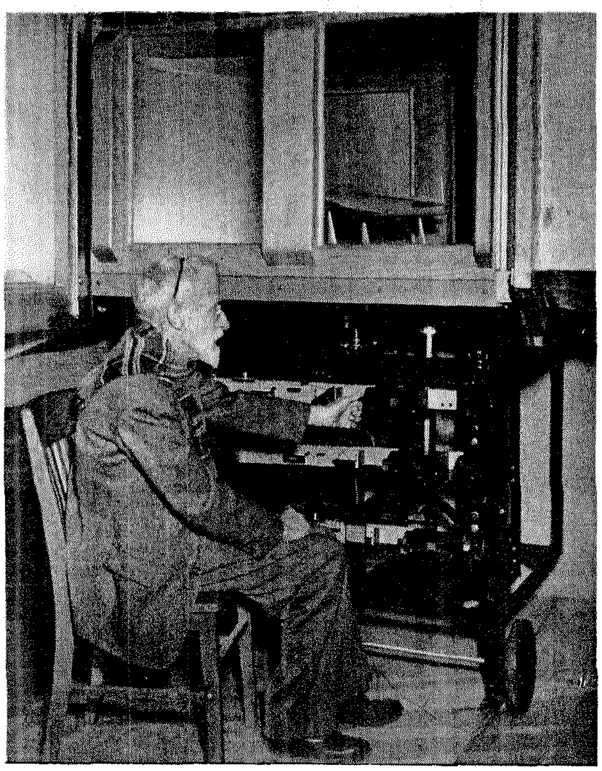
Merrill) to ten times the speed of sound (the hypersonic tunnel—E&S, Nov. '49).

The subsonic Merrill tunnel will be used for instruction and student research work, and will also be available for industrial research in the field of low-speed aerodynamics for planes and missiles as well as for testing aircraft components.

Albert Merrill came to Throop College—forerunner of Caltech—in 1917 when the first wind tunnel was built on the campus. He was, in fact, entrusted with the supervision of the design, construction and operation of the tunnel, which continued in operation until it was destroyed by fire in the '30s.

Mr. Merrill's interest and activity in aeronautics dates back as far as 1892, when he graduated from high school in Boston and delivered a commencement address on progress in flying. Shortly before 1900 he was one of the founders of the Boston Aeronautical Society—probably the first such society in this country.

At the dedication of the Merrill Tunnel last month Dr. Clark Millikan, Director of the Guggenheim Aeronautical Laboratory, recalled some of the countless practical aeronautical inventions for which Dr. Merrill was responsible. One of his early patents was the "Up Only" aileron, which gave lateral control by deflecting upwards only. This eliminated the drag on the down aileron and accordingly eliminated the necessity for the combined use of rudder and aileron—a combination that was one of the basic elements in the famous Wright patent which dominated the field for so many years.



Albert A. Merrill

Another of Mr. Merrill's inventions was the stagger-decalage biplane, which furnishes automatic longitudinal stability without the use of an auxiliary tail.

His most important contributions, however, have been associated with a number of ingenious and powerful techniques for getting accurate and precise experimental data with inexpensive, simple tools.

He was probably the first experimenter to use an automobile to tow a glider for launching purposes. He was the first inventor and user of an "open-air wind tunnel" for testing full-scale manned, captive gliders. He developed the first moving tube micromanometer, which has since become the standard precision manometric instrument of practically all aeronautical laboratories.

But perhaps his greatest contribution was the development of a very small, inexpensive wind tunnel which one man could operate by himself, and hence produce very inexpensively and quickly, valuable scientific data. The new Caltech tunnel, which bears his name, is such a one. It is located above the archway which connects the Central Shops Building with the Optical Shop.

Radiation Detection

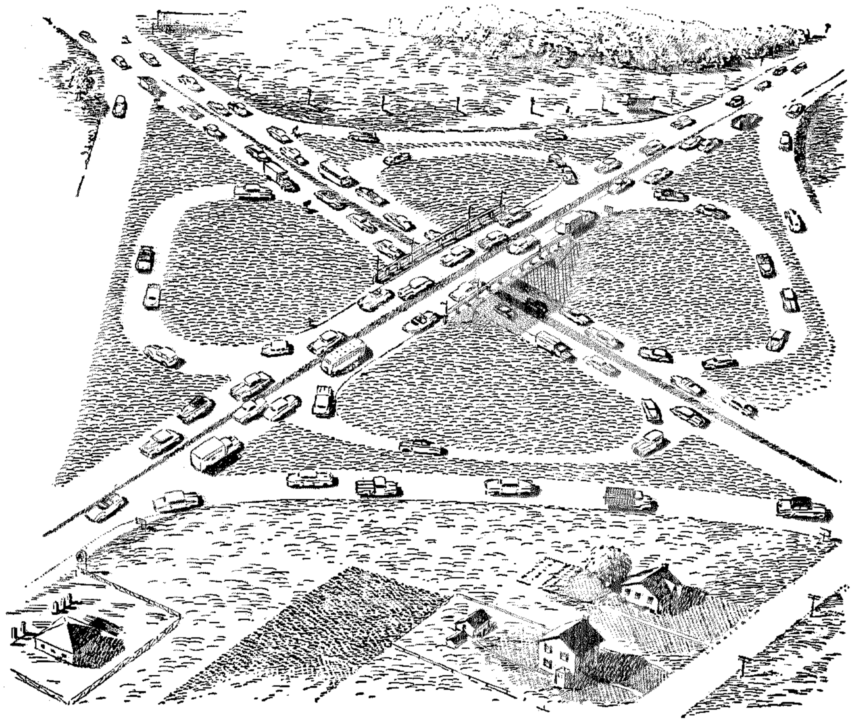
Charles Lauritsen, Professor of Physics, and his son Thomas, Assistant Professor, announced this summer that they had developed a pocket-size radiation detector for general use in case of an atomic disaster.

Several years ago C. C. Lauritsen invented a highly sensitive radiation-measuring device to be used for the protection of people engaged in work with radioactive materials or with X-rays. The new detector, intended for possible use by citizens, rescue teams and military personnel, is simpler, cheaper to make, easier to use, and more rugged.

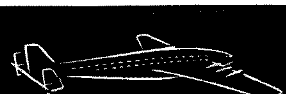
The device will go into production shortly at the Consolidated Engineering Corporation in Pasadena. First production models will probahly go to atomic energy centers, while later models will go to civilian defense headquarters throughout the nation. Sometime next year production should reach the point where the detectors can be sold to the public. They will probably retail at from $15 to $25.

Radiation, of course, is undetectable by the senses. A general body dose of a few hundred roentgens, accumulated in a sufficiently short time, may produce no visible effect but may, nevertheless, result in death in a few days or weeks. Anyone carrying the Lauritsens' pocket-detector, which is about the size of a pack of cigarettes, would be able to determine whether he was absorbing too much radiation. A dial on the face of the instrument records, cumulatively, the amount of radiation absorbed over a 24-hour period. If the dial takes a full 24 hours to reach its maximum point, the person carrying the instrument is safe; but if the dial moves rapidly toward the maximum, the radiation is dangerous. At the

CONTINUED ON PAGE 24

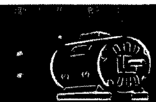


The forgotten half billion



Roebling Aircord contributes importantly to safe, sure "control in the air".

Roebling Elevator Rope is the most widely used wire rope in elevator service.



Roevar Magnet Wire insulation is 10 to 40 times tougher than other types.

IT'S EASY to forget a product that gives almost flawless performance. Most people, for instance, never think of the valve springs in their cars... largely because wire developments have brought them to a point approaching metallurgical and mechanical perfection. The half billion valve springs in service today... closing each valve as often as 12 times a second, from sub-zero temperatures to 400°F... will prove almost 100 per cent dependable for years on end. Roebling is a chief supplier of round spring wire to valve spring manufacturers.

Today, too, Roebling's wide line of wires and wire products offer economies to *every* field of industry. A full range of high carbon specialty wires... wire rope for every sort of rope-rigged equipment... more than 60 types of electrical wire and cable... a complete range of woven wire screens. Write for information about the Roebling products of interest to you.

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EXTRA VALUE . . . THAT'S WHY ***Today it's Roebling!***

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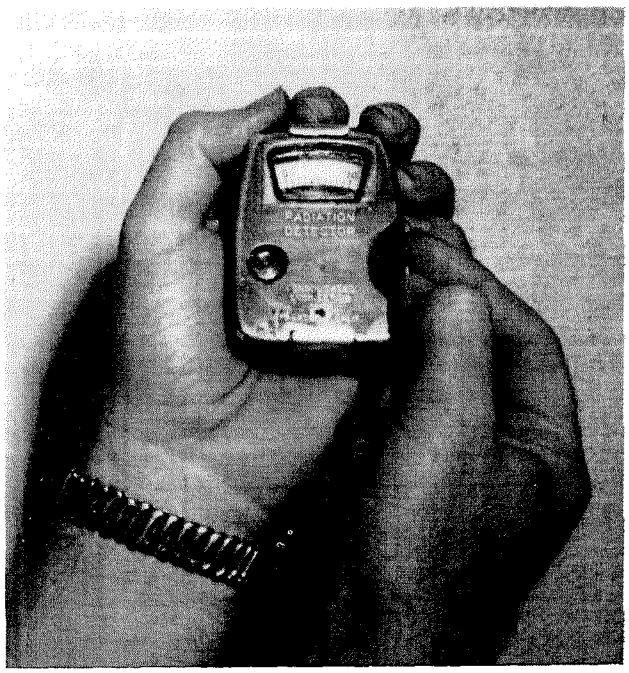
A CENTURY OF CONFIDENCE

end of each 24-hour period, the turn of a knob recharges the instrument for another day.

The instrument is essentially an electrostatic voltmeter of low capacity, mounted in a case that serves as an ionization chamber, and provided with a friction charging device. The voltmeter movement consists of a stiff, light aluminum needle, mounted in a simple pivot arrangement with a spiral restoring spring and repelled by a fixed arm at the same potential. The meter movement, including the repelling arm, is insulated from the case. A stop prevents accidental discharging by limiting the motion of the needle.

Patents on the detector are held by the California Institute Research Foundation, and royalties will be used for Institute research.



Working model of the Lauritsen radiation detector

Arrival

DR. RICHARD P. FEYNMAN has joined the Institute faculty this fall as Professor of Theoretical Physics.

Dr. Feynman comes to Caltech from Cornell University where he has been a member of the Laboratory of Nuclear Studies since 1945. During the war he was a group leader at the Los Alamos Laboratory, and prior to the establishment of that laboratory he worked on earlier stages of the Manhattan project at Princeton University.

Since 1945 Dr. Feynman has made important contributions to our understanding of the structure of the atom and its nucleus. In this work he developed what have become known as "Feynman Diagrams," a technique which has speeded up and simplified many calculations in the field of quantum mechanics. More recently he has been working in the field of quantum electrodynamics, and here too he has added to our understanding of electrical phenomena within the atom.

Last spring Dr. Feynman delivered a series of 12 lectures at Caltech on "Quantum Electrodynamics and Meson Theories," as a part of a series of physics seminars in which other outstanding physicists participated—including Dr. J. R. Oppenheimer, Director of the Institute for Advanced Study at Princeton, N. J., and Dr. I. I. Rabi, Nobel Prize winner in Physics from Columbia University.

A native of New York, Dr. Feynman obtained his bachelor of science degree at the Massachusetts Institute of Technology in 1939 and his Ph.D. degree at Princeton in 1942.

According to President DuBridge, Dr. Feynman's appointment here means that "the Institute now has a well-rounded team of some of the ablest experimental and theoretical physicists in the country."

And Departure

DR. HOWARD P. ROBERTSON, Professor of Mathematical Physics, has taken a leave of absence from the Institute to serve as Deputy Director of the Weapons System Evaluation Group of the Department of Defense in Washington. The Group was set up in 1948 primarily to analyze and evaluate present and future weapons systems. Dr. Robertson, who came to the Institute in 1947, was a member of the National Defense Research Council from 1940 to 1943, and served as a scientific liaison officer to the London Mission of the Office of Scientific Research and Development from 1943 to 1946. He was also an expert consultant to the Secretary of War from 1944 to 1947.

Hughes Fellows

HOWARD HUGHES FELLOWSHIPS in Creative Aeronautics have been awarded this year to Arthur E. Bryson, Jr., of Temple City, Warren E. Mathews of Pasadena and Norman M. Wolcott of Westwood, Calif. Each of the three men will receive a grant from the fund established by Hughes to cover tuition and research expenses, as well as a salary from the Hughes Aircraft Company for work done in connection with study at the Institute.

The fellowship program, combining advanced theoretical training at the Institute with industrial tutorial training at the Hughes Aircraft Company in Culver City, was set up last year in recognition of the growing need for creative research men in aeronautics. The three men awarded fellowships this year are the second group to participate in the program.

Arthur Bryson, 24, attended Haverford College and Northwestern Missouri State Teachers College, and began graduate study toward an advanced degree in aeronautics at Caltech last year.

Warren Mathews, 28, received his B.A. at Ohio Wesleyan University, and an M.S. degree in electrical en-

CONTINUED ON PAGE 26

Bright New World

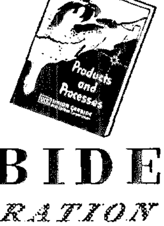
FROM MORNING TILL NIGHT, the colors of the rainbow are all around you—through plastics. A blue plastic clock wakes you, and you flip on an ivory plastic light switch. You take your clothes from a yellow plastic hanger. Plastic toothbrushes come in colors for every member of the family. Cheerful decorating schemes are enhanced by the beauty of plastic drapes. There's no limit to the colors you can get in these versatile materials!

But this is only the start of the plastic story. Plastics help make better clothing. Modern furniture and furnishings owe much to plastics. Much of your food is packaged in clean, clear plastics. Plastics add safety, durability, and appearance to many of your electrical appliances.

These versatile basic materials are man-made. Organic chemicals are the ingredients of the "unfinished" plastics —called resins. From these resins come the many different forms of plastics we know.

The people of Union Carbide are leaders in the production of plastics, resins, and related chemicals. They also provide hundreds of other materials for the use of science and industry.

FREE: *If you would like to know more about many of the things you use every day, send for the illustrated booklet "Products and Processes." It tells how science and industry use UCC's Alloys, Chemicals, Carbons, Gases, and Plastics. Write for free booklet C.*



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gineering at M.I.T. in 1944. He entered Caltech in 1949 and is working towards an advanced degree in classical theoretical physics.

Norman Wolcott was graduated from Harvard University in 1949 and received an M.S. in physics there this year. He will study for an advanced degree in physics at Caltech.

Flair on Campus

MAYBE YOU MISSED the College Review Issue of *Flair* in August—in which case you missed the handsome picture, reproduced below, of Caltech's ASCIT Prexy Ulrich Merten. Merten appeared in a line-up of Big Men on Campus, representing Princeton, Minnesota, Virginia and Caltech respectively—Caltech being characterized by *Flair* as "reputedly the toughest, most advanced, best-equipped technical school in the country."

More than this, though, you missed a good deal of miscellaneous information about Mert's wardrobe. What good this information will do you—or anybody, for that matter—is hard to say, though it's clear that *Flair's* reporter had a regular whee of a time riffling through Merten's dresser and closet in pursuit of the information.

Well, Mert, it seems, keeps his clothing budget down to $200 a year on principle. His premium on neatness forbids his wearing the usual Caltech T shirt and Levis; in fact he doesn't even own a pair of blue jeans, and though he has three or four T shirts he only wears them when tinkering with his car. He has five white shirts, five short-sleeved patterned sport shirts, and five long-sleeved solid-colored sport shirts. This puts Mert way out in front of *Flair's* other BMOCs on shirts, though the Virginia representative takes the lead in suits (7) and is also on record as owning a pair of cuff links, while the Princeton man has the most trousers (5). All of which may possibly have some signficance.

Mert owns 20 ties—all loud, all gifts, and 16 of them never worn.

He has three sport jackets, a dark blue winter suit, an off-white Palm Beach suit, a tuxedo, two pairs of shoes, two sweaters, a raincoat, and three pairs of pajamas for winter wear. "In summer," this little rhapsody on raiment concludes, "he sleeps in his shorts."

Everybody up on Merten's wardrobe now? Further inquiries may be directed to *Flair.* Meanwhile this should at least provide the other occupants of Merten's entry in Ricketts with a good, sound working knowledge of the kind of finery that is available to them if they just play their cards right.

Honors and Awards

DR. IRA S. BOWEN, Director, and Milton Humason, Secretary of the Mt. Wilson and Palomar Observatories, received honorary Doctor of Philosophy degrees from the University of Lund, Sweden, in June. In announcing the awards the University faculty cited Dr. Bowen for his contributions in both atomic and astrophysical research, his interpretation of spectra of nebulae, and the fact that he directs the two largest observatories in the world. Dr. Humanson's citation was for his contributions to astronomical research, and particularly for his "magnificent observation work" in measuring the spectra and radial velocities of far-distant galaxies.

William Howard Clapp

WILLIAM HOWARD CLAPP, Professor Emeritus of Mechanism and Machine Design at the Institute, died on August 7 at the home of his son, Roger, in Vista, Calif. He was 76 years old.

Born in Cleveland, Howard Clapp received his college training at the University of Minnesota. He joined the Caltech faculty in 1911, when the school was called Throop Polytechnic Institute, and served actively until 1944.

Merten and Apollo—Merten's the one in clothes

BOTTLENECKS

Have No Place in Production— or in Your Future Progress!

by CHESTER E. MEYER
Superintendent, Production Scheduling
General Machinery Division
ALLIS-CHALMERS MANUFACTURING COMPANY
(*Graduate Training Course 1938*)

PRODUCTION CONTROL in a big plant like the Allis-Chalmers West Allis Works is a constant campaign to prevent bottlenecks and keep orders moving along smoothly to meet scheduled shipping dates.

CHESTER E. MEYER

Most men face much the same kind of personal problem when they get out of engineering school and plan a program of graduate training and experience leading to a firm position in the work they want to do. They can't afford to risk bottlenecks and blind alleys in that program, either.

Big Opportunity

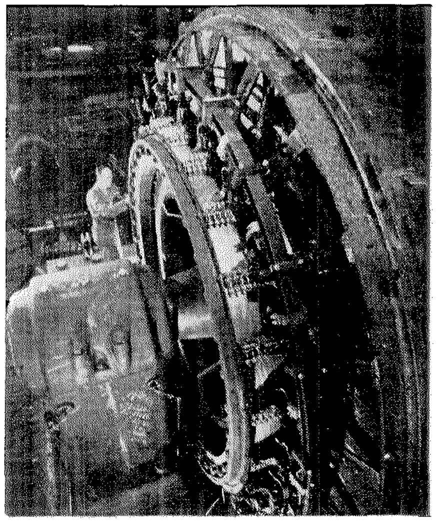
I had this in mind when I graduated from MIT in 1936 and enrolled in the Allis-Chalmers Graduate Training Course. I'd been particularly interested in production and sales. I was looking for practical training, experience and opportunity. And I got them.

First assignment was in Steam Turbine erection. Then I went to the Centrifugal Pump Department, and worked on cost analysis. This job gave me a chance to study plant layout and manufacturing methods, and put me in contact with the Time Study and Planning Department. I liked the work, and finished up the course in that department. I've stayed in the same type of work ever since.

Here in Production Scheduling we pick up each job after the Planning Department has established the routing. It's up to us to set a shipping date, and then work out dates when the job is to be completed in the various shops through which it must go. This requires a thorough knowledge of methods, shop capacities and work loads throughout the entire plant.

Great Diversity of Products

To give some idea of the extent of this operation, here are a few facts about the West Allis Works: The floor area of the buildings is more than 160 acres. There are 14 miles of railway and 4 miles of roads within the plant, and the shops contain more than 30,000 power tools, from small precision machines to the great 40-foot boring mill. It requires 208 traveling cranes to handle materials and equipment. There are twelve great machine, assembly and erection shops, three foundries, pattern shop, tank and plate shop, forge shop, mill shop and many miscellaneous buildings used in manufacturing.



Assembling big direct-current blooming mill motor for test—last step in the manufacturing process before shipment and final installation.

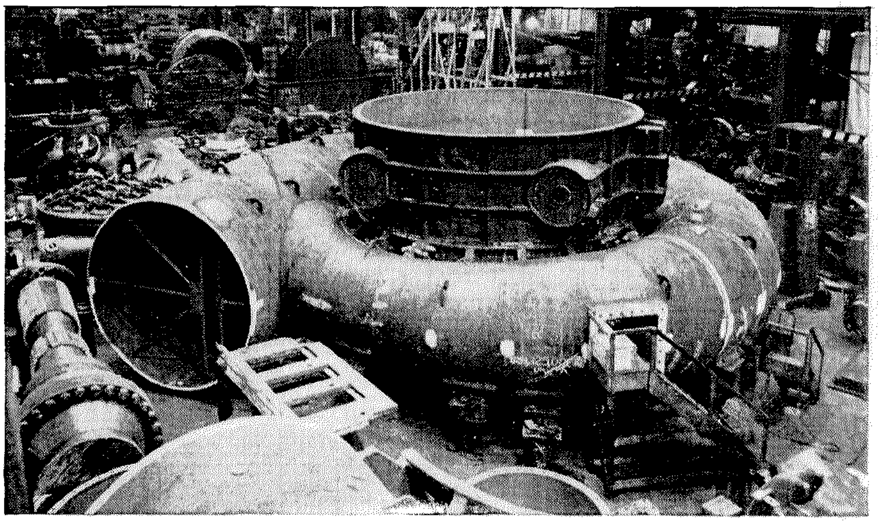
Some of the big jobs going through now include a 107,000 kw steam turbine unit for a midwest utility and two complete new hydraulic turbine and generator units for Hoover Dam. There's an order for six 22,000 hp pumping motors for a West Coast irrigation project, and another for one of the largest power transformers ever built. Rotary kilns up to 400 ft. in length, gyratory crushers weighing 500 tons and 22 million volt Betatrons are all products of these shops. So are delicate electronic and control devices.

Allis-Chalmers designs and builds basic machines for every major industry: steam and hydraulic turbine generators, transformers and other equipment for the electric power industries; crushers, grinding mills, rotary kilns, screens and other machines for mining, ore processing, cement and rock products; flour mills and oil extraction plants; electronic equipment; big pumps, motors, drives . . . to name just a few.

Widest Choice

As you can see, Graduate Training Course engineers at A-C can move in just about any direction they choose—any industry, any type of work from machine design, research and product engineering to manufacturing, selling and installation.

The course is set up to allow students plenty of chance to gain training and experience in the work they choose. There's no reason to run into bottlenecks or dead-end streets—for students help plan their own courses, and are free to change their plans as new interests, new opportunities, present themselves.



Completed parts flow on a planned master schedule from all parts of the great West Allis Works as this large turbine unit takes form. This is a general view of a part of the vast erection shop.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

ALUMNI NEWS

Alumni Calendar, 1950-51

THE 1950-51 ALUMNI ASSOCIATION program gets under way on September 20 when Caltech alumni will be hosts at the traditional Occidental-Caltech Kickoff Luncheon to be held at the Athenaeum. Members of both teams will be on hand, as will the coaches.

After the Oxy game, on September 21, there will be an Alumni Open House on Campus. This event, inaugurated last year, proved to be one of the most successful of all alumni functions. This year, alumni will gather in Dabney Hall after the game—which is being played at Occidental—for refreshments and dancing (both of them free, by the way. This function is on the house).

On December 1 the Alumni Square Dance will be held at the Elks Club in Pasadena.

The annual Dinner Dance date has been set for February 3, at the Oakmont Country Club.

Looking ahead to next spring—Save April 14 for the Alumni Seminar on campus.

Typical scene at the 1950 Alumni Association Field Day, which was held this year in Tournament Park on July 8.

The Annual Meeting of the Alumni Association is to be held on June 6.

Other affairs—dinner meetings in particular—will be set up as prominent speakers can be engaged. But this listing covers the major part of the year's program. There's a handy check list of all these dates on page 37.

1950 Field Day

ONE OF THE GAPS that remains to be filled on next year's Alumni Calendar is the annual Field Day. This year's Field Day, held in Tournament Park on Saturday, July 8, from 1 to 8 p.m., didn't bring as big a turnout as the one held at the Anoakia School in 1949, but it proved to be just about as enjoyable all the same. Softball, volley ball, touch football and tennis were the chief attractions. Not to mention the barbecue dinner. Or the bull sessions. Or—come to think of it—the plentiful cold beer.

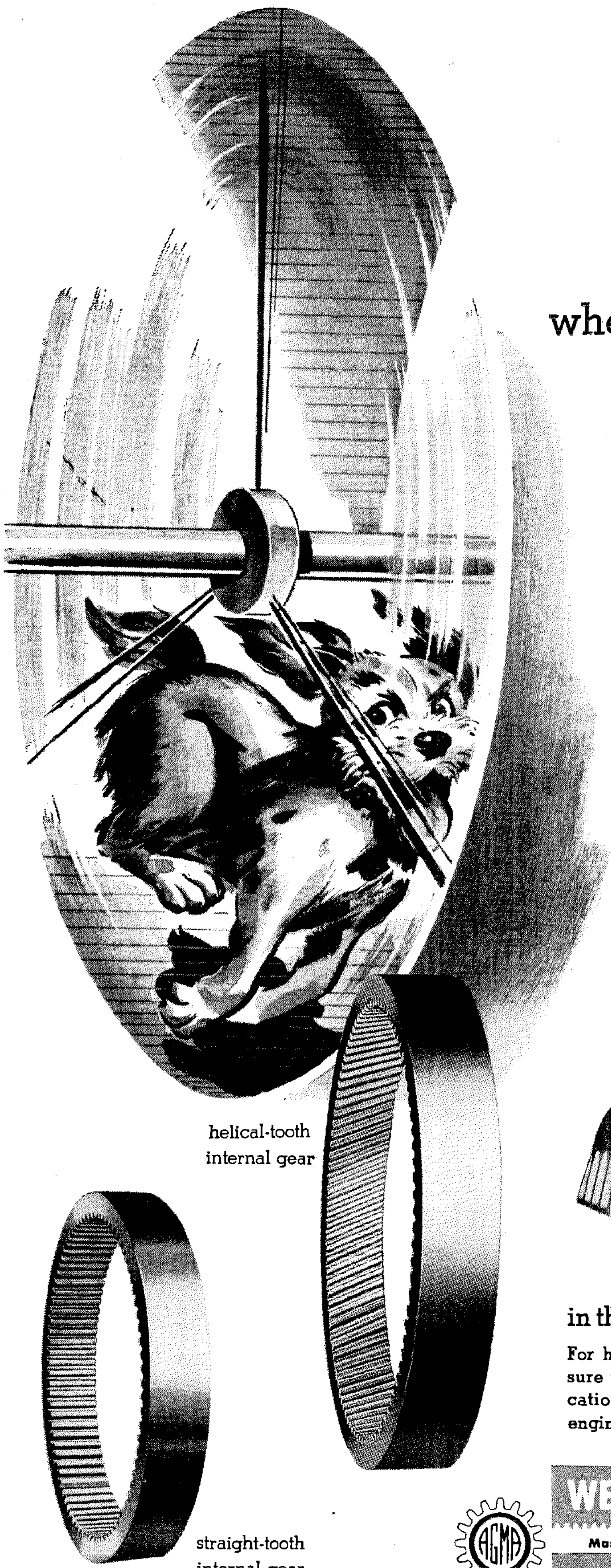
Bob Hare Dies

ROBERT J. HARE '21 died on September 12 in Queen of the Angels Hospital, Los Angeles, as a result of a cerebral hemorrhage. He was 51 years old.

Bob was a member of the Board of Directors of the Alumni Association. After receiving his B.S. in Electrical Engineering from the Institute he joined the Southern California Telephone Company as a student engineer. After several years in the Outside Plant engineering department, he moved into the Transmission and Protection group, with time out in 1935 to serve as Assistant Manager of the Bell System Exhibit at the San Diego International Exposition.

At the time of his death he was a Staff Engineer in the Office of the Chief Engineer of the Pacific Telephone and Telegraph Company in Los Angeles, working on Plant Extension engineering studies. He was a member of the Institute of Radio Engineers and the American Institute of Electrical Engineers.

He is survived by his wife.



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internal gears . . . used in many applications of power transmission where compactness and light weight are important criteria. Helical and straight tooth internals, as well as every other known gear type, are manufactured in our extensive west-coast facilities.

different types

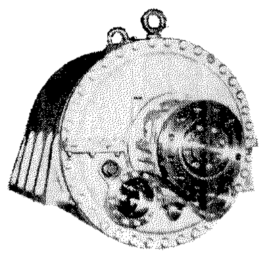
Many configurations of internal gearing have been produced. The commonest in reasonably standard usage, and which can be economically manufactured, are the helical-tooth and straight-tooth designs.

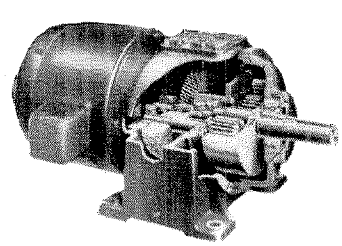
sample applications

A straight-tooth internal gear is used in the final reduction of this industrial Pacific, G-E Motorized, Speed Reducer (below right).

In this planetary marine propulsion unit, helical-tooth internal gearing is employed (below left).

Both units are typical Pacific-Western products—properly designed, employing the right type of gearing for the application.





in the West, it's Pacific-Western Gear Products

For help in *any* question of mechanical-power transmission, be sure to consult a specialist in the design, production, and application of gears and geared products—your Pacific-Western engineer. Call or write your nearest office.

5032

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Pacific Gear & Tool Works

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ALUMNI FUND

Report of the Third Year — 1949-1950

DURING OUR THIRD FUND YEAR, the Caltech Alumni Fund continued its vigorous growth, and reached a cash total of $62,889.19, including income and interest earned. This total sum is the result of gifts from 1,809 loyal alumni, including 47 percent of those alumni who did undergraduate work at Caltech, and 7.3 percent of those who did only graduate work at C.I.T.

During the twelve months preceding June 30, 1950, the Fund grew by $25,018.70. Contributions were received this year from 1,215 alumni, 580 of whom are new contributors. Most of the remaining 635 have contributed regularly each year.

Gifts received by the Fund, broken down by graduating classes, are tabulated below, together with data on the average gifts and the percent of eligibles contributing. The class of '50, our newest alumni, voted to make a class gift to the Fund, thus achieving 100 percent participation for their first year.

Your Fund Committee wishes to thank all of you who have so generously contributed to our first goal—a gymnasium for Tech.

CONTRIBUTORS
1949 - 1950

1896
Haynes, Miss Diantha M.

1900
Harris, Irving C.

1906
Canterbury, H. H.
Maxson, Edgar S.

1911
Ward, Royal V.

1912
Merrifield, J. D.

1913
Gerhart, Ray
Parkinson, Ralph W.

1915
Holt, Herbert B.
Wilcox, Charles H.

1916
Carson, Max H.
Chamberlain, Bernard
Rich, Kenneth W.

1917
Beattie, Joseph A.
Kemp, Archie R.
Kensey, Alexander
Youtz, J. Paul

1918
Andrews, Clark F.
Capra, Frank R.
Essick, L. F.
Heywood, Gene B.
Hoge, Edison R.

1919
Marshall, Fred A.

1920
Barnes, Hartwick M.
Barton, Paul D.
Black, James R.
Hounsell, E. Victor
Hounsell, Theron C.
Lewis, John C.
Linhoff, Harold R.

THIRD YEAR—1949-1950
(As of June 30, 1950)

Year	Total Money Received	Results for Alumni who took Undergraduate Work at C.I.T.					
		Money Rec'd	Number Giving	Average Gift	% of Eligibles Giving	Class Ranking (Av. Gift)	Class Ranking (% Giving)
Prior '15	$ 156.00	$ 156.00	8	19.50	....	12	....
1915	110.00	110.00	2	55.00	25.0	6	23
1916	45.00	45.00	3	15.00	42.9	18	5
1917	60.00	60.00	4	15.00	40.0	18	8
1918	139.26	139.26	5	27.85	17.2	8	34
1919	5.00	5.00	1	5.00	33.3	36	12
1920	205.00	205.00	13	15.77	40.6	17	6
1921	940.00	940.00	10	94.00	27.8	4	18
1922	2645.00	2610.00	23	113.48	40.4	2	7
1923	2555.00	2555.00	22	116.14	52.4	1	2
1924	1710.00	1710.00	17	100.59	23.3	3	27
1925	1130.00	1110.00	34	32.65	44.2	7	4
1926	389.00	354.00	18	19.67	17.6	11	33
1927	333.50	286.00	23	12.43	24.7	26	24
1928	2456.30	456.30	24	19.02	40.0	14	8
1929	462.00	447.00	23	19.43	27.7	13	18
1930	536.26	466.26	20	23.31	18.7	9	32
1931	428.00	423.00	28	15.11	28.3	18	17
1932	1381.00	1381.00	24	57.54	24.5	5	25
1933	272.00	245.00	12	20.42	13.0	10	36
1934	560.00	485.00	30	16.17	29.1	16	16
1935	341.00	317.00	29	10.93	25.7	27	18
1936	567.50	502.50	28	17.95	26.9	15	18
1937	425.00	285.00	19	15.00	16.8	18	35
1938	407.00	378.00	30	12.60	23.6	25	26
1939	373.50	373.50	36	10.07	31.3	29	14
1940	420.00	385.00	29	13.28	20.6	23	30
1941	547.00	527.50	38	13.88	29.5	22	15
1942	488.50	408.50	53	7.71	35.6	32	10
1943	581.00	566.00	43	13.16	34.7	24	11
1944	597.50	577.50	55	10.50	46.2	28	3
1945	492.00	492.00	52	9.46	20.0	30	31
1946	319.00	293.00	34	8.62	21.7	31	28
1947	266.00	226.00	30	7.53	21.7	33	28
1948	395.78	357.78	63	5.68	33.3	34	12
1949	392.00	288.00	53	5.43	25.1	35	22
1950	417.50	417.50	183	2.28	100.0	37	1
Total	$23,648.80	$20,572.80	1119	$18.38	31.2	....	....

Otis, Russell M.
Sawyer, Mark A.
Smith, Donald D.
Smith, Robert Carson
St. Clair, Harry P.
Whitworth, George K.

1921

Case, Henry R.
Champion, Edward L.
Craig, Robert W.
Hare, Robert J.
Honsaker, Horton H.
Makosky, Frank C.
Morrison, Lloyd E.
Mullin, Wynne B.
Quirmbach, Charles F.
Raymond, Albert L.

1922

Ager, Raymond W.
Alles, Gordon A.
Bear, Ralston E.
Bozorth, R. M., Ph.D.
Bulkley, Olcott R.
Catland, Alfred C.
Clever, George H.
Crissman, Robert J.
Darnell, Donald W.
DeVoe, Jay J.
Fleming, Thomas J.
Hall, Albert D.
Henny, Dr. G. C., M.S.
Honsaker, John
Hopper, Francis L.
Jasper, Walter
Keith, Clyde R.
Knight, Alfred W.
Kohtz, Russell H.
Learned, Kenneth A.
Myers, Thomas G.
Ogden, Harold S.
Potter, William D.
Vesper, Howard G.
Whistler, Arthur M.

1923

Baier, Willard E.
Barnett, Harold A.
Blakeley, Loren E.
Dillon, Lyle
Evans, Bernard G.
Fitch, Charles E.
Fowler, L. Dean
Gilbert, Walton E.
Gray, Robert M.
Hopper, Basil
Lewis, Howard B.
Loughridge, Donald H.
North, John R.
Puls, J. H.
Reeves, Hubert A.
Roth, Lawrence P.
Schonborn, Robert
Stromsoe, Douglas A.
Walling, Lloyd A.
Walter, John P.
Woods, Robert E.

1924

Anderson, Kenneth B.
Campbell, Daniel M.
Clark, Rex S.
Dorresten, Edward E.
Gandy, E. Harold
Goodhue, Howard W.
Groat, Frederick J.
Henderson, William G.
Irwin, Emmett M.
Jenkins, Grant V.
Leavitt, Warren B.
Losey, Theodore C.
Maltby, Clifford W.
Miller, Roy
Stoker, Lyman P.
Wakeman, Carrol M.
Winegarden, Howard M.

1925

Alderman, Raymond E.
Allen, William H.
Atherton, Tracy L.
Burmister, Clarence A.
Byrne, Hugh J. P.
Chapman, Albert
Cheney, Lyle H.
Clayton, Frank C. A.
Dalton, Robert H.
Dillon, Robert T.
Erickson, Alfred L.
Foster, Frank M.
Freeman, Henry R.
Fulwider, Robert W.
Hart, Edward W.
Heilbron, Carl H., Jr.
Helms, Jack H.
Henderson, Lawrence P.
Hertenstein, W.
Jones, Walter B.
Karelitz, Michael B.
Larabee, O. Seymour
Maurer, John E.
Maxstadt, Francis W., M.S
Newcomb, Leroy
Noll, Paul E.
Pauling, Prof. L. C., Ph.D.
Pearson, Roland R.
Prentice, Leland B.
Rivinius, Paul C.
Salsbury, Markham E.
Scott, Oliver B.
Simpson, Thomas P.
Spelman, George C.
Thompson, Wilfred G.
Watkins, Robie T.

1926

Bidwell, Charles H.
Coleman, Theodore C.
Edwards, Manley W.
Farly, George M.
Friauf, James B., Ph.D.
Graham, Glenn
Granger, Wayne E.
Halverson, Homer A.
Kiech, Clarence F.
Laws, Allen L.
Lewis, William A., Jr.
Macfarlane, Donald P.
Michelmore, John E.
Moodie, R. W.
Pomeroy, Richard D.
Pompeo, Domenick
Schott, Hermann F.
Sokoloff, Vadim M.
Valby, Edgar
Wulf, Oliver R., Ph.D.

1927

Akers, John F.
Belknap, Kenneth A.
Blankenburg, Rudolph C.
Bower, Maxwell M.
Boyd, James
Collins, George F.
Diamos, G. K. S., M.S.
Farrar, Harry K.
Gardner, David Z., Jr.
Gottier, Thomas L.
Jaeger, Vernon P.
Lilly, Forrest J.
Loxley, Benjamin R.
Mendenhall, H. E., Ph.D.
Peterson, H. Fred
Peterson, Thurman S.
Reynolds, Roland W.
Rodgers, V. Wayne
Ross, Leonard W.
Snyder, Leonard L.
Southwick, Thomas S.
Stanton, W. Layton
Starke, Howard R.
Thompson, Russell E.
Warner, Arthur H., Ph.D.
Wiegand, Frank H.

1928

Armstrong, Dr. R. C.
Beckman, A. O., Ph.D.
Berman, Jack Y.
Brighton, Thomas H.
Coulter, Robert I.

Cutler, Ralph W.
Duval, Richard H.
Evans, Robley D.
Gewertz, Moe W.
Goodall, William M.
Hossack, H. A.
Jacobs, W. Morton
Joujon-Roche, Jean E.
Kaneko, George S.
Kuhn, Jackson G.
Lash, Charles C.
Lombard, Albert E.
Minkler, C. Gordon
Nestle, Alfred C.
Nichols, Donald S.
Olsen, William L.
Ross, Ellwood H.
Sechler, Ernest E.
Thatcher, John W.

1929

Atwater, Eugene
Berman, Isadore
Birge, Knowlton R.
Clark, Donald S.
Cline, Frederick R.
Cravitz, Phillip
Dunham, Fames W.
Evans, Thomas H.
Fredendall, Beverly F.
Grimes, Walter B.
Grunder, Lawrence J.
Hincke, William B.
Hugg, Ernest B.
Huston, Harold M.
Kingman, Kenneth E.
Kircher, Raymond J.
Larrecq, Anthony J.
Lee, Edson C.
Mohr, Wm. H.
Myers, Albert E.
O'Haver, Hubert M.
Roberts, Bolivar
Russell, Kenneth F.
Wheeler, Fred A.
Wolfe, Charles M., M.S.

1930

Arnquist, W. N., Ph.D.
Atkinson, Dr. R. B., Ph.D.
Bode, F. D.
Bungay, Robert H.
Carberry, Deane E.
Chung-Yao, Chao, Ph.D.
DeCamp, L. S.
Giebler, Clyde
Hillman, Ernest C., Jr.
Hodder, Roland F.
Hopper, Rea E.
Howse, S. Eric
Johnson, Josef J.
Johnston, Norris, Ph.D.
Jones, Harlen R. E.
Kinney, Edward E., M.S.
Levine, Ernest
McLean, Ralph S.
Pleasants, J. G., M.S.
Pritchett, Jack D.
Ross, George A.
Sheffet, David
Stipp, Theodore
Thayer, Eugene M.
Whitman, Nathan D.
Zipser, Sidney

1931

Alden, Lucas A.
Arnold, William A.
Biddle, Russell L., Ph.D.
Bolles, Lawrence W.
Boothe, Perry M.
Bovee, John L., Jr.
Cogen, William M.
Detweiler, John S.
Gerschler, James M.
Green, E. F.
Ingham, Herbert S.
Keeley, James
Kircher, Charles E., Jr.
Kuykendall, Charles E.
Langsner, George
Leeper, Laverne D.
Lehman, Robert M.
Lewis, George E.
McMillan, John R.
Murdock, DeWolfe
Overhage, Carl F. J.
Peer, Edward S.
Peterson, Raymond A.
Pratt, Leland D.
Saygol, Charles C.
Sinnette, J. T., Jr.
Smits, Howard G.
Stein, Myer S.
Terry, Paul M.

1932

Anderson, David W.
Arnerich, Paul F.
Atwood, Albert W., Jr.
Bascom, John D.
Behlow, Lewis B.
Bradburn, James R.
Coryell, Charles D.
Crater, Myron L.
Freeman, Robert B.
Harsh, Charles M.
Kent, W. L.
Lyons, Patrick B.
Pickering, William H.
Pruden, Worrell F.
Roach, Harold
Schuhart, Mervin A.
Schultz, Wm. O.
Sheffet, Joseph
Shockley, William
Shull, George O.
Sparks, Brian O.
Swart, Kenneth H.
Thomas, William J.
Wilson, Chester E.

1933

Berkeley, G. Merrill
Binder, Raymond C., M.S.
Clifford, Alfred H., Ph.D.
Davis, Madison T.
Engel, Rene, Ph.D.
Gould, Laurence K.
Johnson, J. Stanley
Lewis, Wyatt H.
Meskell, John E.
Moore, Wm. W.
Perrine, Charles D., Jr.
Prater, Arthur N., M.S.
Randall, John A.
Russell, Richad L.
Spade, J. Clifton
Widess, Moses B.

1934

Anderson, Robert C.
Bollay, William, M.S.
Boykin, Robert O.
Campbell, James R.
Cogen, Saul
Craig, Carroll C.
Desmond, Jack M.
Dietrich, R. A.
Donahue, Willis R., Jr.
Etter, L. Fort
Gordon, Garford
Gulick, Howard E.
Hallanger, Norman L.
Haskins, Ray W.
Howard, Ernest R.
Lien, Elvin B.
McCann, Gilbert
McClain, F. J.
McRae, James W.
Moore, Morton
Naylor, Ralph A.
O'Neil, Hugh M.
Paxon, E. W.
Pearne, John F.
Rooke, Donald R.
Rucker, George F., M.S.
Schaak, Frank A., Jr.
Sharp, Robert P.
Sherborne, John E.
Sluder, Darrell H.
Ugrin, Nick
Van Osdol, George W.

1935

Baldwin, Lawrence W.
Becker, Leon
Beman, Ward W.
Blair, Charles M., Ph.D.
Davenport, Horace W.
Davies, James A.
Dewees, Norman B.
Edwards, Eugene L.
Engelder, Dr. Arthur E.
Etz, Arthur N.
Evans, M. H.
Field, Frank
Fussell, Robert G.
Garner, Clifford S.
Gluckman, Howard P.
Higley, John B.
Jahns, Richard H.
Leppert, Elmer L.
Lindsay, Chester W.
McLean, William B.
Maloney, Fred V.
Rader, Louis T., M.S.
Ray, A. Allen
Reynolds, Edward H.
Ribner, Herbert S.
Roehm, Jack M., M.S.
Slater, Alfred L.
Snow, Neil W.
Stanley, Robert M.
Stick, John C., Jr.
Stuppy, Dr. Lawrence J.
Van Reen, Mabry

1936

Boothe, Raymond H. F.
Bush, Kenyon T.
Carley, Glenn R.
Davis, Frank W.
Dickinson, Holley B.
Douglass, Malcolm E.
Folland, Donald F.
Frost, Arthur M.
Graham, Ernest W., M.S.
Hammond, Paul H.
Heath, Charles O., Jr.
Henderson, Everett B.
Hinshaw, Meral W.
Jensen, Ray
Johnson, Ford L.
Jordan, Charles B.
Klocksiem, John P.
La Boyteaux, Ellsworth
McMahon, M. M.
McRary, Willard L.
Marsh, Robert H.
Meneghelli, Hugo A.
Muller, Conrad R.
Peugh, Verne L.
Sklar, Maurice
Thompson, Rev. Tyler F.
Unholtz, Karl
Whipp, David M.
Woolridge, D. E., Ph.D.

1937

Benton, Ralph S., Jr.
Brice, Richard T., Ph.D.
Carroll, George E.
Cornwall, Ellsworth W.
Ellison, W. J., Jr., M.S.
Fenzi, Warren E.
Frost, Holloway H.
Harper, Dr. Thomas S.
Leggett, Jasper Ridgley
Levinton, Harold L., M.S.
Lloyd, Dr. Paul E., Ph.D.
Lockwood, Robert B.
Miller, Dr. Harry H.
Miller, Nash H., M.S.
Miller, Wendell B.
Moore, Walter Leon
Nichols, Dr. Dean, M.D.
Nolte, Claude B.
Poggi, Martin J.
Radcliffe, Fremont
Ridgway, Richard L.
Schaffner, Paul C.
Strong, Dean Foster, M.S.
Walley, Bernard
Webster, Martin H.
Wetmore, William O.
Wickett, Walton A.

1938

Althouse, Wm. S.
Baker, John R.
Bertram, Sidney
Cardwell, W. T.
Clarke, Charles W.
Dennis, Paul A.
Dixon, Blaine A., Jr.
DuFresne, Armand F.
Ellis, Herbert B.
Evans, Henry K.
Farneman, John D.
Friend, Carl F.
Graybeal, Oran A., Jr.
Harris, Clyde W.
Hopkins, Henry S.
Horine, Carlton L.
Ives, Phillip, Ph.D.
Jewett, Frank B., Jr.
Jones, Ralph W., Jr.
Jurs, Albert E., Jr.
Keller, Samuel H.
Knight, Jack W.
Kryopoulos, P. R., M.S.
McGraw, John T.
McLean, John G.
Nagamatsu, H. T.
Nash, William F., Jr.
North, H. Q.
Osborn, Elburt F., Ph.D.
Palmer, Kenneth J., Ph.D.
Rosencranz, Richard, Jr.
Schomaker, Verner, Ph.D.
Stone, Roland C.
Velasquez, Jose L.
Wilson, Gardner P.
Wood, Homer J.

1939

Anderson, Noah H.
Bishop, Richard H.
Black, John W.
Bonell, Wm. H., M.S.
Bragg, Kenneth R.
Braithwaite, J. W.
Brown, Perry H.
Carstarphen, Charles F.
Connelly, Ronald B.
Craft, Claude Howard
Crozier, George O.
Davis, Harry O., Jr.
Evvard, John C.
Fischer, Harold, M.S.
Fischer, Richard Alfred
Flint, Delos E.
Gerhart, Ray Van Deusen
Goodell, Jack H.
Green, Albert P.
Green, Wm. M.
Hotz, George M.
Lavatelli, Leo S.
Lawson, William G.
Levet, Melvin
Matthew, T. R.
Osborn, John E.
Paul, Carlton H.
Pullen, Keats A.
Ritchey, James C.
Ruggiero, Ralph J.
Shultise, Quido M.
Smith, Josiah E.
Snyder, Willard M.
Stones, J. Eugene
Sullivan, Edwin F.
White, Robert W.
Winchell, Robert W.

1940

Blackinton, Roswell J.
Brose, Frederic M.
Burton, Clifford C.
Ch'en, Shang-Yi, Ph.D.
Cox, Robert O.
Daams, Gerrit
Davies, Claude E.
Dickerson, Edward O.
Foster, Gerald P.
German, Irvine F., Jr.
Gewe, Robert A.
Glassco, Robert B.
Harper, John C.
Jongeneel, James W.
Keighley, G. L., M.S.
Moore, Robert S., M.S.
Nakada, Yoshinao
Palmer, Charles S.
Quarles, Miller W., Jr.
Ray, Robert S., Jr.
Richards, Raymond G.
Russell, Charles D., M.S.
Scarborough, W. Bertram
Smith, Randlow
Steinmetz, David H., III
Stevens, Jean B.
Stone, William W., Jr.
Stoner, Willis A.
Todd, George J.
Van Dyke, Gilbert
Walter, Don
Wells, Robert L., M.S.
White, Howard J.
Worcester, Herbert M., Jr.

1941

Bersbach, Alfred J.
Billman, Glenn W.
Bowles, Robert R.
Bramhall, George H.
Brooks, Philip D.
Campbell, Donald C.
Casserly, Frank G.
Chapin, Wm. F.
Cooper, Robert G.
Corcoran, William H.
Davis, Walter Z.
Dobbins, Willis E.
Edwards, Gene L.
Eusey, Merritt V.
Gally, Sidney K.
Greenhalgh, Francis M.
Hall, Edward A., M.S.
Harlan, James T., Jr.
Harr, George B.
Hiatt, John B.
Jones, G. A.
Jones, Jeremy A.
Jones, Oliver K.
Leighton, Robert B.
Lewis, Joseph W., Jr.
Myers, Charles S., M.S.
Myers, Robert F.
Palmer, John G.
Partch, Newell T.
Partlow, John G.
Paulson, John J.
Rominger, Joseph F.
Rupert, Claud S.
Silberstein, Richard F.
Snodgrass, Reuben
Sohler, Stanley E.
Stewart, Wilton A.
Trindle, Joseph W.
Wahrhaftig, A. L., Ph.D.
Wallace, Roger W.
Weight, Robert H.
Wood, David S.

1942

Albrecht, Albert
Allan, John R.
Almassy, George W.
Andrews, Richard A.
Atkinson, Thomas G.
Bartlett, Edward R.
Bauer, Frederick K.
Bergh, Paul S.
Brandt, Roger
Brown, Charles M.
Brown, Sheldon W., A.E.
Bruce, Victor G.
Church, A. Stanford, M.S.

Clingan, Forest M.
Cox, Richard H.
Densmore, Robert E.
Devault, Robert T.
Felberg, Frederick H.
Franzini, Joseph B.
Fuller, W. P., Jr., M.S.
Gold, S. Kendall
Hall, Robert N.
Head, Alfred B.
Head, Richard M.
Hendrickson, Willard J.
Hicks, William B.
Hill, David L.
Hoagland, Clifford C.
Hunt, Carter
Irving, Jack H.
Jephcott, Donald K.
Kennedy, Wm. G.
Kumm, Emerson L.
Lind, George W., Jr.
Lutz, Philip B.
Lyle, Francis V.
McClain, John F., Jr.
MacRostie, Wayne
Mader, Paul M.
Makepeace, G. R.
Mitchel, Walter P.
Nyborg, Meredith M.
Paul, Albert D.
Pichel, Pichel W.
Price, Harrison A.
Rubel, John H.
Schureman, Kenneth D.
Shapiro, Haskell
Smith, Jack C., Ph.D.
Tomlinson, E. P., Ph.D.
True, Leighton J.
Urbach, Kenneth
Van Orden, Roy C.
Veonhuyzen, Paul N. A.
Veronda, Carol M.
Webster, Paul W.
Weller, LeRoy A., Jr.
Widenmann, John A.

1943

Atkins, Earle R., Jr.
Bacon, John W., Jr.
Blayney, James A.
Buchanan, John Wm.
Bunker, Earle R., Jr.
Carter, Claude L.
Christeanson, W. L.
Dubbs, Clyde A.
Farmer, Howard N., Jr.
Frost, Robert C.
Granicher, Donald I.
Griffith, George D.
Gustavson, Robt. G.
Halpenny, William H.
Hull, James B.
Johnson, Kenneth W.
Jones, Wendell L.
Kendall, George A.
Klein, David J.
Larson, Robert L.
Lawrence Theodore G.
Lingle, Harrison C.
McGee, Charles G.
Mead, Orin
Miller, Herman
Moore, Robert A.
Morris, Deane N.
Neufeld, Lester N.
Powlesland, Kenneth L.
Pugh, Lawrence R.
Reid, D. C.
Rhoades, Rex V.
Ridland, Alexander C.
Schneider, Arthur J. R.
Sherwin, Robert M.
Smith, M. Curtis
Steinle, Shelton Edward
Stephenson, Jack D., M.S.
Stirling, Cedric W., M.S.
Strickland, Charles P.
Sutton, Richard A.
Tenney, Frederick
Terrell, Oscar D.
Wheelock, Wayne S.
Young, James A., Jr.

1944

Allingham, Robert E.
Almquist, Charles C., Jr.
Amster, Warren H.
Andrews, Tway W.
Bair, William P.
Chadwick, Joseph H., Jr.
Clendenen, Frank B.
DeRemer, Kenneth Ross
Dethlefsen, Douglas G.
Donsbach, Weldon R.
Earl, Joseph B.
Furer, Albert B., M.S.
Garland, John J., Jr.
Green Leon, Jr.
Greenwood, Donald T.
Higgins, Horace M.
Hinton, Warren D., Jr.
Hughes, Winfield H.
Kettler, Jack R.
Knemeyer, Franklin H.
Knudsen, Richard A. B.
Kruse, Frederick W., Jr.
Kuhns, Richard E.
Lester, Robert W.
Lin, Chia-Chiao, Ph.D.
Lockwood, Wm. E., Jr.
Long, Neville S.
McAnlis, Robert G.
Martin, Joseph S.
Miller, Charles B.
Mettler, Ruben F.
Mitchell, John A.
Morris, Fred W., Jr.
Nahas, Robert T.
Neutzel, Hans
Odell, Francis E.
Osgood, George M.
Parks, Robert J.
Proctor, Brian
Rattray, Maurice, Jr.
Rempel, John R.
Saplis, Raymond A.
Schnacke, Arthur W.
Shor, George G., Jr.
Sigworth, Harrison W.
Smith, Frank C., Jr.
Smith, George F.
Smith, Philip B.
Smith, Philip H.
Soike, Richard J.
Soloman, Joseph
Swanson, Wilbur M.
Trilling, Leon
Ukropina, John R.
Weidman, Robert M.
Whitmore, John F.
Zivic, John A.

1945

Austin, Dale H.
Bennett, Robert R., M.S.
Bolster, Eugene W.
Cutler, Charles R.
Davy, Louis H.
Dodder, Donald C.
Elko, Edward R.
Elliott, William J.
Erkel, Albert A.
Fenn, George S.
Ford, Harold H.
Francis, Donald L.
Gerber, Raymond C., Jr.
Gerty, John M.
Harrington, Jerome
Harvey, Clifford O., Jr.
Henry, Richard V.
Hook, Joseph F.
Jasper, Richard N.
Killian, Roy G.
Kling, Harry P.
Knox, Robert V.
Leo, Robert E.
Levin, Leslie H.
Mac Dougall, Donald D.
Macomber, Mark M.
Markham, Richard G.
Moore, Max H.
Myers, William A.
Nichols, John H.
Ott, Lloyd E.
Parker, Warren H., Jr.
Parks, Jerome W.
Phillips, Robert E.
Prudden, Terry M.
Scapple, Robert Y.
Schmoker, Robert F.
Shauer, Kenneth M.
Snyder, Donald C.
Springer, Richard E.
Stefanoff, John J.
Stern, John L.
Stevenson, Kenneth M.
Sullivan, Grant D.
Taylor, Edward C., Jr.
Tillman, Donald C.
Tookey, Robert C.
Traverse, Donald K.
White, Ralph S.
Wilson, Melvin N., Jr.
Winter, Ralph D.

1946

Ahern, Dennis J.
Barnes, John W., M.S.
Buford, Phillip N.
Burdg, Charles E.
Burke, John J.
Calligeros, John P.
Chalmers, James F.
Colley, Joseph P.

Delano, Richard H.
Deodati, Joseph B., M.S.
Ellis, Douglas S.
Essig, Frederick C.
Fayram, Richard A., M.S.
Fleming, John E.
Frohman, Robert N.
Gates, Frank S.
Hopkins, Donn E.
Hufford, George A.
Ida, Edward S.
Jensen, Louis K.
Jessen, Howard E.
Jurach, Paul J.
Kuck, Richard G.
Lang, Serge
Lewis, Charles H., M.S.
Lockwood, Glynn H.
McCarthy, James L.
Meixner, George D., Jr.
Misner, William G.
Nurre, Vincent W.
Rechtin, Eberhardt
Siegel, Robert C.
Steele, Harry M., Jr.
Stephenson, Elliott O.
Strong, Herbert W., Jr.
Wilburn, Wm. C., M.S.
Woods, Howard R.
Zagorites, Jerry A.

1947

Bearson, Robert
Belyea, Robert C.
Bennett, Dudley
Beymer, Ellis H.
Caldwell, David O.
Comlossy, Harold
Cooke, David A., M.S.
Cowan, Edwin J.
Felberg, Richard L.
Gammans, George G.
Hall, Elmer E., Jr., M.S.
Hawthorne, Robert G.
Hodges, Merwyn E.
Imster, Harry F., M.S.
Keck, Henry C., I.D.
Lund, Le Val, Jr.
McClure, Gordon
McDonald, Robert R.
Mason, John L.
Mendes, Stanley H.
Miller, Charles N.
Moore, Return F.
Mueller, Albert H. J.
Opperman, David R.
Pascoe, Lucien A.
Rice, Harold E., A.E.
Royden, Herbert N.
Schwennesen, J. L., M.S.
Shaw, Charles B., Jr.
Shoemaker, Eugene M.
Six, Lyle D.
Terry, John P.
Trueblood, K. N., Ph.D.
Vadhanapanich, Charoen
Van Deerlin, David B.
Vieweg, Arthur F.
Werner, Parard B.
Wyszpolski, E. F., M.S.

1948

Alexander, Richard C.
Anderson, Roger A.
Attias, John J.
Bagley, Alan Stevenson
Barlow, Griffith C.
Barraclough, Robert P.
Baugh, Harold W.
Bayley, Rupert M.
Blenkush, P. G., M.S.
Botts, William E.
Brown, Robert J. S.
Buchanan, J. M., M.S.
Butler, Stuart M., Jr.
Chinn, Elroy Kui Chon
Christopherson, W. A.
Cox, Arthur N.
Dalton, Robert D., Jr.
Davis, James Robert
Davis, Wayne K.
Deutsch, Daniel H.
Ferrell, Richard A.
Fletcher, Taylor C.
Fullerton, Paul Wm., Jr.
Fung, Yuan-Cheng, Ph.D.
Gavril, Bruce D.
Hall, Edward N., M.S.
Harrison, Stanley R.
Hedenberg, John W.
Henigson, Robert
Hybertsen, Horace M.
Kaplan, Abner
King, Robert I.
Lamson, Philip
Lang, Thomas G.
Lewis, Howard B., Jr.
Lovelace, Donald E.
MacMillan, Robert S.
Markowitz, Irwin L.
Marshall, Warren M., III
Mehl, Ross M.
Moore, Boude C.
Mullen, John K.
Murphy, Charles G.
Oberman, Carl R.
Olson, Norman E.
Otto, Donald W.
Paul, Charles Craig, I.D.
Peeler, Robert, Jr.
Phillips, E. V., M.S.
Rasmussen, John O., Jr.
Rigsby, George Pierce
Roberson, Harvey L.
Roehm, Richard M.
Roskowski, Edward F.
Ruddick, Ronald B.
Rypinski, Chandos A., Jr.
Sefton, Wayne E.
Shiells, James F., Jr.
Skogstad, Leif, M.S.
Spalding, Donald P., Jr.
Stix, Thomas H.
Stone, Robert S.
Tracy, Tom
Waters, Alfred Earnest
Wechsler, Joseph W.
Williamson, William J.
Winchester, Robert L.
Wolf, Frank J.
Zacharias, Robert

1949

Allen, Thomas E., I.D.
Allinder, Forrest S., Jr.
Andres, John M.
Archer, William E.
Barnes, Stanley M.
Barr, John G.
Bornstein, Murray S., M.S.
Brown, Douglas R.
Browne, Davenport, Jr.
Carter, Hugh C.
Curtis, F. A., Jr., M.S.
Dantine, Walter A., M.S.
Dobrowolski, Joseph A.
Drapes, Alex G.
Fasola, Henry, Jr.
Flam, Frederick H.
Fletcher, Aaron N.
Forester, Charles F.
Funk, Robert B.
Gardiner, Kenneth W.
Gould, Nathaniel
Green, Alan H., M.S.
Green, Joseph M.
Greene, Ronald C.
Harmon, Leonard E., A.E.
Hayward, David K.
Heiman, Jarvin R.
Herzig, Wayne M.
Hibbard, Don E.
Hubay, Paul W.
Hummel, James A.
Johrde, Raymond A.
Katz, Eli
Keinonen, Frank W.
King, Daniel W.
Knight, Charles H., Jr.
Kohnen, Keith D.
Kostelac, John F.
Love, John R.
Lowrey, Richard O., M.S.
McIntosh, James A., I.D.
Morrison, Donald R.
Muehlberger, William R.
Nicolai, Fred H.
Patterson, Richard L.
Peterson, Donald W.
Pilling, Robert R.
Pyle, William D.
Rosicky, Fred G., M.S.
Rumer, William I.
Satre, Leland H.
Schneider, Fred C.
Shore, Bernard
Simons, William H.
Six, Don E.
Six, Gene D.
Smith, Emerson W., M.S.
Thomas, John H.
Vaughan, Philip A., Ph.D.
Vogel, Milton C.
Vrabec, Arundale
Walance, Charles G.
Walquist, Robert L.
Waters, Warren P.
Witkin, Donald E., M.S.
Wolf, Leo, I.D.

PERSONALS

1914

Virgil F. Morse writes that he is working for the City of Los Angeles as C.E. assistant in the Van Nuys Branch of the City Engineer's Office. Currently concentrating on street design, he worked on the Hyperion Sewage Disposal Plant before his transfer to the Van Nuys Branch. The Morses live in Pacoima, have five children (four boys and a girl) and—at last report—nine grandchildren.

1924

George B. Stone has been General Manager of the Los Angeles Branch of the Pacific Electrical & Mechanical Co. since 1943. The company, which engages in electrical construction and contracting, has installed the electrical wiring in a number of buildings on the Caltech campus—has, in fact, just finished installing the electrical work in the new M.E. building.

1921

Malcolm MacDonald, ex-'21, is now Principal of San Fernando High School in Los Angeles.

E. H. Minitie, General Manager of the Minitie Company, Filtration Engineers, reports the arrival of a new grand-daughter in June. This makes it five children and four grandchildren for the Minitie family, and Ernie not only thinks this entitles him to the prize for the class of '21, but "should be a fair challenge to some of the rest of the years too."

1925

Edwin F. Thayer, until recently editor of *Tide*, a national magazine in the advertising field, is now business manager of the midget magazine *Quick*. He is living in Westport, Conn.

Horace C. Adams writes that he's still with the Electrochemicals Dept. at E. I. du Pont de Nemours & Co., but during the past year he's been shifted around as follows: In October 1949, he left his post as Plant Superintendent at El Monte, California, to take on a special assignment in the Production Division at Wilmington, Delaware. In May, 1950, he moved out of this spot into the Production Division of the plant at Niagara Falls, N. Y.—where, when last heard from, he still was.

1926

Robert W. Moodie is now employed as a Senior Structural Engineer by the State of California—in the Design & Planning section of the Division of Architecture of the Department of Public Works in Los Angeles. Two other Tech men in the same Section are *Raymond H. F. Boothe* '36 and *Edwin G. Johnsen* '43. And Tech men in the same Division include *Ralph T. Taylor* '18, and *Ernst Maag* '26.

Manley W. Edwards, who for the past 13 years has served as an engineer on the staff of the Public Utilities Commission of the State of California, has been promoted to the new position of Supervising Engineering Examiner. This position was created on July 1, 1950 to expedite the processing and hearing of the many applications for rate increases by the major private electric, gas, water and telephone utilities in the state.

Dr. Trygve D. Yensen, Ph.D., manager of the magnetic department of the Westinghouse Research Laboratories in East Pittsburgh, Pa., died on July 2 in Prestwick, Scotland. Dr. Yensen, who had retired from his Westinghouse post just a week previous, was en route to Oslo, Norway, to pass his retirement with his four brothers.

Dr. F. A. Nickell, M.S. '28, Ph.D. '31, returned to his home in Pasadena for a short vacation this summer from his job as consulting geologist for the Israel government in the Near East. His job is to suggest the best method of irrigating Israel.

ALUMNI ASSOCIATION OFFICERS

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G. K. Whitworth '20

VICE-PRESIDENT
R. P. Sharp '34

SECRETARY
D. S. Clark '29

TREASURER
H. R. Freeman '25

BOARD OF DIRECTORS
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Theodore Coleman '26
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Donald C. Tillman '45
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William O. Wetmore '37

ALUMNI CHAPTER OFFICERS

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Hagen Lane, Flossmoor, Ill.
Pullman-Standard Car Mfg. Co., 1414 Field St., Hammond, Ind.

VICE-PRESIDENT Le Van Griffis '37
11141 S. Longwood Dr., Chicago 43
Armour Research Foundation, 35 W. 33rd St., Chicago 16

SECRETARY-TREASURER Eben Vey '41
5125 S. Kenwood, Chicago 15
Illinois Institute of Tech., 3300 S. Federal St., Chicago

San Francisco Chapter:

PRESIDENT R. I. Stirton '30
745 Alvarado Road, Berkeley
Oronite Chemical Co., 38 Sansome St., San Francisco

VICE-PRESIDENT Jerome Kohl '40
1149 A High Court, Berkeley 8
Tracerlab, Inc., 2295 San Pablo Ave., Berkeley

SECRETARY-TREASURER R. R. Bowles '41
7960 Terrace Drive, El Cerrito
Calif. Research Corp., 576 Standard Ave., Richmond

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

New York Chapter:

PRESIDENT Richard K. Pond '39
174 North 19th St., East Orange, N. J.
Westinghouse Electric Co., 150 Pacific Ave., Jersey City, N. J.

VICE-PRESIDENT Mason A. Logan '27
17 Pittsford Way, Summit, N. J.
Bell Telephone Labs, 463 West St., New York City

SECRETARY-TREASURER Erwin Baumgarten '40
302 E. Front St., Apt. B-16, Plainfield, N. J.
Calco Division, American Cyanamid Co., Bound Brook, N. J.

Washington, D. C., Chapter:

PRESIDENT Charles Lewis Gazin '27
6420 Broad St., Brookmont, Md.

SECRETARY-TREASURER Clarence A. Burmister '25
5704 Wilson Lane, Bethseda 14, Md.

"More than 200,000 immigrants poured into the area last year," he said, "and next year another 450,000 are expected... In spite of this huge influx of people, however, the land is not incapable of growing food . . . What these people need is water."

Dr. Nickell was formerly connected with the United States Department of Reclamation and he participated in the planning and building of Hoover and Grand Coulee Dams.

S. B. Biddle, Jr., still working for Leeds & Northrup, moved from the San Francisco to the Seattle office over the summer.

1929

Harold M. Huston comes up with a full-dress account of his activities through the last decade—which, he adds, seems to have been "the most rugged of all."

"Pressure from all directions is intense," he says, "—business, civic, fraternal, fiscal, juveniles, bebop, TV and taxes. Have a daughter in Stanford, a swain-aged son in South Pasadena High. Took and taught ESMWT (Engineering, Science, Management and War Training) courses in Caltech's Industrial Relations Section during the war; then taught a course in cost estimating to the now-extinct Industrial Design graduate students.

"After a term on the Alumni Association Board, I got involved in quick succession with the Boy Scouts, YMCA Board of Directors, YMCA Camp and then a term on the South Pasadena Community Chest—of which I was president last year. After a dozen years with C. F. Braun am now nearing a dozen with the Southwest Welding and Manufacturing Company in Alhambra. Still have the same slide rule, same wife, and same nickname—but less and less justification for it." *(The nickname? — "Hasty").*

Robert J. White, still with the Baroid Sales Division of the National Lead Co., has shifted from the Houston, Texas, to the Los Angeles office.

W. J. Olney, partner in the Olney Brothers rug and furniture cleaning firm in Pasadena, has been elected president of the East Pasadena Lions Club.

1930

William B. Hatch, Jr. writes that he's still in the general insurance and land surveying business in Twentynine Palms, now has three daughters.

Roscoe Downs, a member of the firm of Bressi & Bevanda in Los Angeles, is general manager of the contractor's operations for all tunnel and surge-chamber work on the Owens Gorge Hydro-Electric Project. The project — for the development of 112,500 kw of power — is being built for the City of Los Angeles 20 miles north of Bishop.

1933

Stan Keenan writes from Venice that he's now working for the Los Angeles City Power System as an Assistant Automotive Engineer, after having taught school for two years at the Cal-Aero Technological Institute in Glendale. During the war he worked at Douglas Aircraft.

Earl E. Barnett has been on Pacific Tel. & Tel.'s General Plant Staff since the war, in connection with radio and television services. For the past year he has been in charge of toll and television service in Hollywood and at Mount Wilson, as Supervising Wire Chief. He's moved to Hermosa Beach, "where the swimming and fishing are both good and our seven-year-old son enjoys the beach as much as Hopalong Cassidy on TV."

1934

Duncan A. McNaughton, M.S., received his Ph.D. in Geology at USC this June.

Carroll C. Craig writes that he has, for the past three years, been owner and general manager of the Fidelity Manufacturing Co. in Los Angeles, manufacturers of photographic equipment. He is a Lieutenant Commander in the USNR and, since September 1949, Commanding Officer of the Los Angeles Volunteer Reserve Ordnance Unit.

1935

John Ritter is resident engineer for the State Division of Highways on the construction of the Virgil Ave.-Western Ave. unit of the Hollywood Freeway.

Kenneth S. Pitzer appeared in the August 29 issue of *Look* as one of the people whom Look Applauds. "At 36," says *Look*, "he holds perhaps the most challenging scientific job in the world . . . Director of the Division of Research of the U. S. Atomic Energy Commission. As such, he coordinates all atomic research in the physical sciences in universities and AEC laboratories."

Tyler Thompson, who received his Ph.D. in Philosophy at Boston University in June, is now a member of the faculty of Allegheny College in Meadville, Pa. He is married and has three daughters.

Jack Paller has been working for the City of Long Beach since returning from a job on the Columbia River Highway in Oregon. He recently passed the two-day exam for Civil Engineer Registration, has decided to stay in Southern California permanently, "after quite a bit of roving."

1939

John Kaye, M.S. '48, who has been working at the Institute's Hydrodynamics Laboratory since December 1945, joined the faculty of George Washington University (in Washington, D. C.) as Assistant Professor of Mechanical Engineering.

Delos Flint, geologist with the U. S. Geological Survey in Washington, D. C. was married in New York this summer to Frances McCormick of Delmar, N. Y. *Raymond A. Saplis* '44 was best man, *Ray Gerhart* '39 one of the ushers.

1940

John Bell Cabell, M.S., was killed accidentally in a fall at White Water Falls, S. C. on May 27. He had been on active duty with the Corps of Engineers.

J. M. Watkins has become Assistant to the Head of the Design and Production Department at the Pasadena Annex of the Naval Ordnance Test Station.

Cyd Biddison writes that he's still working as Structural Designer for John Case, Structural Engineer, in Los Angeles. Cyd's son, Mark Ellis, is 17 months old now, and a daughter, Celeste Marie, was born last March.

D. B. Carson is back in the Los Angeles office of the General Electric Co., after completing a one-year refresher course in the Industrial Engineering Divisions of GE at Schnectady, New York.

Pierre Marcel Honnell, M.S., received his Ph.D. at Saint Louis University last June.

Victor Wouk, M.S., Ph.D. '42, who has been President and Chief Engineer of the Beta Electric Corp. in New York City since it was founded in 1947, writes that the firm has now taken larger quarters, with five times the production area of the old plant. The company specializes in custom-built high voltage power supplies, along with a standard line of kilovoltimeters, electronic microammeters, portable 0-30 KV power supplies, and portable projection oscilloscopes.

William D. Lewis, M.S., has been advanced to the post of senior geologist in the Bakersfield offices of the General Petroleum Corporation. He has been with the firm since 1945.

1941

Preston M. Hill, M.S., received his Ph.D. in June from Ohio State University.

Robert R. Bowles has taken on a new job as research engineer for the California Research Corp., doing technical service work in catalytic cracking at the Richmond refinery of the Standard Oil Company of California. The Bowles's welcomed a third son, Steven Edward, last February. Robert Jr. is now 7 and Richard 5.

Major Frank G. Casserly, USMC, received his M.S. in Engineering Electronics from the U. S. Naval Postgraduate School at Annapolis in June. He is now stationed with the Marine Corps Equipment Board in Quantico, Va.

1942

Frank Andrew Fleck and his wife have a new daughter, Barbara—born July 5.

Joseph B. Franzini, M.S. '43, recently received a PhD. from Stanford, is now acting as Assistant Professor of Civil Engineering there. He and his wife announced the birth of their third child—and first girl—on June 15.

J. R. Allan writes that he's still at Todd Shipyards in San Pedro; was married in 1947 to Margaret Follansbee; had a son, Robert, born in 1948; is active in several southern California pipe smokers clubs, a v.p. in the International Association of Pipe Smokers Clubs—and would be pleased to hear from anyone interested or curious about pipe club activity.

S. K. Gold and his wife announce the arrival of their first child, a boy, on May 27th.

1943

John M. Essick, M.S., and Rose Koumjian were married this summer in Hollywood, and took off on a two-month wedding trip through Canada.

O. D. Terrell comes up with a full set of vital statistics—as follows:

Family: Wife Kathryn, Married 1947
Son Jeff, Born 1949
Work: Naval Ordnance Test Station, Pasadena; Mechanical Engineer; Head, Structures Branch
Home: Arcadia; Moved into new home there in 1950
Recreation: Have weekend cabin; all friends welcome
Habits: Bad

ALUMNI CALENDAR

1950 - 51

September 20	Oxy-Caltech Kickoff Luncheon
September 21	Open House
December 1	Square Dance
February 3	Dinner Dance
April 14	Annual Seminar
June 6	Annual Meeting

Bob Bennett writes that, of the 11 members of the '43 Fleming Marriage Pact, "only *Bill Fair* has failed to earn his $10 reward. *Jim Blayney* and I have each been awarded the 50% bonus that goes with having a boy, while *Len Alpert, Jack Spencer, Kenny Johnson* and *Bob Bragg* have girls—in fact Johnson and Bragg each have two. The bunch has scattered as far south as Texas, as far east as Illinois, and as far north as Seattle. Most of the boys are still working as engineers, though *Bragg* is becoming a Butane tycoon, Spencer and Fair are teaching, and I am a head janitor for the phone company — well, building maintenance supervisor."

Jesse Blaine Graner received his M.S. in Petroleum Engineering at USC in June.

Edward I. Brown writes that he's now employed by a company where most of the "responsible" jobs are held by Caltech men — Marquardt Aircraft in Van Nuys. The firm employs about 25 Caltech engineers. Ed is in Preliminary Design.

James A. Blayney and his wife announced the arrival of a son on May 29.

Peter Dehlinger, M.S., Ph.D. '50, has been appointed to the staff of Battelle Institute in Columbus, Ohio, where he will be engaged in research for the oil well drilling industry. He was formerly associated with the Shell Oil Company in Los Angeles.

1944

Cornelius Steelink and *Paul Hugo Winter* received M.S. degrees from USC in June — *Steelink* in Chemistry and *Winter* in Civil Engineering.

Allen E. Wolf is employed at the Ballistic Research Laboratories, Aberdeen Proving Ground, as an electronic scientist. The whole Wolf family spent two months in Florida this summer while Al worked on the optical instrumentation for "Bumper" firings—the family now including Kathy, 3, and Terri, 1.

David R. Shefchik reports that he was married in October, 1949 to Dorothy Savage of Duluth, Minn. Until this summer Dave was working as Master Mechanic at the Rabbit Lake & Mahnomen Iron Ore Mines for Pickands Mather & Co. in Crosby, Minn., where he is Assistant Iron Ore Treatment Plant Supervisor for the same firm on the Mesabi Iron Range.

Wesley Sandell was married last February to Ingrid Andersson of Stockholm, Sweden. He's working as a quality control engineer in the Hollywood processing plant of Eastman Kodak.

Neville S. Long has been transferred from the McNary Dam on the Columbia River to Pine Flat Dam on the Kings River in California where he is Engineering Assistant to the Structural Steel and Rigging Superintendent.

1945

John D. McKenney, M.S. '49, was married this month to Joan Sawyer of Pasadena.

Jack Dewey Krause received the degree of Master of Business Administration from USC this June.

Harold H. Ford, who received a Professional degree in Industrial Design from Caltech in 1948 is now a senior designer in General Motors Styling Section in Detroit. He has been doing appearance design in the Product Design Studio there, and engineering development work in the Body Development Studio. He and his wife are living in a Detroit suburb near Cranbrook Art Academy, where Mrs. H. is doing graduate work in sculpture.

Donald C. Tillman, M.S. '46, Civil Enginer Associate with the Street and Parkway Design Division of the City of Los Angeles, is teaching an 18-week course this fall at San Bernardino Valley College on Street and Highway Traffic Engineering.

1946

Howard R. Woods and his wife announced the arrival of a son, Jerry, on July 14. They're living in Bell, California.

Howard Jessen and Mary Susan Carson of Omaha announced their engagement in August, plan to be married this winter. Howard works with the Circo Steel Products Co. in Omaha.

William Moje, who received his Ph.D. from UCLA this June is now at the University of Illinois in Champaign as a Post-Doctoral Fellow. He and wife Suzanne have two children—Steven, 3, and Peggie 1.

Milton A. Strauss, M.S. '48, formerly employed by the American Institute of Aerological Research in Pasadena has moved to Lake Mills, Wisconsin, where he is now in the summer resort business with his father. Milt had one young daughter last we heard and was due to welcome another addition to the family sometime this summer.

Edward S. Ida has been transferred by the Otis Elevator Co. to Sacramento, where he is now Local Manager. Ed and his wife, the former Barbara Engle, have two daughters—Janice, 2, and Carol, not yet 1.

1947

John Latimer Mason, M.S. '48, Ph.D. '50, and Mary Frances Draeger of Beverly

Hills were married late this summer.

Robert Malcolm Stewart Jr. and Beverly Wade were married in South Pasadena in July. Both Stewarts have been with the Pasadena Civic Orchestra.

Albert Mueller, M.S. '49, and Ardita Williams of San Marino announced their engagement on July 9, plan to be married in December.

Manfred Eimer, M.S. '48, and Gretchen Gentner of Pasadena were married in June, honeymooned in Colorado and have settled down in South Pasadena. He's working for his Ph.D. in Aeronautics at the Institute.

Harold Comlossy, Jr. and Ann Eccles of Eagle Rock were married in Los Angeles on July 2, honeymooned in Santa Barbara, now live in South Gate.

John A. Kelly M.S. '47 and Gayle Zeiss were married in early June in Los Altos. He's an aeronautical engineer at Moffet Field.

1948

Keith Wilbur Henderson received his M.S. in Electrical Engineering from USC this June.

Howard W. Green, still living in Pasadena, writes that he's still working at the same plant, though for a new owner. What used to be W. C. Hardesty Co., Inc., is now the Vegetable Oil Products Co. in Los Angeles. Big news at the Greens though, is the arrival of their first baby, a girl, on July 20.

John O. Rasmussen Jr. was married on August 27 to Louise Brooks in Red Bluff, Calif.

Mayette E. Denson, Jr., M.S., Ph.D. '50, is working for the Stanolind Oil and Gas Company in the Research Laboratory in Tulsa, Oklahoma.

Lawrence Noon, M.S. '49, is now working for the Technicolor Motion Picture Corporation as Assistant to the Process Supervisor in Los Angeles. He was married in December 1949 to Dorothy Dale, lives in Pasadena.

Arthur N. Cox writes from Pretoria, Transvaal in the Union of South Africa, where he is doing astronomical research with Dr. John B. Irwin of Indiana University: "We are having a great time here in this double-language country with all its wonderful scenery. I hope to cover most of the scenery by the end of January when I must return to Indiana University to continue my graduate work. Trust the weather is as nice in Pasadena as it is in South Africa."

1949

Edward Levonian is now in India, where he expects to remain about a year. He and his brother-in-law have initiated an educational film company and are engaged in taking 16-mm films of the life of the people in India, Pakistan, and the Middle East. By ingenuity, audacity, and good luck they recently succeeded in making their way into Tibet. They have penetrated to a village of the Himalayas so remote that the natives had not yet heard of World War II. Ed also succeeded in reaching the actual source of the Ganges River, "the most sacred spot in the world for the Orthodox Hindu." He adds: "Having heard that a bath at this point absolves the bather of all previous sins, I hastened to plunge into the icy water."

Rolf M. Sinclair is now a graduate student at Rice Institute in Houston, Texas, where he has been awarded a fellowship in physics. *Ken Famularo* and *Jim Hummel* are two other '49ers from Tech there. Rolf spent the summer at the Georgia Tech Experiment Station.

Charles George Walance and his wife announced the arrival of Ann Elizabeth on July 9.

Allen T. Puder, M.S., has completed the Westinghouse Graduate training program, is now working as an engineer for developing high temperature materials for gas and steam turbines in south Philadelphia. The Puders live in a Philadelphia suburb and—most important of all—have two twin girls, born on April 6.

Robert M. Stewart, M.S. '50, and Beverly Wade of South Pasadena who were married on July 8, now live in Berkeley, where Bob is a Junior Chemical Engineer at Cutter Laboratories.

1950

Odell Carson is working in the Technical Division at the Hanford Works near Richland, Washington. This is the plutonium manufacturing plant operated by General Electric for the U. S. Atomic Energy Commission. Odell's in the Operational Training Program, which gives technical grads the opportunity of spending an average of three months in different parts of the huge plant before settling down to a permanent assignment.

Leonard Edelstein, M.S., and Elaine Platt, who were married in Los Angeles in June, are now living at Fort Lawton, Seattle, Wash. Len, who graduated from West Point in 1946, was one of nine men selected for special advanced studies at Caltech.

Eugene G. Spencer and Charlotte Paris were married in Pasadena on June 16.

Jay Allen Montgomery and Jean Claire Edwards were married in June. She worked in the student employment office.

ALUMNI ASSOCIATION

CALIFORNIA INSTITUTE OF TECHNOLOGY

STATEMENT OF INCOME
For the year ended June 30, 1950

INCOME

Dues			$6,554.35
Income from Consolidated Portfolio of C.I.T.:			
Normal income		$1,027.20	
Gain upon sale of investments		60.65	1,087.85
Net income (prior to certain expenses provided for in the General Budget of C.I.T.) from publication of Engineering and Science Monthly			1,954.28
			9,596.48
Less expense in connection with publication of Engineering and Science Monthly:			
Allocation to C.I.T. for Engineering and Science reserve fund		1,954.28	
Subscriptions for Association members		4,430.00	6,384.28
			3,212.20
Other income:			
Program Committee	$2,089.75		
Less expense	1,969.94	119.81	
Social Committee	1,005.10		
Less expense	1,055.50	(50.40)	
Seminar Committee	1,319.00		
Less expenes	1,150.08	168.92	
Athletic Committee	108.75		
Less expense	155.54	(46.79)	
Placement Committee	944.00		
Less expense	957.77	(13.77)	
Sundry		12.26	190.03
			3,402.23

EXPENSE

Administration:			
Directors' expense		$149.04	
Postage		291.18	
Supplies		494.61	
Miscellaneous		49.94	
		984.77	
Alumni Fund reports and solicitations:			
Printing	$666.66		
Postage and miscellaneous	232.32	898.98	
Association membership solicitations:			
Printing	232.86		
Postage and miscellaneous	118.04	350.90	
Student relations, including $150.00 assistance to student publications		153.88	2,388.53
NET INCOME			$1,013.70

BALANCE SHEET
As of June 30, 1950

ASSETS

Demand deposit in bank		$7,739.18
Postage deposit		50.76
Investments, at cost:		
Share in Consolidated Portfolio of C.I.T.	$23,983.37	
U. S. Treasury bonds	222.00	24,205.37
Furniture and fixtures		221.04
Expense applicable to 1950-1951 year		26.81
		$32,243.16

LIABILITIES

Accounts payable	$ 276.30
1950-1951 membership dues paid in advance	5,104.69
	5,380.99

SURPLUS

Life membership reserve:			
Fully paid memberships		$23,850.00	
Payments on life memberships under the installment payment plan		1,283.50	
		25,133.50	
Unappropriated income:			
Balance June 30, 1949	$395.28		
Adjustments to life membership reserve	319.69		
Excess of income over expense, year ended June 30, 1950	1,013.70	1,728.67	26,862.17
			$32,243.16

AUDITOR'S REPORT

Alumni Association California
Institute of Technology
Pasadena, California

I have examined the balance sheet of Alumni Association California Institute of Technology as of June 30, 1950 and the related statement of income for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as were considered necessary in the circumstances.

In my opinion, the accompanying balance sheet and statement of income present fairly the financial position of Alumni Association California Institute of Technology at June 30, 1950 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Howard W. Finney
Certified Public Accountant

September 11, 1950

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this  small

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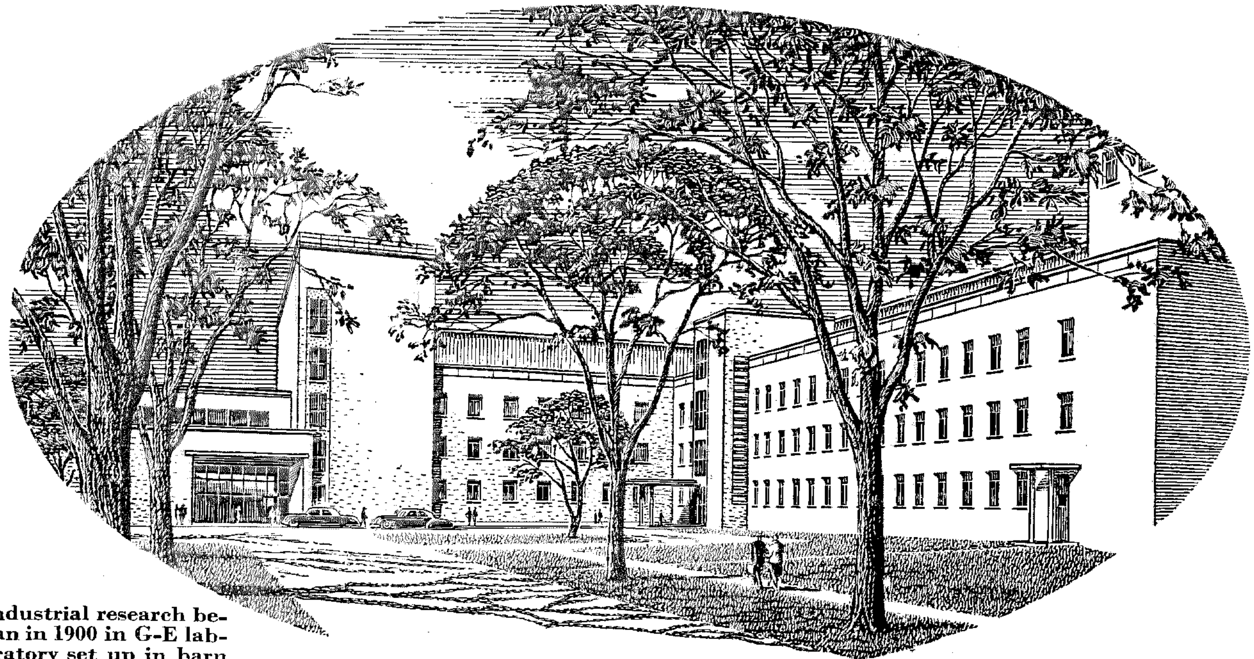
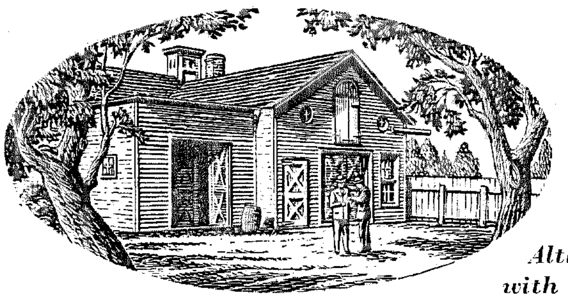
A

50 YEARS of General Electric Research





Industrial research began in 1900 in G-E laboratory set up in barn behind home of Charles P. Steinmetz.

When the General Electric Research Laboratory was established in 1900, it was the first industrial laboratory devoted to fundamental research.

At that time E. W. Rice, Jr., then vice president of General Electric, said:

Although our engineers have always been liberally supplied with every facility for the development of new and original designs and improvements of existing standards, it has been deemed wise during the past year to establish a laboratory to be devoted exclusively to original research. It is hoped by this means that many profitable fields may be discovered.

Many profitable fields *were* discovered—profitable not only for General Electric but also for industry, the American public, and the world.

A half century ago the industrial experimental laboratory was itself an experiment. This month it begins its second half century with the dedication of a new building, greatly augmenting the facilities it offers to the advancement of man's knowledge.

You can put your confidence in—

GENERAL ELECTRIC