March, 1949

ENGINEERING AND SCIENCE

Student elections . . . page 15

PUBLISHED BY THE CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION

Turn right to Modern Living

at the sign which says "Adequate Wiring"

You can't miss, if you follow these directions. The Adequate Wiring sign clearly marks the way to added comfort and increased convenience which the home owner calls "Modern Living."

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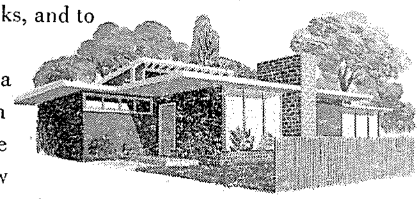

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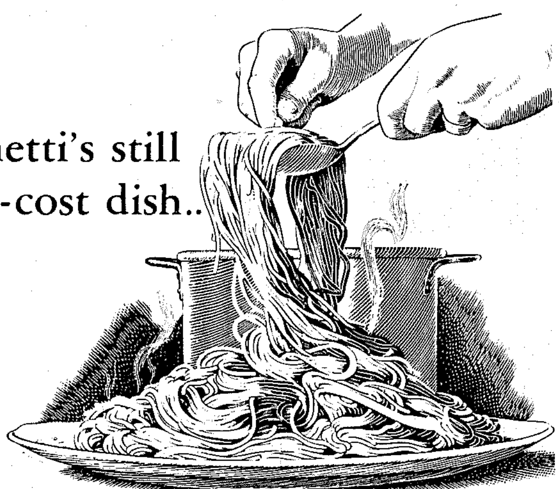
When you build or remodel, have an Adequate Wiring advisor go over your plans with you. His services are available to owners, architects and contractors anywhere in Edison territory, through your nearest Edison office. There is no cost or obligation.

Southern California Edison Company

Spaghetti's still a low-cost dish..



but even more economical is the Gas to cook it!

GAS COSTS YOU EVEN LESS NOW THAN IN 1939!

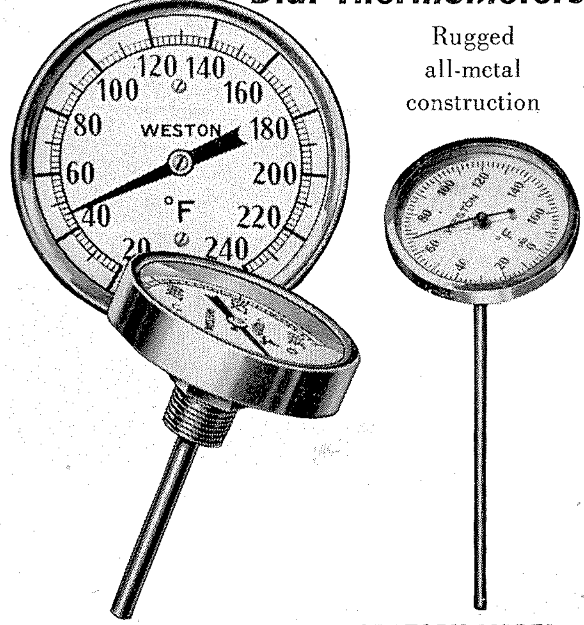
No matter how you economize these days, your costs are high. So are ours. But we have taken increasing costs in stride and kept down the price you pay for gas by 1) serving more gas to more people . . . 60% more customers than ten years ago . . . and 2) striving constantly to find new ways to achieve greater efficiency and more economical operation. Now more than ever your household bargain is GAS!

SOUTHERN CALIFORNIA GAS CO.
SOUTHERN COUNTIES GAS CO.

Easy to read WESTON

Dial Thermometers

Rugged all-metal construction



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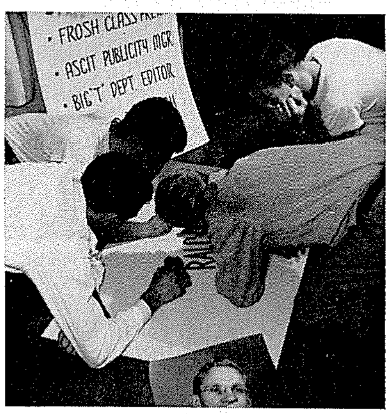
ENGINEERING AND SCIENCE

Monthly

The Truth Shall Make You Free

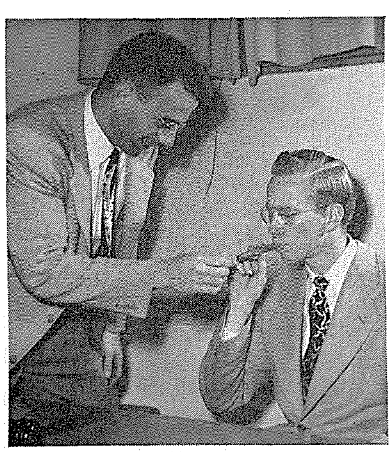
In this issue



On the cover

For a few feverish weeks in February the politicians took over the campus. Nominations for new ASCIT officers were made early in the month. On the 21st, campaigning got under way, and for four frenzied days the campus was strewn with posters, pledges and oratory. Election day came on the 24th, and by Wednesday, March 2, the new officers of the student governing body were taking the oath of office.

The picture on this month's cover shows Ralph Lovberg's campaign getting under way. In campaign headquarters (Lovberg's room in Blacker, that is) loyal henchmen are turning out the campaign literature that helped put Lovberg over. The shot below records the moment, at the end of the swearing-in ceremonies, when Lovberg performed his first official duty as ASCIT president: He's lighting up the traditional cigar which has just been presented him by the outgoing president, Stan Barnes. For other pictures of the ASCIT elections, see page 15.



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ENGINEERING AND SCIENCE MONTHLY

Published at the California Institute of Technology

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The Main Line

MARCH, 1949

In Paul Bunyan's time, this year would probably be ear-marked as the winter of the blue snow.

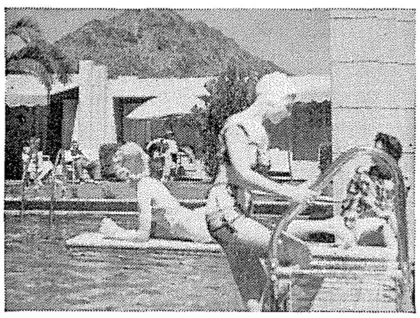
In any event, it has been a record breaker all over our lines and beyond. We've had seagulls making three-point landings on icy lakes in San Francisco's Golden Gate Park. We've had snow in downtown Los Angeles (which Easterners libelously claim was immediately labeled "the whitest, fluffiest, and prettiest snow anywhere in the United States"). Up in the high Sierra ski fans have gone delirious with joy. There's nearly as much snow as there is mountain.

And on the railroad, everybody wants to get transferred to the Tucson division.

Since we have to keep *all* our trains running (not just the ones to the southwest) many of our people have to stay where it's cold.

Desert's nice now

While our Pacific Coast weather has moderated, we'd still like to remind you that it's wonderful now in the desert country. If you can take a few days off, it's easy to put yourself into this picture:



We have some fine trains serving Palm Springs, Imperial Valley, Phoenix, Tucson, Douglas and all the rest of the resort and guest ranch country. Take your choice of luxurious Pullman or smart, economical chair car accommodations. Any Southern Pacific representative will be glad to help you absorb some winter sunshine.

Boji Boji

Being a railroad has its lighter side. Sometimes we get letters from out-of-the-way places that ask us, in obscure language, for travel literature. The most recent request deserves wider acclaim than most. Here it is, complete with original spelling:

David E.
B.V.M.C. College
Boji Boji
Agbor 14th 1948

Dear Sir

I have the honour most humbly and respectfully to forward this my humble application before you, of which will meet you with success.

I have been hearing of your good news, and I want to become one of your intimate friend. I hope that it will not course your annoyernce by hearing me telling you to send me one of your catalogue.

Please I shall be very glad if you have sympathetic of sending it to me and I hope failour will not be the last of it.

I beg to close with love, while I remain

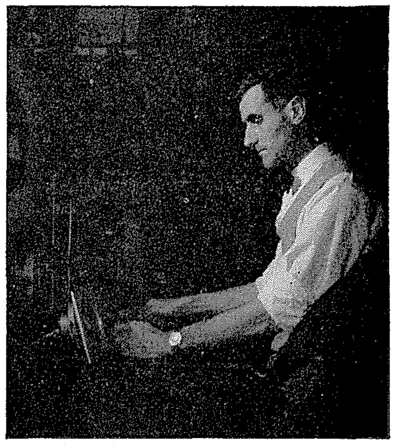
Yours truly
Agbor, Nigeria /S/David E.

After checking the atlas to make sure there is such a place as Boji Boji, and that Agbor really is a place in Nigeria, and not a month in the Nigerian calendar as it appeared at first, we sent David a "catalogue" of our Four Scenic Routes across America.

Sears-Roebuck of travel

David's letter sounded a little strange, but the catalogue idea is sound. When you get right down to it, our Four Scenic Routes booklet is really a catalogue. (It's called "How to See Twice as Much" and shows a lot of the wonderful things to see along our lines.) You can sit down with it and order a tailor-made trip as easily as you can get a yard of calico from a mail order house. If you'd like to have one, just drop us a line. (*Southern Pacific, Room 406, 610 So. Main Street, Los Angeles.*) It was originally designed for folks back east who were planning a trip to California, but of course it works both ways.

In this issue CONT'D.



Motor man

Peter Kyropoulos, who wrote "What's New About the New Cars" on page 7, is Assistant Professor of Mechanical Engineering at Caltech, and in charge of the Internal Combustion Laboratory. He's been interested in motors most of his life. Before coming to the United States in 1937 he was a motorcycle enthusiast. (Motorcycling, let it be noted here, is a more respectable enthusiasm in his home town of Gottingen, and in Europe in general, than it is in this country.) Over here, Kyropoulos shifted his enthusiasm to automobiles.

In 1938, after receiving his M.S. in Mechanical Engineering at Caltech, he went to work for Consolidated Vultee Aircraft Corp. in Detroit, where he had—and took—every opportunity to visit the automobile factories. Back at Caltech for further training under a Vultee Research Fellowship, Kyropoulos became an instructor in the mechanical engineering department in 1943. He received his Ph.D. here last year. He is an active member of the Society of Automotive Engineers, and, for what it's worth, this expert on '49 cars has two cars himself—a '41 Studebaker Champion and a well-preserved '31 Chevy.

PICTURE CREDITS

Cover—Hugh Stoddart '49
pp. 1, 2, 3—Hugh Stoddart
p. 5 (top)—Ross Madden-Black Star
pp. 7, 10—Cartoons—Bruce Barnes
p. 13—Ross Madden-Black Star
p. 15—Hugh Stoddart
p. 20 (left)—Maryland Studio
p. 20 (lower right)—Hugh Stoddart
p. 21—Barton's

The State of the Institute

Highlights and sidelights from President DuBridge's Report

THE ANNUAL REPORT of the California Institute of Technology, now coming off the press, will go out to alumni this month. Previously, alumni have only received a summary, but this year they will be getting the complete report. Crammed with information on such diverse matters as the high cost of athletic injuries ($2,015.75) and the present state of student morale (high), the 1947-48 report also includes these high lights and side lights from the Report of the President:

The students

Best boys? Though the number of applicants has fallen from the astronomical figures of 1946 and 1947, we must still turn away two out of every three men who are well enough qualified to take our entrance examinations. Are we sure we admit the best one-third? Are we really finding tomorrow's leaders? Under the direction of Dean Jones, careful studies have been undertaken to try to answer these questions and to correlate performance at the Institute and in later life with the various kinds of pre-admission information which we are able to obtain. For example, a special series of College Entrance Board examinations was given entering freshmen in the Fall of 1948 to determine how useful such examinations may be in predicting success at the Institute. Also we are steadily expanding and improving our system of interviewing prospective students, searching always to find evidence of those qualities which make for creative leadership.

Freshmen. The report of the Associate Dean for Freshmen points out the unusually large "mortality" (31 out of 170) in the freshman class. It was only 13 out of 180 last year. Are the students we are now getting from high schools "soft", or unprepared for college standards? Or has our experience with more mature veterans led us to expect too much of unseasoned high school graduates? Or are we just being too tough?

How many? It will be noted in the Report of the Registrar that our total student body in 1947-48 declined somewhat in size from the previous year: 1323 against 1391. The enrollment at the beginning of the year 1948-49 was 1270. This is still 32 per cent above the highest pre-war figure of 962. It is anticipated that when the present large junior and senior classes are graduated, and when the graduate body has been stabilized at more manageable proportions, we will level off in 1951-52 with a student body of about 720 undergraduate and 450 graduate students.

Young men. The youthfulness of our alumni needs to be emphasized. Of the 4,862 men who have received degrees of any grade from the Institute, 54 per cent have been awarded these degrees since 1938. The 1948 Commencement alone increased the size of the total alumni body by 8.5 per cent. Of the 4,862 degree holders only 3,289 (69 per cent) received their bachelor's degrees from the Institute. The others received advanced degrees here following undergraduate work at other institutions.

Morale. Two significant commentaries on undergraduate scholarship and morale may be mentioned at this point: in three terms only four upper class students were required to withdraw for failure to meet scholastic requirements; and in only two cases were the privileges of the Institute denied to students as a result of violation of the Honor System.

More Ph.D.'s. At Commencement on June 11, 1948, 312 graduate degrees were conferred; of these 217 were Master of Science, 52 were Engineer, and 43 were Doctor of Philosophy degrees. The number of Engineer's degrees was less than for the previous year, but the number of Ph.D. degrees was the largest ever awarded by the Institute at one Commencement.

Veterans. The peak in number of graduate students receiving veteran benefits was probably reached during the year 1947-48. During the year, 57 per cent of the graduate students were thus assisted, whereas only 41 per cent received this aid in 1946-47. It is believed, however, that the number and percentage will decrease during the years to follow. As this occurs, the need for other assistance to worthy students will grow, and more dependence will be placed necessarily upon Institute scholarships, assistantships, and fellowships, and those financed by industries, foundations, and governmental agencies.

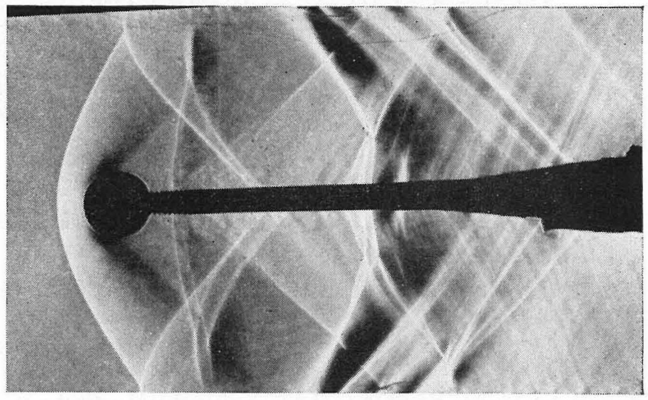
The staff: it's growing

One to three. As a result of the increase in the number of faculty members there is now at the Institute one faculty member for every four students. If graduate assistants who are actually teaching are included, then we have more than one instructor for every three students. Also, the total number of paid employees of the Institute, the majority of whom are professionally trained, greatly exceeds our total student body. Ratios of this kind are quite exceptional in our generally overcrowded educational institutions, and the Institute is fortunate, indeed, to be able to maintain such unusual opportunities for student and faculty contacts as now exist.

Best teaching? A poll of student opinion of teaching was conducted during the year and the "score" for each faculty member was given to him. Each man now knows at least how the students rate him, and it is already clear that many are determined to improve their standings. The President's Office declined to accept a compilation of these ratings; their reliability is far too uncertain for official use. However, some general results were illuminating. For example, there was little correlation between age or experience and the students' ratings of teaching effectiveness. Some of the highest scores were awarded to young instructors or even graduate assistants.

Research: there's plenty

. . . In Aeronautics. In the Guggenheim Laboratory and in the Jet Propulsion Laboratory important forward steps have been made in both experimental and theoretical studies of air flow at supersonic speeds. A small wind tunnel (of 2½-inch aperture) has been operating at speeds up to twice the speed of sound, and a large unit (10 by 12 inches) has just been completed at the Jet Propulsion Laboratory. A new tunnel in the Gugenheim Laboratory is nearing completion for speeds from 7 to 10 times the speed of sound, and at JPL a larger tunnel (10 by 12 inches) for 4.5 times sound velocity will be complete next year. These facilities provide outstanding opportunities for basic studies at these high velocities.



AERONAUTICS: *Shock wave configuration in 2½" wind tunnel as air flows around sphere at 1.24 times speed of sound. A new tunnel may reach Mach 10.*

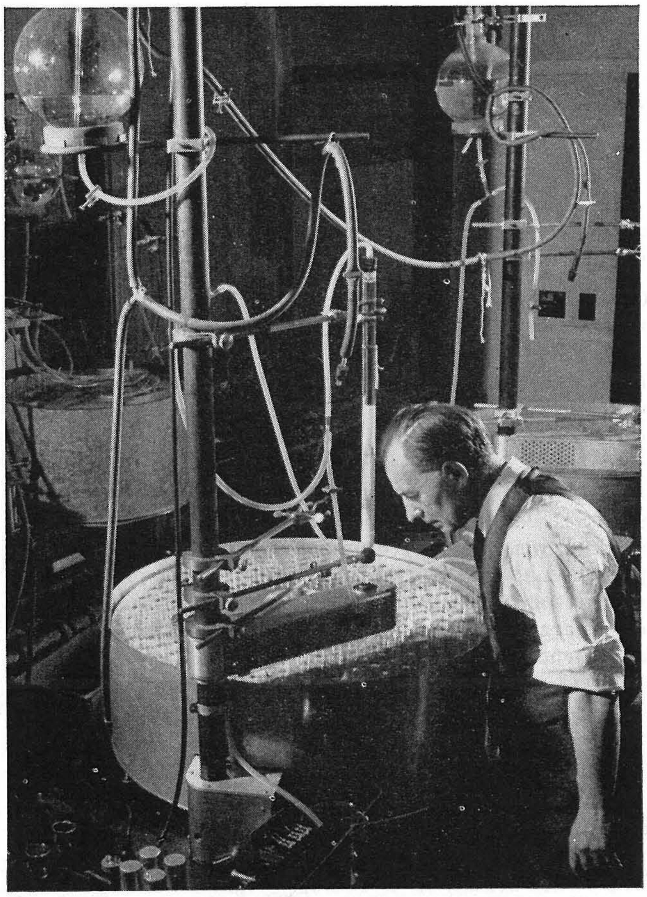
. . . In Engineering. The study of the flow of liquids is as important for the designer of ships as the study of air flow is for the designer of aircraft. Yet, curiously enough, water tunnels for such studies are less common than wind tunnels. The Institute Hydrodynamics Laboratory has pioneered in the development of superb equipment for research in this field, and new knowledge of the nature of liquid turbulence, cavitation (bubble formation), and other phenomena is now being revealed.

A new electrical analog computer for high-speed analysis and solution of mathematical and engineering problems has gone into operation during the year. It is in continuous demand and already highly successful. Professor G. D. McCann and his group are busy improving and enlarging it to extend its usefulness. It is a major asset to both the research and instructional program on the campus and is extensively employed for solution of problems brought in by industrial and government agencies.

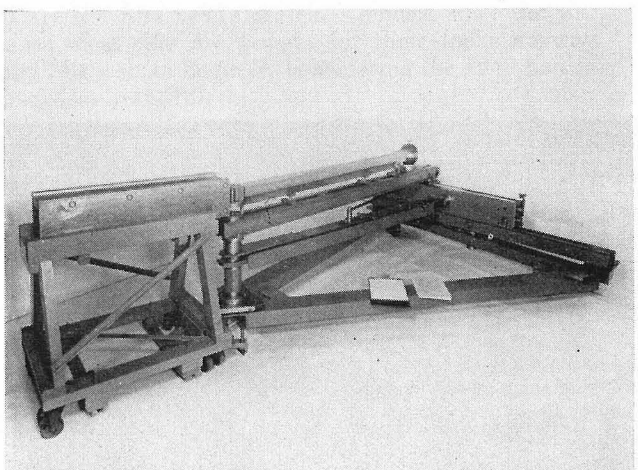
. . . In Chemistry and Biology. The Divisions of Chemistry and Biology pursue their long-range program aimed at a better understanding of life. Seldom has such a basic and comprehensive program in any field been undertaken by such a brilliant and adequately equipped group of scientists. The $700,000 grant by the Rockefeller Foundation to this program is in itself a superb tribute to the men involved, to the results already achieved, and to the importance of the future program.

During the year steady progress was made on many aspects of this program. Significant advances were made in understanding the nature and behavior of viruses (see *Research in Progress*, page 12)—those basic things which seem to be the intermediate link between the living and the nonliving. They can be seen with the electron microscope, and the way in which certain types of virus attack and destroy bacteria is now understood as a result of studies here and elsewhere. Astonishing, however, is the discovery that these bacterial viruses are made up of sub-units, each of which is remarkably like that other basic unit of life, the unit of heredity, called the gene. Here is a field where heredity and life are apparently reduced to their simplest form, and further studies are certain to yield basic new information.

. . . In Physics. Cosmic rays have been a perennial source of fascination to physicists ever since the pioneering work of R. A. Millikan here in the early 1920's. They loom larger and larger in the world of physics as time goes on. Cosmic ray work by C. D. Anderson at the Institute first revealed the positron in 1932. Then came Anderson's discovery of the mesotron in 1936. Now it is found (first by Powell in England) that there are two kinds of mesotrons, one being 50 per cent heavier than the other. Each may be either positive or negative, and the heavy one may decay into a light one. Anderson has made observations of the decay of the light mesotron into an electron and presumably some neutral particle. Professor R. F. Christy and his students are attempting with some success to elucidate the theory of these mysterious processes. All that can now be said is that the secret of nuclear forces and nuclear energy is closely tied to the understanding of mesotrons.



BIOLOGY: *Electronically controlled machine built by Dr. Henry Borsook (above) and Dr. Geoffrey Keighly helps Caltech biochemists separate and collect proteins and amino acids — the fabric of all living cells.*

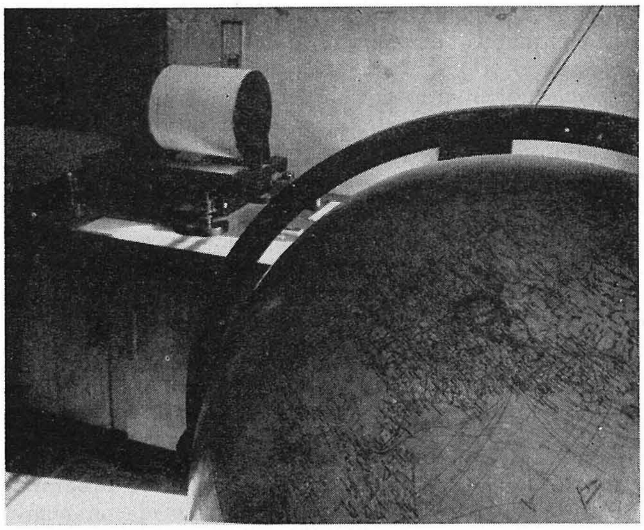


PHYSICS: *First direct measurements of gamma ray wave lengths have been made with this spectrometer.*

Nuclear forces are under investigation from other angles in the Kellogg Radiation Laboratory under the direction of Professors C. C. Lauritsen and W. A. Fowler. Their measurements are making more precise and complete our understanding of the release of nuclear energy in the sun and stars—the primary source of energy in the universe. Professor J. W. M. DuMond and his colleagues have had spectacular success in making the first direct measurements of the wave length of nuclear gamma rays, using a new curved-crystal spectrometer.

. . . In Geology. The division of the Geological Sciences, among its many activities, concentrates on two of peculiar interest to Southern California—oil and earthquakes. Its graduates, excellently trained in physics, chemistry, geology and geophysics, are in urgent demand by the petroleum industry. The Seismology Laboratory not only participates in a world-wide earthquake analysis program, but is making basic studies of the structure of the earth's crust by analyzing the propagation of earthquake waves. The tiny earth-tremors produced by a

GEOLOGY: *In the Seismological Lab automatic recorders amass data for world-wide earthquake analysis program.*



storm at sea (microseisms) are now being intensively studied and provide an important meteorological tool.

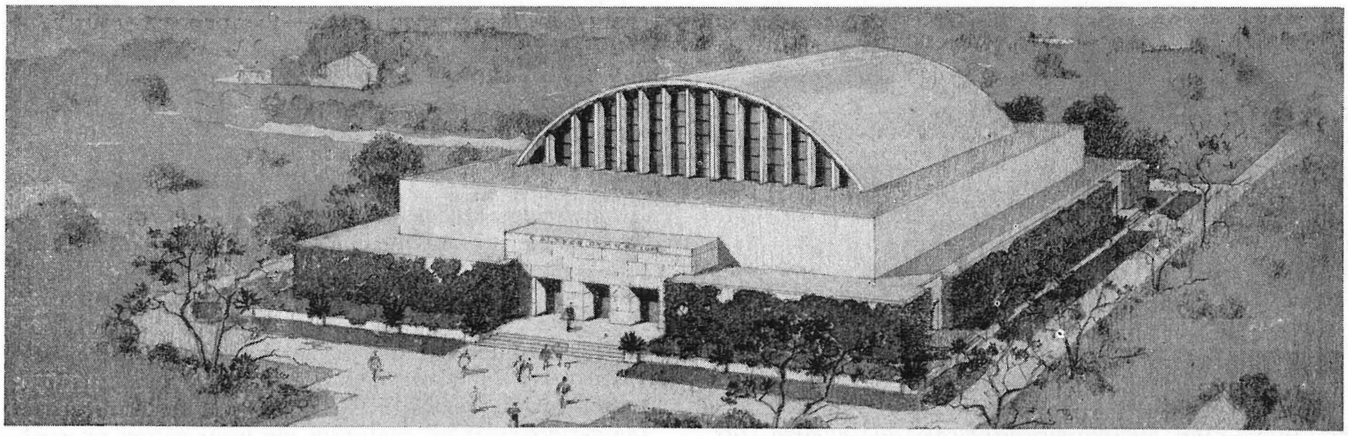
Government research. The fact that government contracts have reached such a large volume ($4,600,000 for 1947-48) has led some to suppose that this represents expenditure for enterprises foreign to our educational program; that is, for secret military research. This supposition is far from the truth. Of the $1,200,000 spent for contract research projects on the campus during the past year, practically all was for basic nonsecret research, and none was for the development of specific weapons or equipment. Even at the Jet Propulsion Laboratory (the major off-campus project, and by far the largest contract enterprise) the work carried on is largely basic research in fuels, propulsions, motors and structures—not rocket weapons.

Buildings and land

Buildings. In the last report two building projects were mentioned as being about ready to get under way. The construction of a Biology Annex has now been completed and will provide much needed new facilities. The proposed Earhart Plant Research Laboratory was for a time endangered because mounting costs had far outrun the original gift of the Earhart Foundation. However, the Foundation generously met the situation and increased its pledge from $200,000 to $407,000. Construction began immediately on receipt of news of this action, and this valuable and unique laboratory and greenhouse will be ready for use in the spring of 1949.

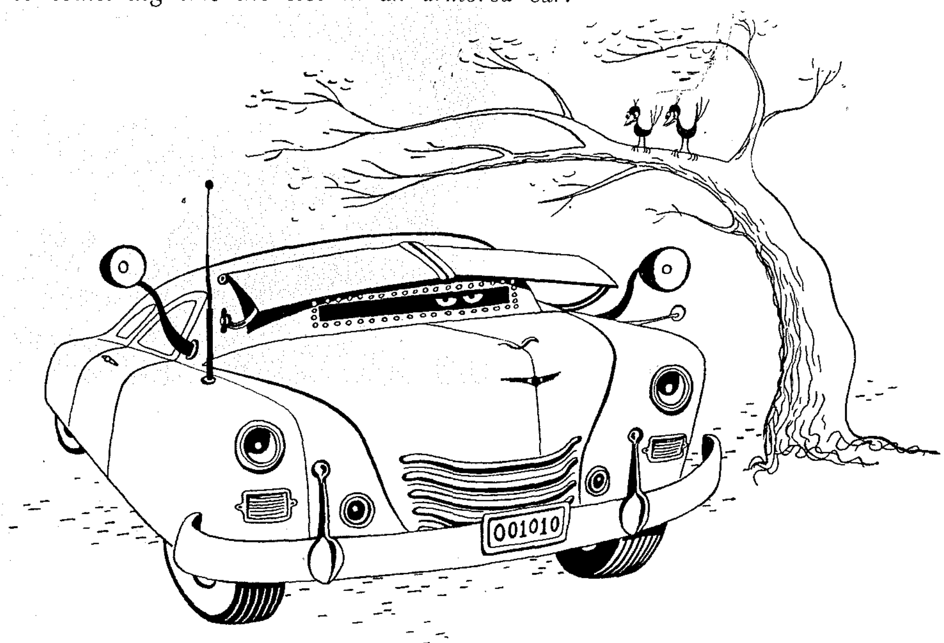
Land. The final contract for the purchase of Tournament Park by the Institute was completed in August, 1948, and title will pass into Institute hands as soon as the necessary rezoning of the area has been completed. The long delay was due solely to the extended process of determining the portion of the Park to be retained by the City, and to the necessity of a complete survey of boundaries and of existing utilities and easements. The Institute is not yet in a position to proceed with the construction of the proposed athletic facilities, but will immediately arrange additional car-parking areas to relieve the parking problem.

Gym. The organization of the new Alumni Fund, announced in last year's report, was completed by the Alumni Association during the year and a very large group of alumni generously cooperated in getting a campaign under way. By August, 1948, the cash receipts had totaled over $20,000 and an additional $50,000 had been promised for the future. This is truly a magnificent start, and the Association deserves both thanks and congratulations. But the alumni officers are not yet satisfied and are seeking to secure a much wider participation of alumni. Those who have given have been generous. Many have not yet responded to the call. But we may be sure that the response will grow as the alumni come to appreciate the need of the Institute for their support. The alumni proposal to devote the initial proceeds of the Fund to expanding the athletic facilities of the Institute is most welcome and timely. There is a desperate need—long recognized—for such facilities, and Tournament Park now offers the necessary site for them.



BUILDINGS: *Architect's preliminary sketch of the proposed Caltech Gymnasium — goal of the Alumni Fund.*

In the sportier models the driver's vision is reduced to something like the slot in an armored car.



What's new about the new cars

by Peter Kyropoulos

THE 1949 AUTOMOBILES, with a few exceptions, are the first newly designed models since the war. Because most cars are bought for their looks anyway, it might be well to begin by considering the 1949 bodies-more-or-less-beautiful.

It is pretty well agreed now that the front has to seat three, and that is what the average body is designed around. The bumper-to-bumper length has not changed materially on any of the cars, nor has the tread. The body width has increased in many cases, and has reached the upper practicable limit—unless we raise a new generation of garages and parking lots. One manufacturer has a compromise solution: the seats can be made up into a bed so that the driver can stay in the car for the night if he gets into the garage but finds it too narrow to get the car doors open.

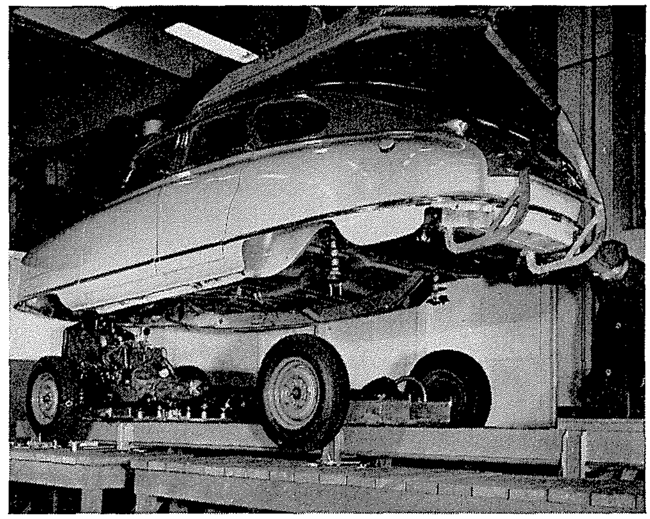
There is a tendency to style front and rear in a similar fashion. It all started a year or two ago with Studebaker—of which they used to say that you did not know whether it was coming or going. (There followed some reflections on Paul G. Hoffman's way of running the ERP, but I am assured that Paul G. did not style the car, and any similarity is purely coincidental).

More window area is provided all around and visibility has been improved, except in one direction—straight ahead of the driver. (But then, nobody seems to care where he is going, anyway; being content just to keep in touch with the bumper ahead). Buick, for instance, obtained an increase in window area of roughly 25 per cent, chiefly by enlarging the rear window. Total window area in the Buick is now 25 square feet.

Eyelids (outside visors over the windshield) are not standard equipment, but everybody seems to be sold some sooner or later. The sportier models reduce the drivers' vision between the hood and the visor to something like the slot through which one peers out of an armored car.

Kaiser-Frazer and a few others are reviving the non-convertible convertible. Called the hard top convertible, it has a metal roof with baby blue satin or the like pasted over it. How long do I think that idea will last? When I asked this at a gathering of automobile people, they wanted to know who was that heckler and why didn't he go home? I did, which is why I don't know the answer.

Since running boards disappeared, we have been fall-



THE NASH: *Unitized body is lowered to running gear on Nash assembly line. The Nash has no separate chassis; the frame is welded into the body.*

ing out of cars and crawling in. Now there is one where you fall both ways—the only car you step down into, the Hudson.

Interiors are about the same as before, except for Nash's combination instrument panel and steering wheel, which has been tried before ('39 Olds, I think, and '48 Cadillac, or thereabouts).

If you think the interiors are too elaborate, read what *Motor*, the British magazine, has to say: "The shining plastic dashboard of the Nash contrasts somewhat garishly with the quiet tones of the Austin A-40—dour and doughty, my dear fellow."

It's all in the point of view. *Motor* also says: "As a reliable and rugged design, the Willys jeep station wagon points the way to inexpensive but soundly constructed small U. S. vehicles." There is a strong feeling here that a dolled-up army "vehicle" does not point the way to anything.

Cadillac is very proud of its tail light-tank filler-neck combination. I think it gives the rear fender the looks of a battle axe, but I am not a stylist.

Television is not yet generally provided for in cars but it can be had. It offers many possibilities. The aircraft people consider the prone position beneficial for higher speeds and accelerations. One might conceive of an arrangement where the driver is in the prone position and views the road through television with intermittent flashbacks to the major league games. The prone position would allow cars to pile up at much higher speeds than heretofore possible.

The Nash "Airflyte" is the first American car to close the front fender as well as the rear, with only a small cut-out to facilitate removal of the wheel. The bumper jack lifts the body and allows the springs to extend so that the wheel clears the fender. (Note: this is more or less literally quoted from some sales propaganda. I should like to try it sometime, preferably on a side road with plenty of camber, in the rain, at midnight, and in evening clothes.)

Swing low, sweet chariot

Bigger and better bodies hide, in general, the same chassis as before, except for a general trend toward shorter wheel bases. Ford has at long last given up the transverse springs and has independent front wheel suspensions and longitudinal rear springs.

The only departure from conventional chassis design is made by Hudson. The two main longitudinal members of the frame pass outside the rear wheels with only subsidiary members passing inboard over the axle beam. This permits an almost flat floor. Rear wheel removal is made possible by the use of a bumper jack which drops the axle low enough to remove the wheel, together with a small removable panel in the lower edge of the rear fender. Although termed "a brave mechanical innovation" by *Motor*, this general type of frame construction has been used on Citroen's front wheel models since the early 30's.

The Nash, as before, does not have a separate chassis. The frame is welded right into the body which, in itself, takes the place of the structural member. Rear axle location is provided by a rigid torque tube, diagonals and a stabilizer bar. The rear is sprung by coil springs (minimum weight, no friction, no squeaks). Damping is provided by shock absorbers.

Front wheel drive and a rear engine have been talked about, but there seems to be no desire on anybody's part to try them. The arguments pro and con are not very forceful. Several companies have experimental models of either kind in their bone yards. None seem to have taken. Independent rear wheel suspension, popular in Europe, likewise does not seem to arouse any enthusiasm here. It is true that a definite need for either of these designs has yet to be demonstrated.

After some thirteen years of development, General Motors has come out with what is ultimately to be a high compression ratio engine (also called the Kettering engine). After preliminary single cylinder tests, a prototype was designed as a counterpart to the Oldsmobile 6, with a compression ratio of 12.5 to 1. Some of the important characteristics of this engine are compared with the conventional engine in the table on p. 9.

The comparison shows a material gain in fuel economy due to increased compression ratio. That in itself is no news. Special engines have been operated at such high compression ratios before and improved economy has been observed. The interesting thing is that this engine finally led to the new Cadillac and Oldsmobile V-8 engines, both of which are production engines.

Also note that overhead valves are necessary with high compression ratios since the combustion chamber is very small, and there is not sufficient room for valve opening in the L head.

Engine data are as follows:

	CADILLAC	OLDS 8-98
Type	V-8, 90 degrees	Valve in head
Bore (in.) '49	3 13/16	3 3/4
Bore (in.) '48	3 1/2	3 1/4
Stroke (in.) '49	3 5/8	3 7/16
Stroke (in.) '48	4 1/2	3 7/8
Displacement (cu. in.) '49	331	303
" '48	346	257.1
Compression ratio '49	7.5:1	7.25:1
" " '48	7.25:1	7.0:1
Rated brake horsepower '49	160@3800 rpm	135@3600 rpm
" " " '48	150@3400 rpm	115@3600 rpm

The crankshaft of the new V-8 has five main bearings instead of the conventional three. This increases engine rigidity and prevents what is known as "roughness" in the engine game. This is a nice feature now, but a

	12.5 COMPRESSION RATIO ENGINE	1946 STOCK ENGINE
Number of cylinders	6	6
Valves	Overhead	L-head
Bore and stroke	3⅜ x 3⅜	3½ x 4⅛
Displacement (cu. in.)	181	238
Compression ratio	12.5:1	6.4:1
Compression pressure, 2000 rpm (lbs per sq. in. gage)	420	165
Peak pressure, 2000 rpm (lbs per sq. in. gage)	1150	525
Friction hp, 2000 rpm	10.5	14
Maximum brake hp	95 at 3000 rpm	85 at 3400
Min. brake specific fuel consumption (lbs. of fuel per bhp hr.)	.40 at 2000 rpm	.54 at 2000 rpm
Miles per gallon, 40 mph Oldsmobile Sedan	26.5	18.5

High compression and conventional engines: how they compare

necessity when the engines are ultimately used at the high compression ratios for which they were designed.

For the Olds, a fuel consumption of .533 lbs.—fuel/bhp-hr is reported, against about .56 for the old engine. This is, of course, no breathtaking change—only about five per cent. A 12.5:1 compression ratio would improve this to about .45, or by about 20 per cent. The mileages should follow the same trend.

Cadillac, Oldsmobile and Buick, all overhead valve engines, have hydraulic valve lifters. This is a real necessity on this engine type, since it eliminates tappet clearance, which makes the O.H.V. engine noisy. (By the way, engine sound proofing is very carefully worked out on the three G.M. cars). The hydraulic valve lifter has been redesigned to avoid collection of sludge in this mechanism, which gave a lot of trouble on the old V-12 and V-16 Cadillacs.

Summing it up, the high compression engine is the only really different basic item in '49 cars. It is likely to influence car design for years to come. There will be trouble, grief, and lots of griping about the engines for awhile, but that is natural, and no change is made without it.

Chevrolet's compression ratio is 6.6:1, as against 6.5 before. Nash has a 7:1 compression ratio on both the side valve "600" and the overhead valve Ambassador. Chrysler has not released much information about '49 models to date (February, 1949), but it is known that all compression ratios will be 7:1, except for the Chrysler 8, which will have 7.25:1.

Chemical hay for mechanical horses

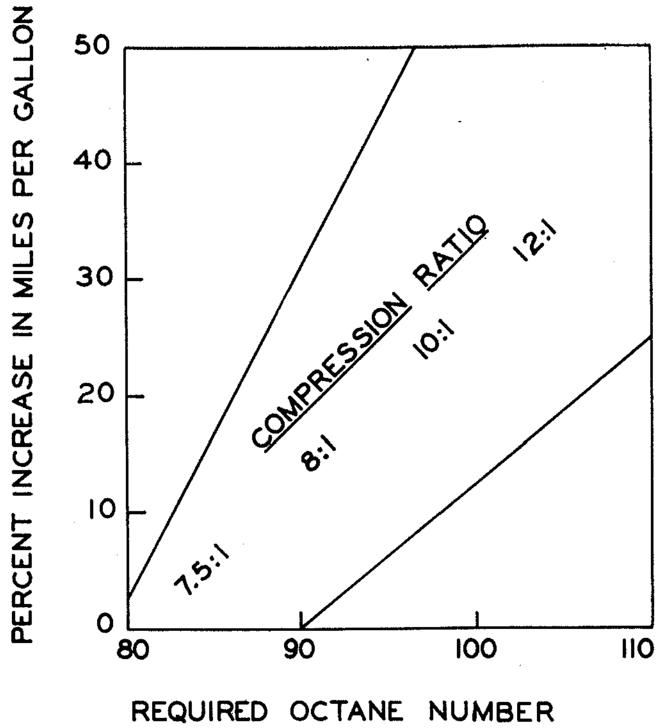
In the foregoing discussion there is an apparent discrepancy. On the one hand, we see the possible gains due to high compression ratios; on the other hand, we find the actual engines (Olds and Cadillac) with compression ratios only slightly higher than before.

The answer is that higher compression ratios require fuels with higher knock ratings. The chart (right) shows a correlation of compression ratio, octane number requirement, and gain in fuel economy. The data were obtained on experimental engines; the gains are expressed in per cent of consumptions of 1946-47 production cars.

The development of the high compression engine was carried out, using the miracle fuel "triptane" (2,2,3 trimethyl-butane). One can get an idea of its relative rating by comparing critical compression ratios (i.e., the maximum compression ratio with which the fuel will operate without detonation or knock).

	CRITICAL CR
Fuel with zero octane number (normal heptane)	3
Commercial gasolines (1948)	4.5 → 7.5
Iso-octane, Octane number 100 by definition	8
Natural gas (mixture of different hydro-carbons)	11-12
Triptane	13
Benzene	16
Methane	16

Road experience with the high compression engine has shown that a fuel of somewhat less than 100 octane number can be used. This is, nevertheless, still far



Center area, bounded by rules, shows how octane number requirements and fuel consumption improvements increase with higher compression ratios.

above the present commercial gasoline rating, and inexpensive high octane fuels are not yet in sight. As a result, the present high compression engines are operated at compression ratios comparable to the present fuels. It is clear that the gains in fuel economy are not spectacular, perhaps five to ten per cent over other engines. As better fuels become available, it will be possible to raise the compression ratios.

Several subterfuges are possible which, theoretically at least, could be used to reconcile the user to high fuel cost.

A dual fuel system is one possibility. Since high octane fuel is only needed at high power, an automatic shift from regular fuel to high octane fuel could be made. A similar scheme has been used successfully for take-off of aircraft. This would reduce the overall cost of operation, and also increase the effectiveness of the limited quantity of high octane gasoline which can be produced. Nevertheless, it would be a nuisance on a passenger car and would most likely not work half the time.

Injection of water, water-alcohol mixtures, or alcohol, water and tetra-ethyl lead, is another possibility to increase the octane rating when the throttle is opened wide enough to require a high octane fuel. The feasibility of this scheme has also been demonstrated in air-craft engines. For passenger cars it is pretty well ruled out by considerations of engine lift, since injection of water and high lead content increases cylinder wear and promotes oil contamination beyond the tolerable limit.

Direct injection of the fuel into the cylinder near top dead center (Diesel style) allows utilization of low octane fuels. Experimental engines have been operated at 10:1 compression ratio with 40 octane fuel. The high cost of injection systems is a serious obstacle to this mode of operation.

The practicability of any of these proposals, as well as their acceptance by the driving and buying public, remains to be established.

It is well to emphasize here that engine fuel and operating conditions are inseparably interconnected. Each engine type has its peculiar problems and there are great differences between passenger car service, heavy duty truck and bus service, and air-craft engine service. Many schemes are perfectly useful and applicable in one type, and utterly out of the question in another.

Mechanized minds for cars

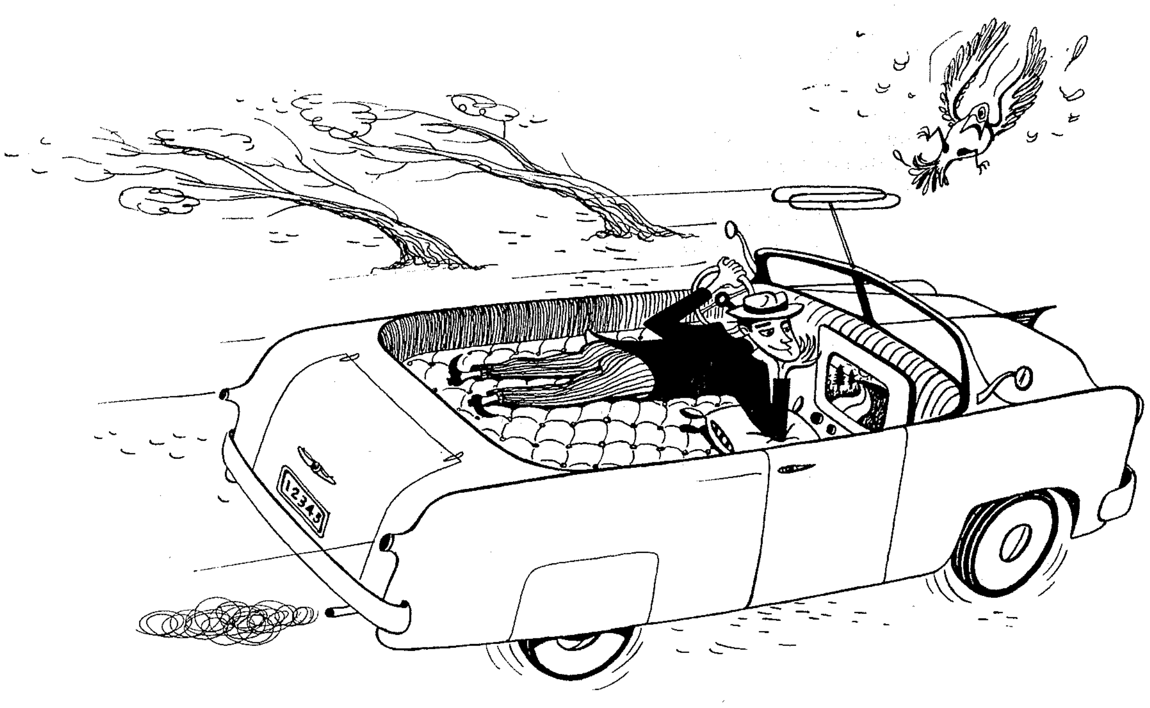
Automatic transmissions are like electric razors: you hate them when you first get them. But the automatic transmission is here to stay. It is really a sound development.

Engineers—as a matter of fact many men—take great pride in shifting gears without clashing. Women, in general, do not share this feeling, and they have for years been strongly in favor of more automatic operations.

By far the simplest arrangement is the Chrysler fluid drive. It is, after all, a conventional transmission with a fluid coupling. It is the best compromise between a conventional and a fully automatic transmission. Service experience is excellent over a long period of years. I hope the fluid drive will appear eventually on the Plymouth, at least optionally.

Cadillac and Oldsmobile are using the hydramatic transmission, and Pontiac joined them last year. This is a combination of a planetary transmission (of model T fame), a fluid coupling, and an automatic shift mechanism. In spite of what you may hear, this is a popular transmission. Ninety-eight per cent of the Cadillac buyers specify it in preference to a conventional transmission.

Service experience is fairly good and service facilities



Television in automobiles offers many exciting possibilities.

are improving, as mechanics are getting more familiar with the device. The factories have worked out very good trouble-shooting techniques.

This is not the place for a detailed description of the hydramatic drive, but those who are interested can find explanations on all levels of elaborateness in the automotive literature.

One thing must be borne in mind in connection with any automatic transmission: It is designed around average normal driving requirements, and that does not include lugging trailers, off-road driving, or similar stunts.

The Buick Dynaflow differs from the other transmissions in principle of operation. It consists essentially of a centrifugal pump driving a hydraulic turbine. Such an arrangement is called a torque converter in contrast to a fluid coupling (Chrysler and hydramatic). This is not a new device, but has been in use for years on heavy duty equipment, such as power shovels and winches. (No comparison between Buicks and steam shovels is implied or intended, even though some rumormongers are trying to find similarities as far as fuel consumption is concerned.)

The Dynaflow transmission includes a planetary gear and reversing gear, combined in one box between the torque converter and the drive shaft. The planetary gear is used as an "underdrive", i.e., it gives a lower gear for maximum torque, or added braking power going downhill. It can be engaged or disengaged at any speed below 45 mph, and serves as an accelerating gear. The conventional clutch has been eliminated entirely.

Chevrolet has given up the vacuum gear shift and now has the conventional manual shift. Presumably, a torque converter type transmission is in the offing for 1950 Chevrolets. That will no doubt shift the so-called "low priced car" (Did I hear anybody laugh?) to automatic transmissions, no matter how loud the protestations ("Who, me? Never!") in some quarters today.

One change for the Chevy

Aside from restyling, this is the only significant change the 1949 Chevy seems to have. An access hole from the hood to the instrument wiring should prove a boon to the serviceman, even though it will remain unnoticed by most owners.

It is often argued that an automatic transmission necessarily results in higher fuel consumption. This is true if we consider transmission efficiency only. Actually, automatic transmission, engine, and rear axle are an integrated unit. By proper selection of gear ratios and shift points, the designer can see to it that the engine operates at a lower specific fuel consumption (lbs-fuel/bhp-hr) than the average driver would and does obtain. As a result, the road economy is not necessarily lower for automatic than for conventional transmission.

There are two general objections to non-conventional transmissions today: it is too hard to start an engine by pushing the car, and there is no way to make the engine hold the car when parked on a hill.

Both items are minor, but a great nuisance. The Buick Dynaflow has a locking device for this purpose. Ford is equipped with an overdrive, but otherwise a conventional transmission. Studebaker has the same overdrive-free wheeling combination that has been used for many years. Hudson has what is called the "drivemaster" transmission. According to the sales literature, this is an ingenious device which relieves the driver of all responsibilities. But the drivemaster is actually a new name for an old improvement. Though Hudson introduced an automatic shifting gear a good many years ago, before everyone else, it is essentially the same mechanism today.

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Do Americans Want a Small, Light Car? E. R. Grace. *SAE*, January 12, 1948.

Softest ride this side of heaven

Periodically, the low pressure tire is revived. This seems to be one of those periods. (Someone claims that the occurrence is $\pi/4$ times the period of appearance of the sea snake in Loch Ness.)

There is no doubt that bigger and softer lines give softer rides, and keep the car from shaking apart. Even though people inflate these tires to the conventional pressures, an improvement in ride quality is obtained. (22 lbs. per square inch is recommended for the low pressure tires). Besides, the monotony of standardized tire sizes is broken. Other advantages—parking is harder; the old tire chains won't fit, which is just as well, because on some bodies there is no room for them anyway between the low pressure tire and the fender.

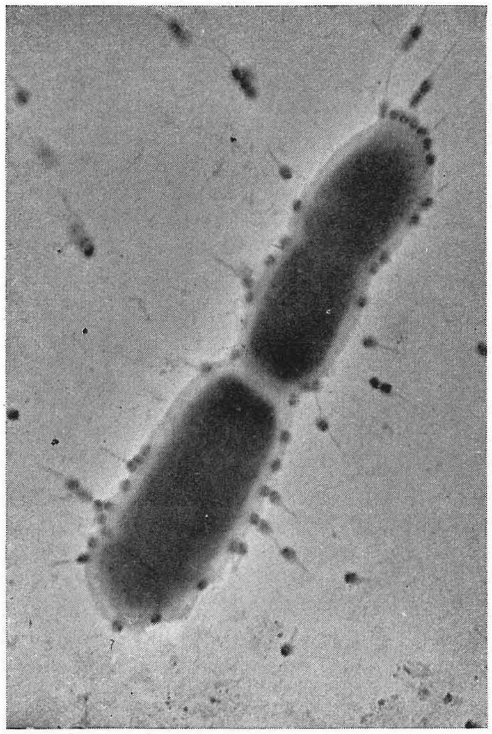
Small, light cars

High initial prices, high monthly payments (due to government regulation), and high operating cost have revived the question of whether the U. S. public wants a small car or not. A survey has shown that people are interested in a cheaper car, but that they expect it to be equivalent in size to the present "big three".

Small European cars are being sold in this country as long as anything with four wheels sells. Tolerable for city traffic, they are painfully underpowered for anything outside the city, just as U. S. cars are too bulky for comfort on the European road. This is not a question of good or bad, but one of design to fit the needs.

Industry is definitely working on smaller cars. Plymouth and Dodge are going to offer a "small series" with a wheelbase of 111 inches (Plymouth) and 115 inches (Dodge) against 118½ and 123½ inches for the De Luxe series. What price reduction will go along with this is not known yet.

Magnified 25,000 times, this dividing bacterium coli is being attacked on all sides by bacterial viruses.



Caltech researchers are making spectacular strides in their war on the

VIRUS

CONTROL OF MANY serious virus diseases may come as a result of researches now under way in Caltech's Biology Division.

The same researches may also bring important knowledge of how certain kinds of protein—the stuff from which all living things grow—are created. The explanation of why these things are tied up together lies in the special nature of the virus itself.

Viruses stand at the borderline of life. Unbelievably small, they can be seen only with the newest kinds of electron microscopes. They can be crystallized, like salt or sugar—and after becoming crystals, and then being "decrystallized," they can actually "come to life" again and reproduce themselves. They can continue to live and reproduce themselves as long as they have some other living thing to grow on.

Viruses live and grow inside living cells. Some kinds of viruses live inside the cells of plants, and some inside the cells of animals and people. Still other viruses live inside bacteria, which are also cells—ones that live independently.

Viruses, however, are much harder to get at than bacteria. Many of the techniques for trapping bacteria—such as the use of fine filters—fail when tried on the virus. In many cases we can attack bacteria with drugs and kill them. But when we try to kill a virus, we are very likely to kill the cell in which it lives, too. Unlike bacteria, viruses resist many things such as penicillin and sulfa drugs. Like bacteria, to make matters worse, viruses can change—so that once a way to attack them

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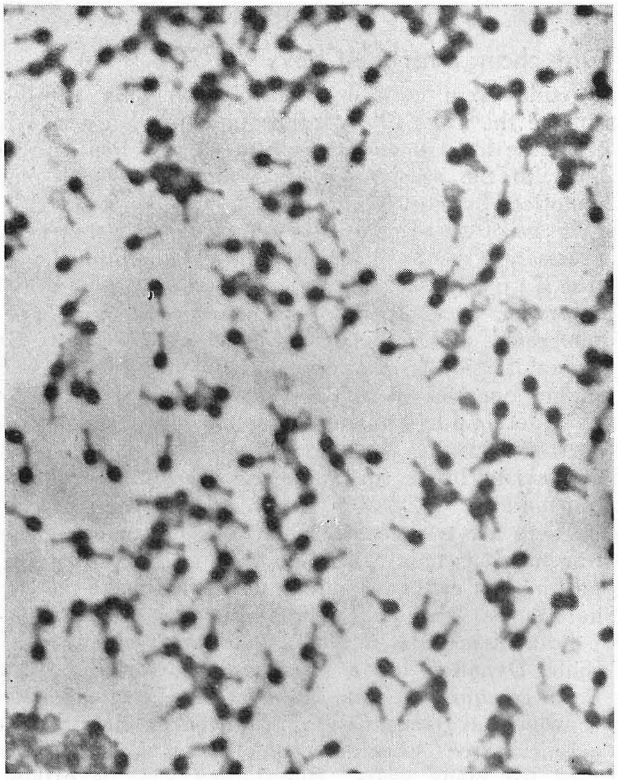
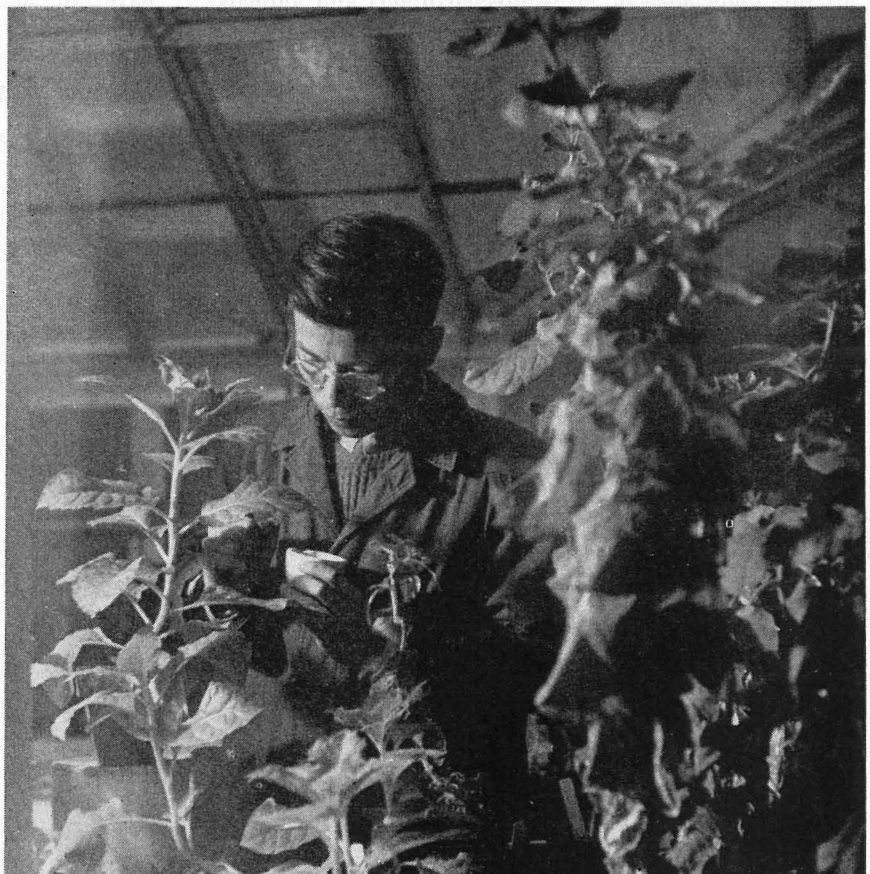


A concentrated culture of bacterial viruses is magnified 40,000 times by the electron microscope.

Researchers in bacterial virology meet at daily luncheon seminars in Dr. Delbruck's laboratory. From left to right group includes: J. Weigle, Geneva; O. Maaloe, Copenhagen; E. Wollman, Pasteur Institute in Paris; Merck Fellow G. S. Stent; Dr. Delbruck and G. Soli, graduate student from Italy.



At right, researcher in plant virology inspects mosaic-infected tobacco. Picture was taken through special plastic screen that protects plants from virus-carrying insects.

Virus CONTINUED FROM PAGE 12

is discovered, they can change themselves to a form which is immune to that attack.

For these reasons, viruses of all kinds are a major threat to plant and animal life. A virus is responsible for poliomyelitis, for example, and for such diseases as rabies, influenza, mumps and yellow fever. Plant viruses cause the sugar beet curly top, tomato spot and tobacco mosaic that are such serious crop destroyers. A plant virus got a foothold in a California orange grove some years ago and by last year this disease, known as the "quick decline," had killed whole large areas of orange trees. These are just a few of the diseases caused by viruses; there are hundreds of others.

Second front

For years, people have been trying to fight plant and animal viruses with such expedients as inoculation, immunization, spray, fumigation, isolation and the breeding of resistant strains. Valuable research on these lines is being followed at many centers today. Working along more fundamental lines, other researchers have accumulated a lot of sound knowledge about the nature of the abnormal, virus-infected cell—including the remarkable isolation of the virus itself. But research at Caltech is along radically different lines.

The Institute staff believes that the route to a truly complete understanding of the abnormal cell lies in an understanding of the normal cell. While this may sound like obviously simple reasoning, it is a fact that amid all this knowledge of virus-infected plants and animals there has been practically no knowledge of what a normal, healthy plant cell is really like.

Now, however, as a result of recent advances at the Institute, researchers feel that they know enough about the composition and inner workings of the normal cell to ask themselves how the virus fits into this machinery.

An answer to the question of what a virus makes itself out of is already foreshadowed in one line of research at the Institute. And if the answer is found, it may help to explain how all living matter gets made.

To see why this is so, it is necessary to remember that all living bodies are composed of cells. These cells in turn are made up chiefly of the fundamental life-stuff called protein. Viruses too are made up of protein, but it is different from healthy cell-protein.

Virus precursor?

Recently Institute researchers have discovered a normal plant-cell protein that is similar in its chemical makeup to virus protein. This recently-discovered protein lives in healthy cells, and acts like a healthy, harmless protein. Institute researchers, under the direction of Drs. S. G. Wildman and James Bonner, have set out to find the relationship between normal protein and virus protein.

Could it be that some slight disorder in the cell, they wonder, suddenly changes the normal protein into the virus protein? Is that the stuff from which the virus gets made?

Perhaps there is the possibility that this new protein is actually a precursor of a virus. It is an axiom in biology that "nothing grows out of nothing"; that everything must have something to grow on. And perhaps here in this virus-like protein the biologists have found the thing that virus grows on. In the case of the virus that causes the tobacco mosaic disease, a very large proportion of protein in the normal leaf cell is somehow converted into this foreign protein. Is it possible that the tobacco mosaic protein, then, gets made at the expense of normal tobacco leaf protein?

Whatever the answer, the Caltech virus researchers are probing extremely close to the question of how any virus—plant or animal—gets made.

As to the problem of how a virus reproduces itself, this question is being attacked not only through work on plant viruses, but through some unique work on bacterial viruses as well. These tiny particles that live inside the microscopic bodies of germs are just as deadly to their host, the bacterium, as the plant virus is to its host, the plant—thus proving the lines,

Big bugs have little bugs
Upon their backs to bite 'em
And little bugs have littler bugs
And so *ad infinitum.*

Caltech researchers, under the direction of Dr. Max Delbrück, have recently discovered that this "bug within a bug," the germ-inhabiting virus, has a sexual mode of reproduction. For these bacterial viruses have been found to be made up of sub-units, each of which is very like that ultimate particle of life, the gene. Furthermore, these same researchers have discovered they can breed special strains of bacterial virus.

In an ordinary living cell there are many thousands of genes, while in a virus there are but a few gene-like sub-units. Thus, in being able to breed strains of these viruses under carefully controlled laboratory conditions, and then to study their composition, these researchers have an unusually straightforward approach to the lowest known level of life.

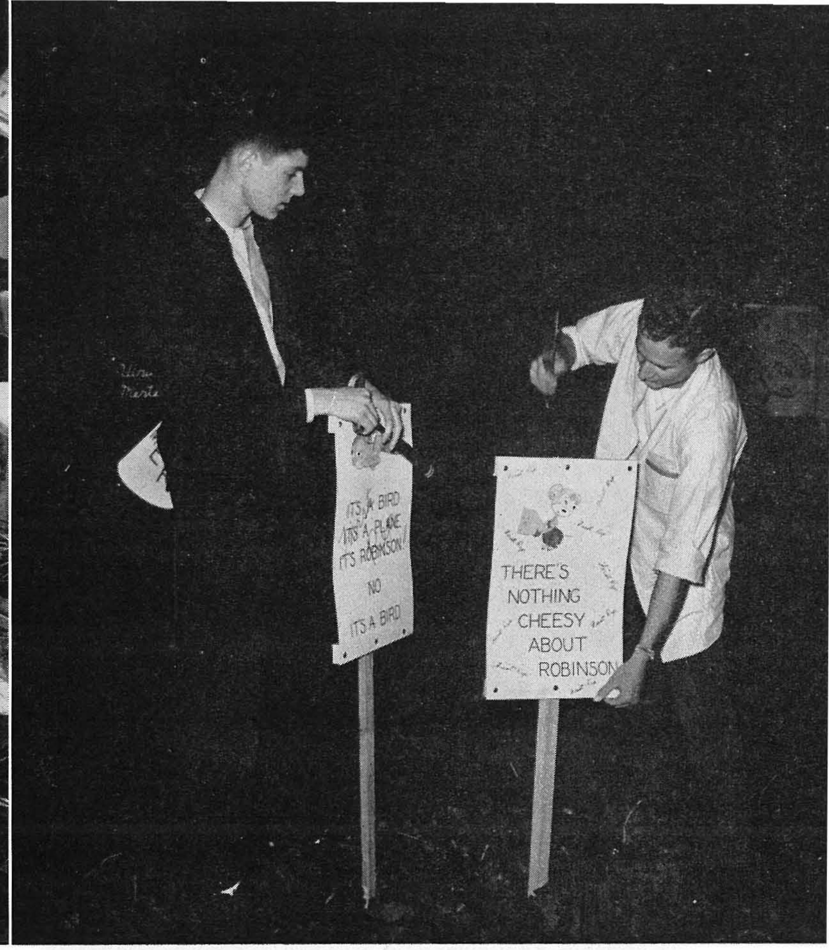
Guinea pigs

So, while plant virus researchers breed special strains of virus-infected plants in their laboratory, the greenhouse, bacterial virus researchers breed special strains of germ-inhabiting viruses in test tubes. Thus, for both groups, the virus may become a kind of guinea pig that can tell us about the origin of new virus diseases, and about their epidemiology.

At Caltech, therefore—thanks to a unique staff and a unique approach to these problems—virus research has been established on a small but hopeful base. From this, research can go steadily ahead until, linking with researches in other lines at the Institute, it begins to piece together the total picture of virus life, of the abnormal or cancerous cell, and beyond that, of the ultimate nature of the living cell.

This account of the virus research program in Caltech's Biology Division is the second in a series of reports on research in progress at the Institute. Next month: the analysis laboratory and the electric analog computer.

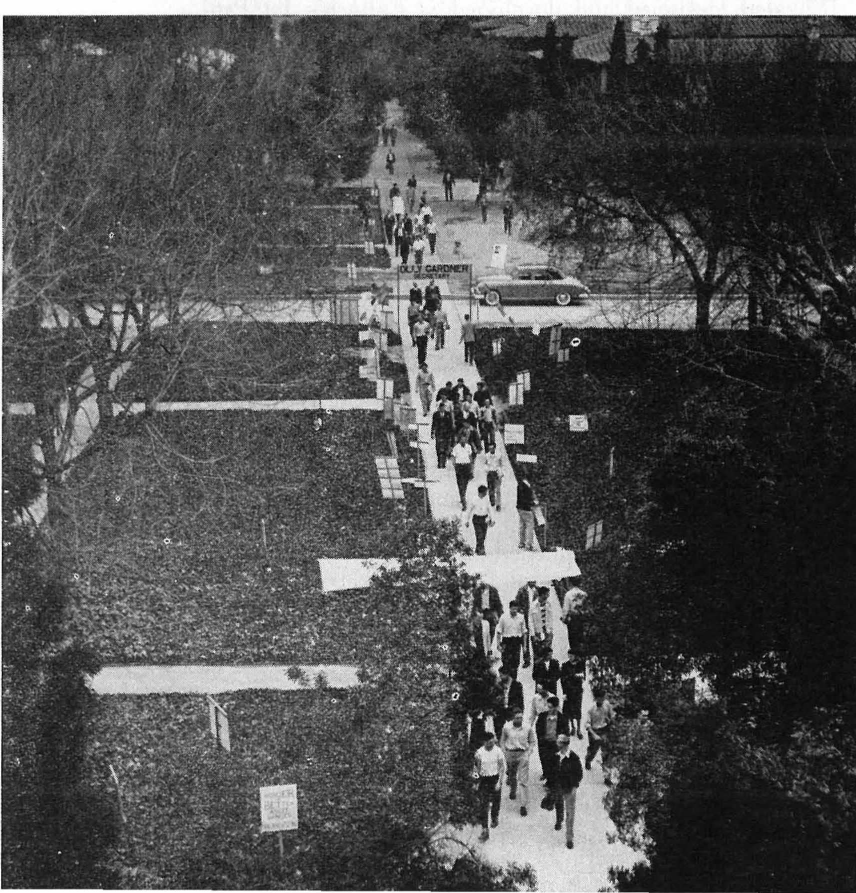
ASCIT nominees are nothing if not versatile. Dave Oakley, left, sweats out his own campaign literature.



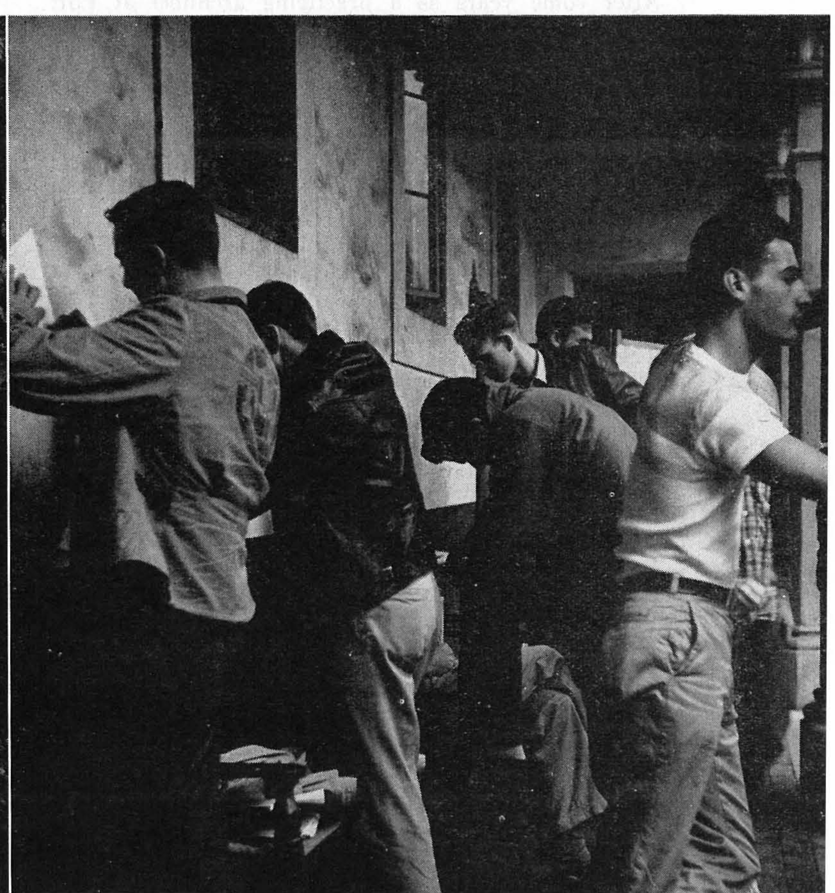
Bruce Robinson, right, socks home a point at official start of campaigning — 12:01 a.m., February 21.

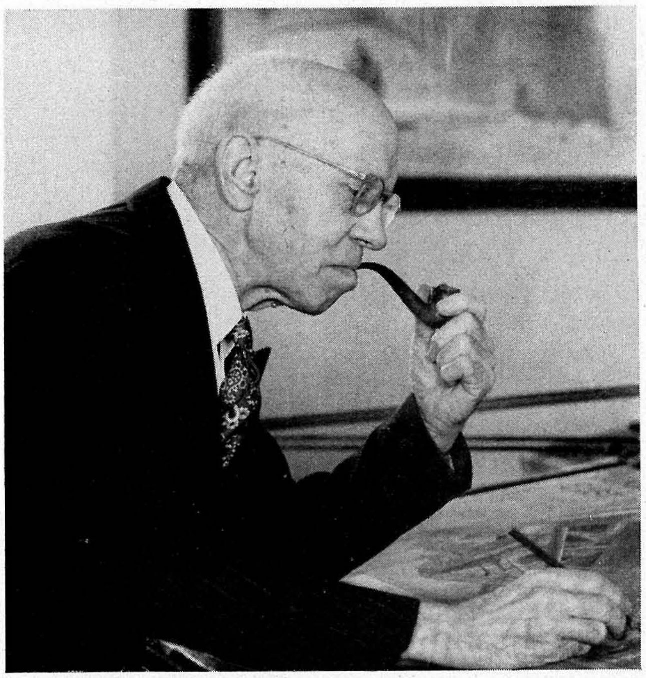
Campus politics: the ASCIT goes to the polls

Candidates' posters sprout like iceplant along campus walks as election campaigns get into full swing.



Polls open in Blacker Court to a good-sized turnout. Total of 581 votes were cast — out of a possible 720.





THE MONTH AT CALTECH

RUSSELL PORTER DIES

DR. RUSSELL W. PORTER, design artist for the Hale Telescope and nationally known "father of amateur astronomy," died February 22 of a heart attack at his home in Pasadena. Although retired as Research Associate in optics and instrument design at Caltech, he was active up to the time of his death, and was busy with drawings for a Palomar spectrograph a few days before he was stricken. He was 77 years old.

Trained as an architect at M.I.T., Dr. Porter turned first to Arctic exploration. He made eight expeditions between 1894 and 1906, discovering a number of new islands and mapping more than 500 miles of new coastline. On one adventure he was lost for two years with a small party of men.

After some years as a practicing architect at Port Clyde, Maine, Dr. Porter taught briefly at M.I.T. and then went to the Bureau of Standards during World War I. It was immediately after this that he began designing telescopes and writing the articles that aroused national interest in amateur astronomy.

In 1928, Dr. George Ellery Hale called him to Pasadena to help with the 200-inch. His three-dimensional drawings of the instrument's components, so vivid that the function of each part could instantly be grasped, and so exact that it was often claimed they could serve as blueprints, eventually became nationally known.

After twenty years' work, it was Dr. Porter's wish that he might live to see the stars through the Hale telescope; and his wish was satisfied. A few weeks before his death he said, "I've seen enough to know the telescope is going to be even better than we had thought."

Co-author of the book, *Amateur Telescope Making*, Dr. Porter was to have been awarded the honorary degree of Doctor of Science by Middlebury College, in his native Vermont, this spring.

STERLING DINNER

ABOUT 200 CALIFORNIA Institute Associates and faculty members gathered at the California Club on February 24 to honor Dr. J. E. Wallace Sterling, president-elect of Stanford University, and Mrs. Sterling. Dr. Sterling, now Director of the Huntington Library and for many years the Edward S. Harkness Professor of History and Government at Caltech, leaves for his new job around April 1.

Principal speaker at the dinner was Bohus Benes, nephew of the late President Eduard Benes of Czechoslovakia, and Czechoslovakian Consul at San Francisco from 1942 until 1948. Discussing the Russian threat to peace, Mr. Benes urged a strong union of Western democracies supporting a program of military preparedness, a healthy economy, and a positive policy for winning the masses of Europe to the democratic cause.

ROCKET RECORD

ON FEBRUARY 24 a WAC Corporal rocket—originated, designed and developed at Caltech's Jet Propulsion Laboratory—set new records for altitude and speed at the White Sands Proving Ground in New Mexico. Carried up to a height of 20 miles in the nose of a German V-2, the WAC Corporal, launched by remote control, reached an altitude of 252 miles, and a speed of 5,000 miles an hour. The previous altitude record of 114 miles, and speed record of 3,600 miles an hour, were registered by a V-2 at White Sands on December 17, 1946.

Caltech scientists worked a year to develop the WAC Corporal—actually the second high-altitude rocket designed at JPL. It followed the pattern of the original WAC Corporal, designed from 1944 to 1946, but it posed some pretty special problems of its own. Propellents had to be devised to free it from the parent rocket, which was traveling almost a mile a second at launching time. The V-2 had to be controlled to facilitate the remote-control launching of the smaller rocket. Because there was virtually no air at the altitude at which the WAC Corporal was launched, it was necessary to develop some forms of control for the rockets other than aerodynamics. (Wings, tails and fins would have little effect in the rarefied atmosphere.) And combustive elements that would operate at high altitudes had to be developed.

According to Brig. Gen. Philip G. Blackmore, commanding officer at the White Sands Proving Ground, this was "the greatest height ever reached by a man-made object . . . the rocket was for all practical purposes outside the earth's atmosphere."

"The success of this flight," he said, "opens up new vistas for scientific research in the field of guided missiles and exploration of the unknown regions of the atmosphere."

THE CHEMISTRY OF SMOG

DR. ARIE J. HAAGEN-SMIT, Professor of Bio-Organic Chemistry in the Biology Division, furnished the Los Angeles County Air Pollution Control District with a new lead in its attack on the smog problem this month. Applying the technique which he developed, and used so successfully in flavor studies of pineapple (E & S—January '49), Dr. Haagen-Smit, in an analysis of air samples from this area, found "surprisingly large quantities" of substances known as organic peroxides.

Organic peroxides, which result from incomplete combustion, are known to be extremely irritating. Though they have never before been reported as significant air pollutants, they may well be the most important cause of eye irritation in the Los Angeles area. Determined efforts for several years to find the eye irritant in smog —notably by the Stanford Research Institute, on behalf of the oil industry—at one time indicated that elementary sulphur might be to blame. But the Haagen-Smit studies, preliminary as they are, found almost no trace of sulphur.

Opening up a whole new field of investigation into the smog problem, Dr. Haagen-Smit is now working out a test technique to be used by District researchers.

PRAY TO GEOLOGY

LLOYD C. PRAY, National Research Council Fellow at the Institute since 1946, has been appointed Instructor in the Division of Geological Sciences, beginning July 1.

A graduate of Carleton College, Pray came to Caltech in 1941 for advanced studies in geology, and received his M.S. in 1943. He then joined the U.S. Geological Survey, leaving in 1944 for a two year stretch in the Navy. At the end of the war he returned to the Institute to continue his studies toward a doctorate.

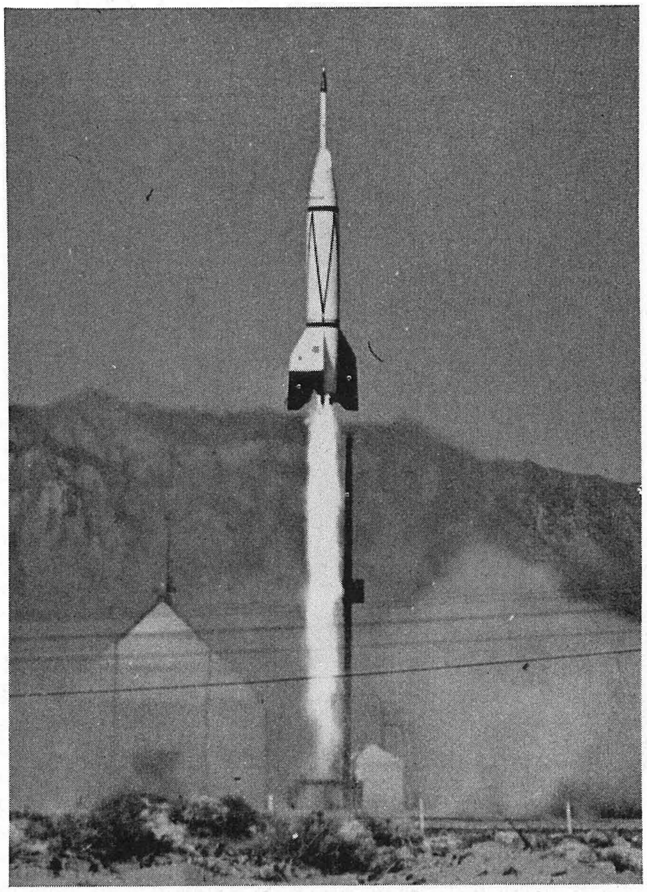
An able and energetic student, interested in general geology, Pray will be a valuable reinforcement for the Division's strong program of field instruction.

SUMMER SESSIONS

THE INDUSTRIAL RELATIONS Section of Caltech is announcing its second annual series of summer courses in Management and Personnel Training. The schedule:

June 19-June 24:	Negotiation and Administration of Union Contracts
June 26-July 1:	Employment
July 5-July 9:	Training of Employees and Supervisors
July 10-July 15:	National Income and Its Distribution
July 17-July 22:	Integrating a Personnel Program

Conference leaders will include Lawrence A. Appley, President of the American Management Association; L. Clayton Hill, Professor of Industrial Relations, School of Business Administration, University of Michigan; Gilbert Brighouse, Chairman of the Department of Psychology, Occidental College; Martin S. Firth, Director of Program Research and Development, General Motors Institute; M. I. Gershenson, Chief of the Division of Labor Statistics and Research of the State of California; Leo Wolman, Professor of Economics, Columbia University; and from Caltech—Richard O. Sensor, Assistant Professor of Industrial Relations; Ray E. Untereiner, Professor of Economics; Robert D. Gray, Director of the Industrial Relations Section; and Arthur H. Young, Industrial Relations.



Take-off of two-stage rocket which set a new altitude record (252 miles) last month at White Sands.

THE EDGE OF THE UNIVERSE?

DR. IRA S. BOWEN, director of the Palomar and Mt. Wilson observatories, announced last month that the 200-inch Hale telescope has proved its power by photographing nebulae situated a billion light years (about 6,000,000,000,000,000,000,000 miles) from the earth.

Dr. Edwin S. Hubble, research director of the observatories, make the observation during regular tests with the 200-inch mirror. In order to determine the distance accurately, the photograph, together with other Palomar test pictures, will be compared with photographs of the same area, taken by the 100-inch Mt. Wilson telescope, which show objects half a billion light years away.

The supposed edge of the known universe is one billion light years from the earth. One billion light years is also at the end of the full power of the 200-inch telescope. This is the true importance of Dr. Bowen's announcement—that the 200-inch is already doing what was expected of it, even though it wasn't expected to be doing it until final adjustments are completed some time next fall.

P.M.S.Blackett: A loud, clear and persuasive voice

BOOKS

FEAR, WAR, AND THE BOMB:

Military and Political Consequences of Atomic Energy
by P.M.S.Blackett
Whittlesey House,New York 244 pp. $3.50

Reviewed by William A. Fowler
Professor of Physics

IN *Fear, War, and the Bomb*, P. M. S. Blackett, officer in the Royal Navy in World War I, director of the largest school of cosmic ray research in Europe, pioneer in operational research in World War II, holder of the American Medal of Merit, and winner of the Nobel Prize in physics for 1948, strides into the no man's land of the present cold war between Russia and the United States. From there his voice is loud, clear and persuasive—but it is destined to fall on ears already skeptical of the words and advice of scientists in general, and atomic scientists in particular.

This is unfortunate. *Fear, War, and the Bomb* (prosaically, but more accurately, published in England as *Military and Political Consequences of Atomic Energy*) is the first statement by a scientist of note which differs from the post-Hiroshima apologia of the great majority of articulate physicists—and which has any chance of reaching a large and widespread audience. The unanimity of American scientists on the subject, coupled with the paucity of facts and figures available to the American public, has led (for better or worse) from Hiroshima, through the Acheson-Lilienthal Report, through the Baruch Plan, to the present impasse in Soviet-American relations on atomic energy—which is not only characteristic, but perhaps the most intransigent of all these relations.

Blackett's book is an attempt to answer the question: "Why has the Soviet Union objected to the generous and idealistic proposal for the control of atomic energy made by the American delegation to the United Nations Atomic Energy Commission?" There is no doubt that Blackett's answer is sympathetic to the position of the Soviet Union. It will be unfortunate if, for this reason, it is not given the impartial attention which it deserves, as a treatment of a difficult subject from a point of view which—though not held by the majority of those well-versed in one fundamental aspect of the subject; the scientific—is still a thoughtful and thought-provoking one. It will be especially unfortunate if we find no other defense of our own position than to accuse Blackett of following the Soviet line, and hence dismiss his analysis forthwith.

Blackett begins with an analysis of the problem of how the invention of the atomic bomb affects warfare. He draws his answer from the broad lesson of the second World War—that the aerial bombing offensive against Germany involved the dropping of over one million tons of ordinary bombs without leading to a decisive failure of either civilian morale or production. The documentary evidence advanced in support of this thesis, taken mainly from the official reports of the United States Strategic Bombing Survey, may come as a surprise to many Americans. He concludes that any future war in which America and Russia are the chief contestants would certainly not be decided by atomic bombing alone—in spite of the equivalence of one atomic bomb to two thousand tons of ordinary explosive.

Blackett maintains that atomic bombs were dropped on Hiroshima and Nagasaki not for military reasons—Japan was already defeated—but for real and compelling diplomatic reasons, occasioned in large measure by the knowledge that Stalin had assured Roosevelt at Yalta that Russia would declare war on Japan three months after V-E day. The European war ended on May 8. The Soviet offensive was due, and did start, on August 8. The bomb was dropped on Hiroshima on August 6. Blackett comments: "So we may conclude that the dropping of atomic bombs was not so much the last military act of the second World War, as the first major operation of the cold diplomatic war with Russia now in progress."

Control vs. stalemate

From here the argument runs that the United States approached the problem of international atomic energy control, not only ashamed to have been the first to use atomic weapons, but completely over-impressed by the part these weapons would play in future warfare. As a consequence, in the Baruch Plan the United States insisted on *special* treatment of atomic energy problems by the United Nations from the beginning; the creation of an International Atomic Development Authority not subject to veto in the Security Council; the separation of atomic bomb disarmament from all other forms; the control of *all* atomic energy developments by the Authority; the establishment of special penalties for violations of any ultimate agreements; and the location of atomic energy plants for strategic reasons primarily based on the needs of the Authority, rather than on the industrial needs of the individual countries involved.

On the other hand, Russia, unwilling to accept any impediment to her own progress toward equality with America in the atomic energy field, insisted on the establishment of an Authority with limited inspection rights, and only on condition that a general disarmament convention concerning all types of weapons—including biological as well as atomic—be ratified and implemented; that the veto in the Security Council be applicable; and that the *stages* by which operations in atomic energy development permitted to individual nations could come into effect be decided beforehand rather than left to the discretion of the Authority.

With this Blackett concludes that "the deadlock remained to the end much as it was in the beginning. For sound objective reasons, Russia and America put forward proposals appropriate to their own interests. Owing to the great difference between the strategic situations of the two Powers and between the levels of their atomic energy developments, these proposals were completely antagonistic, and each completely unacceptable to the other."

Blackett offers little in the way of a solution of the problem. Only four pages constitute his final chapter on "A Way Out?" He argues essentially that the Soviet proposal be adopted at present, with provisions for the eventual adoption of many aspects of the Baruch Plan as Russia advances, without outside interference, through the many stages of atomic energy development necessary to bring her abreast of the United States.

This reviewer finds it difficult to believe with Blackett that atomic bombing will not be incredibly more effective than the aerial bombing of World War II—that the first atomic bomb was dropped on August 6, 1945 for any other reason than that the first product of a planned and large-scale American war effort was ready at the time—and that America's seemingly generous plan for the control of atomic warfare is actually a plan to control the development of atomic processes for use as industrial sources of energy in other countries.

On the other hand, there is much to be said—in retrospect, to be sure—in criticism of our conduct of atomic energy negotiations in the United Nations. Our stubbornness, as well as Russia's, necessarily led to the present stalemate. Our insistence, beginning with Baruch's first speech to the Commission, that no essential deviation from the American Plan would be acceptable, was a fundamental error if we expected to reach a mutual agreement with the other contracting parties.

Our refusal to accede to the Soviet requirement for a prior agreement on disarmament was in keeping, it is true, with our lack of faith in a time-worn method which failed so miserably to prevent World War II, but was nevertheless in error in that we did not make it the first step in a real program of mutual give and take. Last but not least, our insistence on retaining the so-called "secrets" until such time as adequate safeguards, in our opinion, had been established, was in error not only in regard to scientific tradition, but also in regard to our own past tradition in the development of many technical aspects of current civilized life.

Blackett's book is a controversial one. It will anger and further bewilder many well-meaning people. If it brings to the American public the realization that there can be an honest difference of opinion on the scientific aspects of the present Soviet-American impasse, it may lead to their insistence that the facts—and *all the facts*—about atomic energy and atomic weapons be made available immediately. Our dilemma arises today for one and only one reason—our scientists, our military men, our statesmen, our President have attempted to answer a difficult problem without an appeal to the bulwark of democracy: *enlightened* public opinion.

ALUMNI *news*

BOARD VACANCIES

IN ACCORDANCE with Section 3.04 of the By-Laws of the Association, the Directors met as a nominating committee on February 15, 1949. Five vacancies will occur on the Board at the end of the current fiscal year, one vacancy to be filled from the present Board and four to be elected by the Association. The present members of the Board and the year in which their terms of office expire, follow:

N. A. D'Arcy, Jr. '28	1950	R. F. Mettler '44	1950
E. R. Hoge '18	1949	W. B. Miller '37	1949
R. M. Lehman '31	1950	W. D. Sellers '25	1949
H. B. Lewis '23	1949	G. K. Whitworth '20	1950
J. W. Lewis '41	1949		

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

Richard C. Armstrong '28	Robert P. Sharp '34
Fritz W. Karge '18	Carl Tutschulte '31

In accordance with Section 3.04 of the By-Laws of the Association: ". . . Additional nominations may be made by petitions signed by at least ten (10) regular members in good standing, provided that the petitions must be received by the Secretary not later than April fifteenth."

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

D. S. CLARK, Secretary

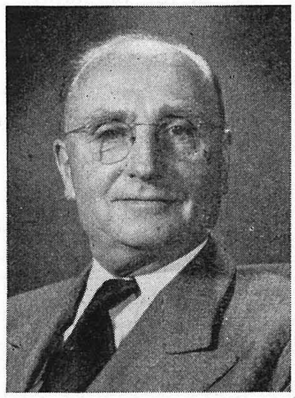
The nominees:

RICHARD ARMSTRONG, M.D., received his B.S. in Applied Chemistry in 1928. After a few months in chemical research with the Union Oil Co., he joined the research department of the Riverside Cement Co., working under Hubert Woods '23. In 1931-32 he managed to get some necessary pre-medical credits for part-time studies in Caltech's Biology Division, and in 1935 he left Riverside Cement for the University of Michigan Medical School at Ann Arbor. There followed "four years of hard labor."

From 1939 to 1942 he served his internship, followed by residency in Ophthalmology, at the University Hospital in Ann Arbor—with a few months out in the winter of 1941-42 as a fellow in residence at the Wilmer Eye Institute, Johns Hopkins Hospital.

From 1942 to 1946 he was a medical officer assigned to the U.S. Army Air Force. Two years of this was spent in duty at the Aero Medical Laboratory at Wright Field. In August of 1946 he returned to Pasadena at long last and started in private practice limited to the eye.

He is a member of Tau Beta Pi and the medical society Alpha Omega Alpha. On the staff of the Huntington Memorial Hospital and St. Luke Hospital, he is also Instructor in Ophthalmology at the College of Medical Evangelists in Los Angeles, a member of several Ophthalmological organizations, and a Fellow of the American Medical Association.



FRITZ KARGE received his B.S. in Civil Engineering in 1918, on leave of absence from the Union Oil Company of California. He was a member of the Dorm Club, and chairman of the Executive Committee in his senior year. After graduation he became Supervisor of Civil Engineering Design for Union Oil, then Chief Engineer of the Pipe Line Department, and—currently—Civil and Mechanical Engineer in the Plant Process Division of the Manufacturing Department.

His service with the company was interrupted from February 1942 to July 1943 when he was connected with the Fluor Corporation.

A member of Tau Beta Pi, the American Society of Civil Engineers, and the American Society of Mechanical Engineers, Mr. Karge has served the Alumni Association on another occasion—as President, in 1920-21.

ROBERT P. SHARP received his bachelor's degree in 1934 and his master's degree in 1935 in Geology. He was a three-year letterman — quarterback of the football team, and in his senior year captain of the team, as well as vice-president of the student body. He was a member of Tau Beta Pi, and was awarded the honor key on graduation.

In the fall of 1935 he went to Harvard on a scholarship. In 1936-37 he was an Austin Teaching Fellow, and in 1937-38 he held the Woodworth Fellowship at Harvard. He received his Ph.D. at Harvard in 1938, for a thesis involving structural and physiographic study of the Ruby-East Humboldt Mountains in Nevada.

In 1938 Dr. Sharp joined the faculty of the University of Illinois, where he remained until after the outbreak of the war, when he was commissioned in the Arctic, Desert, and Tropic Information Center of the Army Air Forces. His work there was largely with the Arctic Section. After his discharge he went to the University of Minnesota as Professor of Geomorphology, and in September 1947 he returned to Caltech as Professor of Geomorphology. His research projects include studies of existing glaciers in Alaska and Canada—and if you missed reading about these in E & S (Nov. '48) Dr. Sharp will be telling about them, in person, at this year's Alumni Seminar (see below).

CARL TUTSCHULTE received his B.S. in Mechanical Engineering in 1931. He was a member of the Varsity Club, and on the staff of the California Tech. He worked in a film processing laboratory and on construction work until 1934, when he became an engineer engaged in sub-surface structural interpretations and correlations for the Shell Oil Company. In 1936 he joined the Tide Water Associated Oil Company as a production engineer, and in 1937 he was placed in the Los Angeles Basin District to initiate production engineering work in the field. After he had spent a year and a half organizing and building up this application of engineering to production operations, the company decided to have all its young engineers trained for production experience in the Los Angeles Basin District under his supervision and that of the Division Superintendent. During the past four years he has engaged in all his company's unitization and gas injection studies.

He is a member of several A.P.I. and A.I.M.E. committees, and has written numerous technical papers for the oil industry.

WASHINGTON CHAPTER NOTE

TWENTY ALUMNI and fifteen wives and guests met at the Roger-Smith Hotel in Washington for a dinner-meeting on January 14. As the purpose of the gathering was primarily that of making and renewing acquaintances, no important business was transacted. Tentative plans were made for a meeting in April.

HONORARY MEMBERSHIP

ON JANUARY 18, Dr. J. E. Wallace Sterling (see page 16) was elected an honorary member of the Alumni Association. He was presented with a special framed certificate by the Board of Directors.

Dr. Sterling is the seventh man to be so honored by the Alumni Association. Other honorary members are President L. A. DuBridge, Dr. R. A. Millikan, Prof. William Clapp, Prof. George R. MacMinn, Charles Schwieso, and Prof. Royal W. Sorensen.

SEMINAR ROUNDUP

THE 12TH ANNUAL ALUMNI SEMINAR, set for Saturday, April 9, will include talks by ten members of the Caltech faculty, in addition to an address by President DuBridge at the Seminar Dinner. As a supplement to the planned program for the Seminar (E & S—February '49), résumés of the ten scheduled lectures appear below:

Scientific work in Postwar Europe *by Linus Pauling*

DURING THREE European trips, extending over a total of twelve months, Dr. Pauling had an opportunity to observe scientific work in a dozen countries. He will report on some new scientific discoveries, on the post-war problems which are interfering with scientific development, and on the efforts to solve them.

High energy accelerators *by Robert V. Langmuir*

HIGH ENERGY accelerators like the betatron and the cyclotron are limited to particle energies below 100 million electron volts. The new synchrotrons and frequency modulated cyclotrons have made greatly increased energies available to nuclear physicists. These machines have already produced mesotrons in the laboratory, and it is expected that the studies of such mesotrons will lead to a better understanding of nuclear forces. Dr. Langmuir will discuss the principles of the various machines. Construction of a 600 MEV synchrotron at Caltech is now under consideration.

Sun and earth's atmosphere *by Oliver R. Wulf*

THE SUN EMITS a vast amount of light, of which only a minute fraction falls on the earth. Of this small fraction, moreover, a considerable portion is reflected back into space. Dr. Wulf's talk will concentrate on the light that is absorbed in the high atmosphere, where it carries out photochemical reactions that are of significance for biological processes as well as for everyday life.

Nerve repair *by A. van Harreveld*

AFTER DAMAGE to a peripheral nerve, processes of degeneration and regeneration take place which may result in a restoration of the function of the organs innervated by the afflicted nerves. Dr. van Harreveld will describe the processes which lead to functional repair, and the measures which can be taken to support them.

The gas turbine *by W. D. Rannie*

MR. RANNIE WILL cover the history of the gas turbine and its possible applications in the future, in view of its known advantages and limitations.

Science mission to Japan *by Royal W. Sorensen*

AS A MEMBER of the Scientific Advisory Committee, Prof. Sorensen, with five other scientists, visited Japan in 1947 to review scientific and industrial development. As a V.I.P. Sorensen had an unusual opportunity to observe occupied Japan. His talk will include not only technical developments in Japan, but also comments on Japanese life today, and Caltech alumni in that country.

Goals of industrial relations *by Robert D. Gray*

MR. GRAY WILL furnish a much-needed definition of "good" industrial relations, as well as a practical explanation of the real goal of industrial relations—which is only incidentally industrial peace.

Alaskan glacier studies *by Robert P. Sharp*

DR. SHARP WILL give a first-hand account of Caltech's glaciological investigations of the Malaspina Glacier in Alaska, and the Seward Ice Field in Canada, in the summer of 1948. The talk is to be illustrated with Kodachrome slides.

The Guam model at Azusa *by Robert T. Knapp*

A DESIGN STUDY for Apra Harbor at Guam has just been completed in the harbor laboratory at Azusa. It has been carried out for the Navy's Bureau of Yards and Docks, which is improving the harbor for use as a naval base. The model covers about 15,000 square feet, and represents an area of some 50 square miles. Waves and currents are produced in the model, and the effects of various breakwater configurations are investigated. Measurements of the wave motion are made both electrically and photographically. The model will be in operation during the inspection trip, scheduled for 3 p.m., following Dr. Knapp's talk.

The impact of psychology *by Hunter Mead*

IT IS SOMETIMES said that we live in a world different from that of our grandfathers because of three men: Darwin, Marx and Freud. The psychologist believes that in the long run Freud will prove the most influential of the three—or rather, he believes that psychology may do more to influence our thinking than social and economic systems, or even discoveries in the better established sciences, can do.

In view of the youth of psychology (about 70 years) no one can predict a limit to the modifications this infant science may bring in human thinking. Dr. Mead will discuss some of the modifications it has already brought about.

PERSONALS

1922

Donald W. Darnell was recently made President of the Fluor Corp., Ltd., of Los Angeles. Darnell joined the company in 1925 as an engineer, climbed to the top through the positions of chief engineer, vice-president, and—since 1947—vice-president and general manager.

1927

D. Lewis Gazin M.S. '28, Ph.D. '30, who was active in organizing the new Alumni Chapter in Washington, is Curator of Vertebrate Paleontology at the Smithsonian Institution. Currently he is doing research in Eocene and Paleocene mammals, plans to spend next summer in field studies in New Mexico and Wyoming.

1928

Jean E. (Ed) Joujon-Roche is Safety Engineer for Shell Oil on the Pacific Coast. Ed has been with the company for the past nineteen years, except for a stint with the U. S. Army Engineers from 1941-45. Also with Shell: **Alex Clark**, M.S. '32, Exploration Manager in the Rocky Mountain Division, and **Frank W. Bell**, M.S. '33, Division Geologist of San Joaquin Valley.

1929

Stanley W. Lohman, M.S. '38, is with the Ground Water Branch of the U.S. Geological Survey, as District Engineer for Colorado and Wyoming.

1930

Ira C. Bechtold is Director of Research and Development for the Fluor Corp., Ltd., in Los Angeles.

1933

Ygnacio Bonillas, M.S. '35, is now Vice-President and Director, as well as Chief Geologist, of the Richmond Exploration Co., subsidiary of Standard Oil of California, in Venezuela.

1936

Victor Veysey announces his retirement as Works Manager of the General Tire and Rubber Co's South Pasadena plant. He is moving to Brawley, Calif., to operate a large ranch, owned by his family for many years.

1939

Walter H. Munk, M.S. '39, Ph. D. '47, has returned to the Scripps Institute of Oceanography at La Jolla, where he is Assistant Professor of Geophysics, after spending six months in Oslo, Norway, as a Fellow of the Guggenheim Foundation.

1940

Mortimer Staatz is doing graduate work in geology at Columbia University. He expects to get his doctorate at the end of this year.

George F. Wheeler, M.S., married Dorothy Wilson of Atlanta, Georgia, in that city on January 26. He is instructor of physics at Georgia Tech.

David H. Steinmetz, III, was married in February to Miss Verna Louise Pace of San Marino. Mrs. Steinmetz is a graduate of Stanford, a member of Delta Gamma and of Phi Beta Kappa. After an extensive wedding tour through the West Indies, the couple will settle in Los Angeles.

1941

Charles L. Dailey, M.S. '42, is co-author of a new book, *Computation Curves for Compressible Fluid Problems*, published in January by John Wiley & Sons. Dailey works on the Navy Jet Propulsion Project at the University of Southern California.

Dale Turner, as Assistant to the Chief Seismologist for Superior Oil Co., is currently watching progress on the world's deepest well—the Superior Limoniera Well in the San Joaquin Valley. It reached 17,992 feet in February.

1942

Willard P. Fuller, M.S., is Resident Geologist for Anaconda in the Tintic Mining District, Utah. He reports that he is sometimes overly-resident, as for example in January, when he was three days snowbound at the North Lily Mine.

1944

George G. Shor writes from Lovington, New Mexico, that he has been promoted by Seismic Explorations, Inc., from Computer to Party Chief of a seismic field crew. "For the benefit of any alumni who are amateur radio ops," he says, "I'm active on the 40-meter ham band every night around midnight—call sign W5PHL—and glad to talk."

William P. Harland reports the recent announcement of his engagement to Miss Noli Lattin of Vancouver, B.C. Harland is Resident Engineer of the Shawinigan Engineering Co., Ltd., at Shawinigan Falls, Quebec, and is supervising construction of chemical plants in the plastics industry.

1945

Stanley D. Clark is working for Standard Oil in Fresno, but plans to enter law school next fall. He's the father of a 5-month-old son.

1946

Daniel Cortes-Guzman, M.S., married Gilda Andrade Diaz, on February 22, in Mexico City.

1947

John Pettley, M.S., has returned from an 18-months visit to his home in England to become instructor in the Webb School of California, in Claremont.

Don Granicher is a chemical engineer with the Stearns-Rogers Co. in Denver.

Arnold Nevis is now in his second year at Harvard Medical School.

Harold Hipsh is back on the campus working for another degree in aeronautics. He spent last summer at Oak Ridge, working for Fairchild Aircraft.

Dale Meier, M.S. '48, is at UCLA studying for a Ph. D. in chemistry. He was married last summer to the former Helen Ledin.

1948

Len Herzog is at M.I.T., doing research on radio-active tracer methods in mineral engineering.

H. W. Agnew, M.S., is on the engineering staff of the Bralorne Gold Mines, in Bralorne, British Columbia.

Index to Advertisers

Change Your Mind...

Most of us have, at one time or another

by J. L. SINGLETON
Vice-Pres. and Director of Sales,
General Machinery Division
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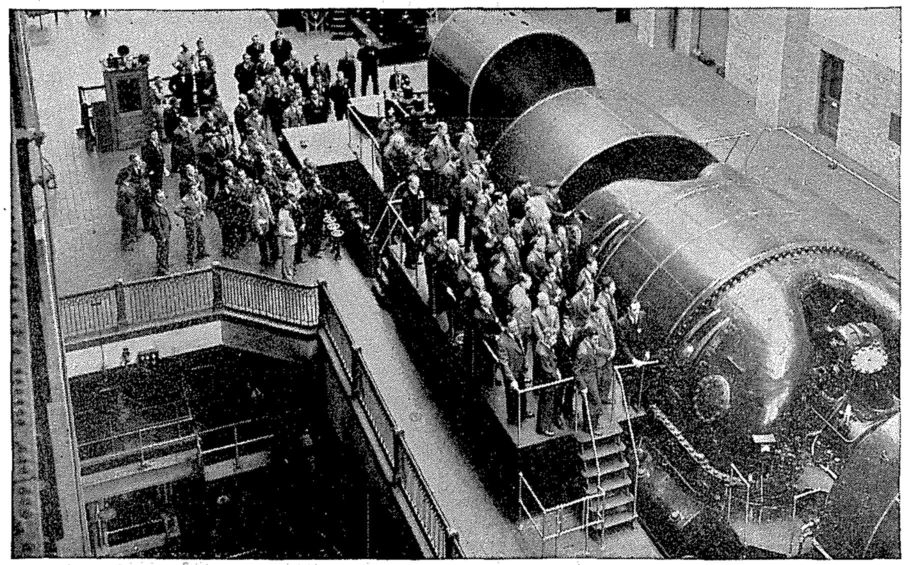

One of the three 80,000 kw Allis-Chalmers steam turbine generating units now in service in a big mid-western power plant. A fourth unit is being built, and a fifth is on order.

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J. L. SINGLETON

I've noticed since that it's not unusual for Graduate Training Course students at Allis-Chalmers to change their minds. Here, opportunities have a way of seeking out a man according to his ability. Sometimes these opportunities are in fields that he had not fully understood or considered before. There are so many kinds of work to do here that a man is almost sure to end up in work that will bring him the most in personal satisfaction and advancement.

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If you have ability and a leaning toward sales work, you'll have plenty of chance to test and develop it at Allis-Chalmers during your Graduate Training Course. Then you take your place in a Coast-to-Coast sales organization—perhaps even in a foreign office.

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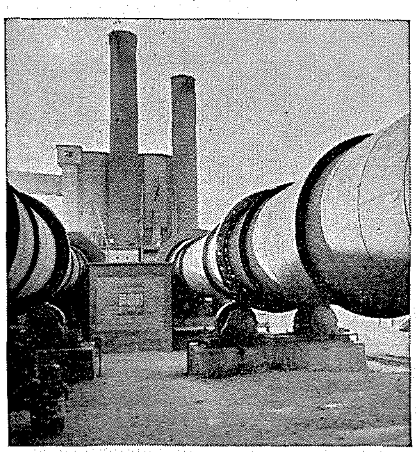
The Graduate Training Course here doesn't hold you down. You help plan it yourself, and are free to change as you go along. You work with engineers of national reputation—divide your time between shops and offices—can earn advanced degrees in engineering at the same time.

Those are some of the things that appealed to me 23 years ago. They're still good.



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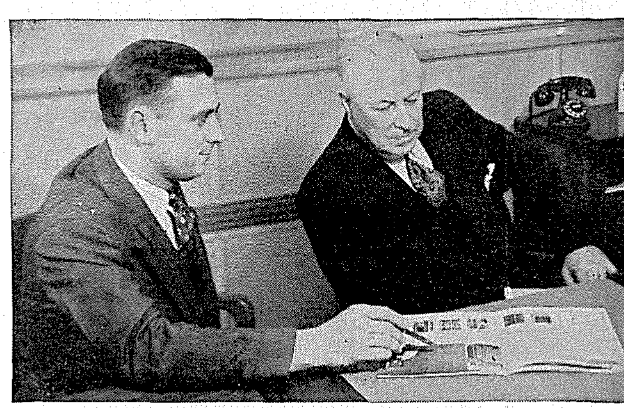

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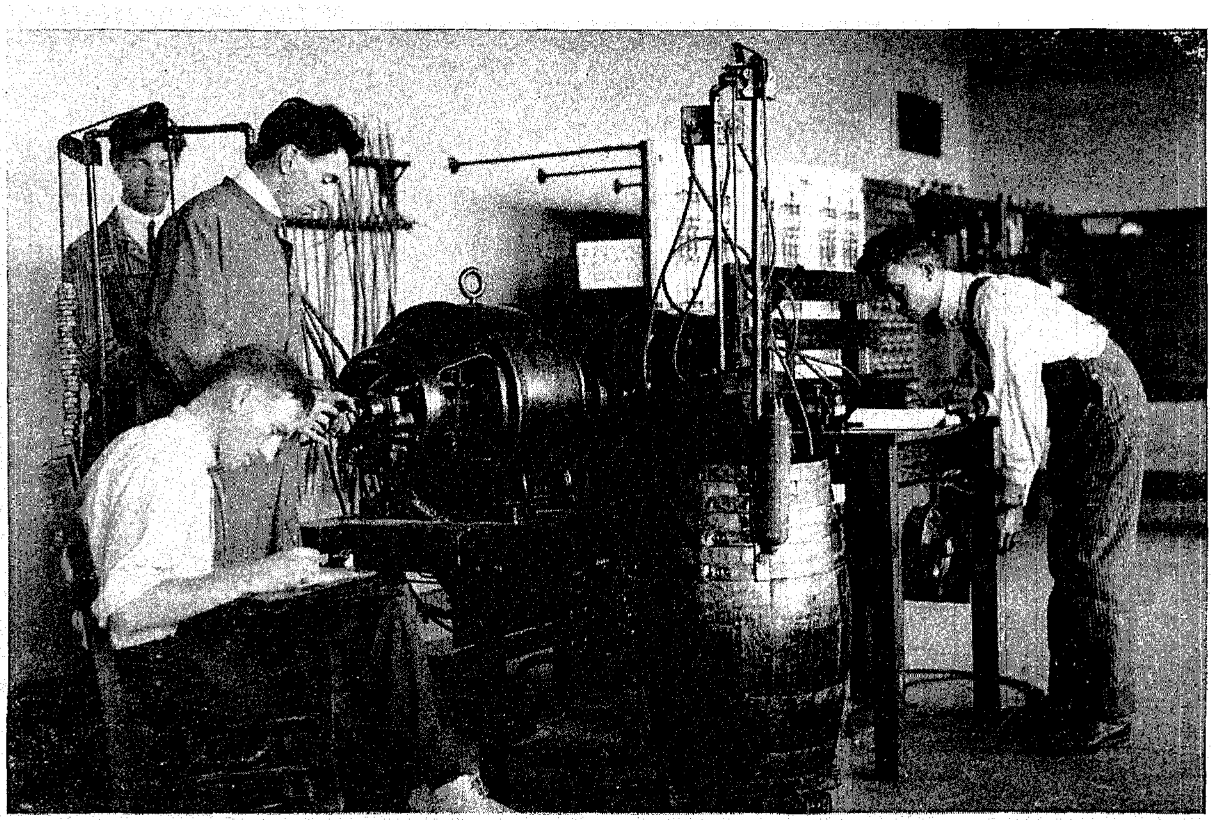

Times have changed, son

The ME lab doesn't look like this anymore. But if you live in Southern California, you'll have a chance to catch up on Caltech at the Annual Alumni Seminar, Saturday, April 9. There will be talks by prominent faculty members on everything from gas turbines to glaciers, and a dinner at which President DuBridge will be the speaker. Programs and reservation blanks are in the mail. The dinner will be held at the Masonic Hall, 200 S. Euclid, Pasadena. Dinner reservations cost $2.50 and must be returned before April 5 to

THE ALUMNI OFFICE
1201 EAST CALIFORNIA STREET
PASADENA 4, CALIFORNIA

For more Seminar information, see page 21