ENGINEERING AND SCIENCE

June, 1949

The Phytotron . . . page 3

PUBLISHED BY THE CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION

The Main Line

JUNE, 1949

Last month we gave you a preview of our first post-war streamliner—the *Shasta Daylight* between Portland and San Francisco—which will be in service this summer. And we promised to tell you more about it this month.

"Breathing" Windows

One of the things that are new and different about the *Shasta Daylight* are the huge, Sky-View picture windows. Not only are they wider and higher than you've ever seen in a train before—they've been specially designed with "breather" equipment so that fogging and moisture can't form on the glass. There's a lot to see between Portland and San Francisco, and the *Shasta Daylight's* windows let you see all of it.

Have you ever struggled with a vestibule door on a train? You won't on the *Shasta Daylight*. You'll just touch a door plate and the door will swing open, stay open while you go through, then close automatically.

No-draft Ventilation

There will be an ingenious system of "zone" heating on the *Shasta Daylight*. When a door is opened and cold air enters one end of a car, heating units in that "zone" only come on immediately to bring the temperature back to normal. There is no overheating of other parts of the car. This also permits both sides of the cars to be equally warm, even though a cold wind may be blowing against one side.

The train is, of course, air-conditioned. Improvements have been made here, too, with the addition of "pressurizing". (This, the car-makers explained to us, merely means that there is a slight air pressure in the cars which prevents dust and dirt from entering. It also insures just the right amount of fresh air in the cars at all times.)

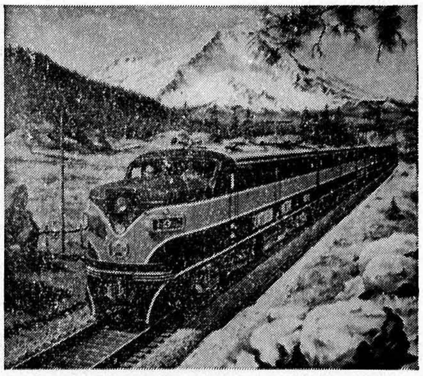
"Hammock" Seats

Seats in the chair cars on the *Shasta Daylight* are of a new design, and use a softer foam rubber than formerly. "Hammock" suspension is used in the seats and seat backs to provide extra comfort. You probably won't want to take a nap on this train—there'll be so much to see—but it's easy enough to do if you should want to catch forty winks.

Interiors of the cars are bright and cheery, and the combination of no-glare fluorescent lighting and bright fabrics in drapes and carpets (patterned after the natural colorings of the Pacific Northwest) produce a truly beautiful effect.

Another feature to add to your comfort is a complicated gadget in the brake system which makes stopping smoother. (We won't try to explain how it works, but together with the smooth-starting Diesel locomotives, they make the train just about the slickest thing on wheels.)

All in all, the *Shasta Daylight*—the million dollar train with the million dollar view—will represent a thrilling new experience in low-cost, luxury train travel.



Trip Tips (Quickies)

Re the Pacific Northwest, a couple of capsule suggestions:

For a glorious vacation in that evergreen wonderland . . . Mt. Shasta, Crater Lake, Portland . . . go via S.P.'s Shasta Route.

For a different roundtrip East, same advice: take Shasta Route one way, take another of S.P.'s four cross country routes the other—see twice as much on your roundtrip.

Through daily service from Los Angeles via San Francisco on the *West Coast;* 3 Shasta Route trains daily from San Francisco.

S•P The friendly Southern Pacific

In this issue

On the cover is a picture of one of the air conditioned greenhouses in the new Earhart Plant Research Laboratory. Water, circulating over the glass roof of the greenhouse, accomplishes a double purpose—it absorbs the far infra-red radiation from sunlight, and it serves as a cooling tower for the compressors in the laboratory.

The story of the *phytotron* is on page 3, written by Dr. Frits Went, who is in charge of the new laboratory. Born in Utrecht, Holland, Dr. Went received his A.B. (1922), M.S. (1925), and Ph.D. (1927) from the University of Utrecht. From 1928 to 1930 he served as a botanist in the Botanic Gardens in Buitenzorg, Java, and from 1930 to 1932 he was director of the Foreigners' Laboratory there. He came to Caltech as Professor of Plant Physiology in 1933. Because of his extreme fondness for the tomato plant as experimental material in his work, his colleagues have already begun to refer to the new phytotron as the tomatotron.

Charles Susskind, author of "The British Way" on page 18, has spent a total of six years in England. He is inordinately proud of being an Associate of the British Institution of Radio Engineers, a title which is granted only after an examination and which (in Britain) would always appear after his name, with academic degrees.

After receiving his B.S. in Electrical Engineering from Caltech in 1948, Mr. Susskind took his English-born wife back to England for a summer visit, during which most of the material for his article was assembled. He is now at Yale, working for his doctorate.

"The British Way" was first published, in a slightly different form, in the *Journal of Engineering Education.*

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LETTERS

SIRS: In a letter published in the April E & S one of your readers posed a problem:

"Given twelve balls identical in appearance, eleven of which are identical in weight. To find which of the twelve is the odd ball, *and* whether it is heavier or lighter, in three weighings on a pan balance."

O.K. I—for one—can't get the answer. What is it?

New York City — T. L. Kelly '30

There are probably half a dozen ways in which you can reach a solution to this one, but here's one way to do it. Give each ball a number for convenience. First, weigh numbers 1-4 against numbers 5-8 (inclusive). If these don't balance—and say numbers 1-4 are heavier—the second weighing might be numbers 1, 2, and 12 against numbers 3, 4, and 5. If, for example, the pans then balance, the odd one must be number 6, 7, or 8, and must be light. Weighing any two of these against each other will tell which of the three is the light one.

If, on the other hand, the second weighing does not balance, and assuming that numbers 1, 2, and 12 are heavier, weighing number 1 against number 2 will suffice to locate the odd one and to indicate whether it is heavier or lighter.

If the first weighing balances, the second might be numbers 9 and 10 against numbers 1 and 11.

In general, you should never make a weighing that is certain to be unbalanced—such as six balls against six at first, for example—because it's inefficient and won't allow solution in three weighings.

—*Editor*

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SIRS: In the "letters" column of your April issue a reader suggested you run a regular puzzle section in E & S. Here are a couple to start on. These problems were invented by J. Marvin Blair—a graduate student who gets his M.S. this

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PICTURE CREDITS
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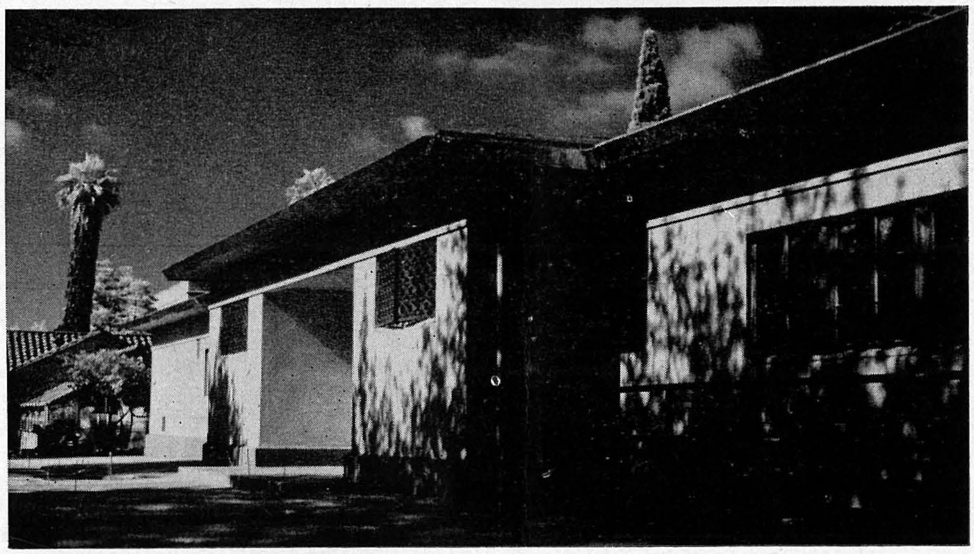
pp. 16-17—Ross Madden-Black Star
p. 23—Drawings by J. Marvin Blair

THE PHYTOTRON



Caltech dedicates its fabulous weather-factory

by Frits W. Went

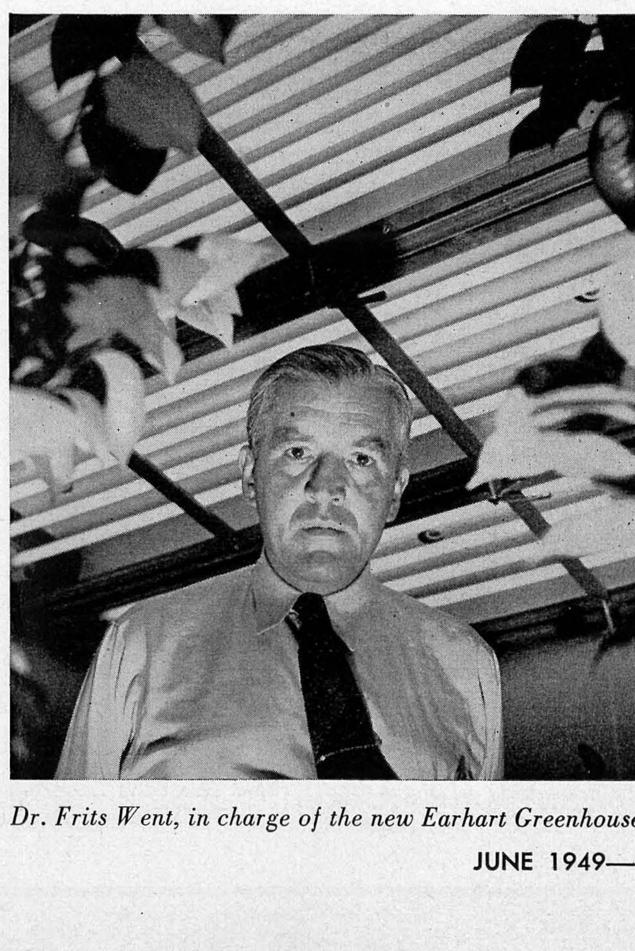
CALTECH'S Earhart Plant Research Laboratory, dedicated on June 7, is the first laboratory in the world in which plants can be grown under every possible climatic condition. Light, temperature, humidity, gas content of the air, wind, rain, and fog—all these factors can be simultaneously and independently controlled. The laboratory can create Sacramento Valley climate in one room and New England climate in another; it can even take the weather records of a single ranch and reproduce that ranch's particular climate.

The Earhart Laboratory will give us, for the first time, exact knowledge of how climate affects plants. It will provide plant material for basic research of a uniformity which has never before been possible on such a scale. It should tell us more about how to match plants to climate; how to predict ripening, flowering, and other phases of the growth cycle; how to control plant growth.

Since 1939 Caltech biologists have been able to study certain climatic requirements of plants in the air-conditioned greenhouses across from the campus on San Pasqual Street. These greenhouses—first of their kind—were built as an experiment, but they quickly became an absolute necessity in plant physiology work. By 1947 space limitations and the limited number of different conditions which could be reproduced in these greenhouses made expansion essential.

This expansion was made possible by the Earhart Foundation of Ann Arbor, Michigan, which made available all funds necessary for the development, construction, and equipment of the Plant Research Laboratory. The estimated cost of $200,000 has now swelled to $407,000.

To make certain that this awesome machine will not be mistaken for a mere greenhouse, Caltech's plant physiologists have unofficially christened the Earhart Plant Research Laboratory the *phytotron*—from the Greek *phyton*, meaning plant, and *tron*, which has come to mean device. Any similarity between the term phytotron and such terms as betatron, synchrotron, cyclotron, and bevatron is intentional. Caltech's plant physiologists happen to believe that the phytotron is as



Dr. Frits Went, in charge of the new Earhart Greenhouse.

The control room is the brains of the new laboratory. Here, every possible climatic condition can be created.

marvellously complicated as any of the highly-touted "atom-smashing" machines of the physicists.

The phytotron consists of six air-conditioned greenhouses in which natural daylight is used as a light source, and thirteen air-conditioned laboratories equipped with artificial light from fluorescent lamps. In addition there are eleven darkrooms and nine general laboratories kept at constant temperature and humidity.

The heart—or brains—of the building is the control room. All damper and valve control circuits are brought into this room on a 3.5 x 9 ft panel, with indicators and regulators. All circuits can be interchanged here, providing for unlimited flexibility.

Indicators for fans and pumps occupy a second panel. A third has time-clock circuits, with plugs to connect artificial light panels and other equipment to scheduling switches. Plugs for all electrical laboratory circuits are on another panel. Along the south wall of the control room a multiple CO_2 recorder will be placed, which can measure the CO_2 content of the air in twelve different rooms and greenhouses simultaneously.

In all greenhouses and light and dark rooms the air moves at a uniform rate of about 10 m./min. upward past the plants. Without radical changes it is impossible to increase this rate very much without unbalancing the air movement in the rest of the laboratory. Therefore, to conduct wind experiments, a wind tunnel has been built in one air-conditioned room. Plants placed in the tunnel can be subjected to air velocities up to 500 m./min.

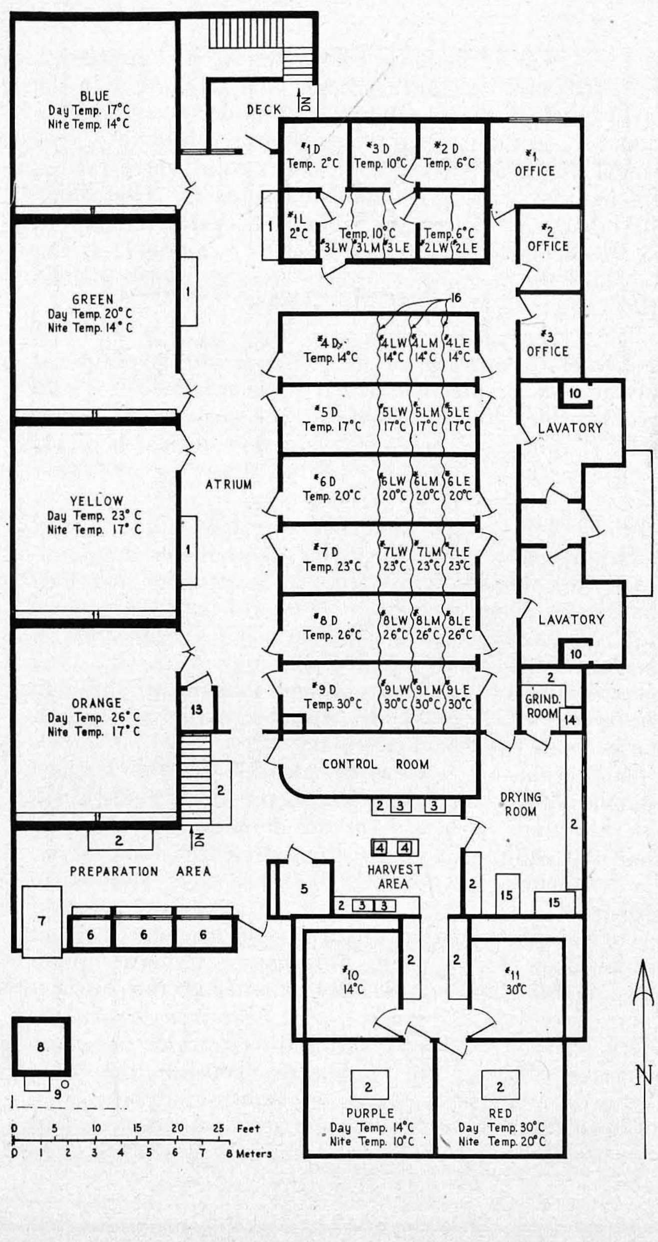
In another air-conditioned room, equipped with artificial light panels, a slotted steel floor and waterproof electrical outlets, rain and fog can be produced. A sump pump delivers water at atmospheric pressure to spray nozzles in the ceiling of the room. By changing the nozzle heads, rain of different intensity and drop size can be produced. The water disappears through the slotted floor and returns through a drain in the subfloor to the sump pump. In the same room a fog machine can produce fogs of different particle sizes.

Gas content of the air

Two rooms in the basement can be used for experiments on changed gas content of the air. They are made of concrete, with all openings towards the outside sealed. Each has a complete air conditioning unit, fluorescent ceiling lights, and a small ante-chamber, which acts as a gas trap. Still another gas trap has to be passed before anyone can enter the building or go outside. The fresh air intake to each room can be closed hermetically, and the exhaust ducts, which have a separate exhaust fan, can be closed in the same way.

These special gas rooms can not only be used for experiments on changed gas content of the air, or the effects of uncommon gases on plants (such as smog gases), but they can serve for quarantine, or for work with C_{14}.

The regular air conditioners for the several rooms cannot lower the relative humidity below 50 per cent, or at most 40 per cent. To study effects of very low humidity, one of the temperature-controlled rooms has been connected with a separate duct system to a



First-floor plan of the Earhart Plant Research Laboratory. Main entrance, right, center. is on Michigan Ave.

"Kathabar" unit, which can decrease the humidity much further. To this end, air from the room is circulated through an absorption tower, in which a concentrated LiCl solution is sprayed over cooling coils. This removes the water vapor from the circulating air. In another part of the Kathabar unit the LiCl is continuously regenerated by spraying it over heating coils and passing a stream of air over them, which is then exhausted towards the outside.

Photographic equipment

All plants growing in the greenhouses will be photographed at regular intervals. This is done with a "photorecord" camera fixed at one end of the atrium. The camera is prefocused, and set at a standard diaphragm and exposure time. One truck at a time is wheeled in front of the camera, the wheels are brought over marks on the floor, and with a foot pedal the floodlights are turned on, illuminating the truck. The same foot movement automatically takes the picture and moves the film one frame further, so that the stage is set for a picture of the next truck.

In a basement studio, pictures of plants will be made for reproduction purposes. Since no plants can be taken into the greenhouse without fumigation, it would be impossible to use outside studios for such photographic work.

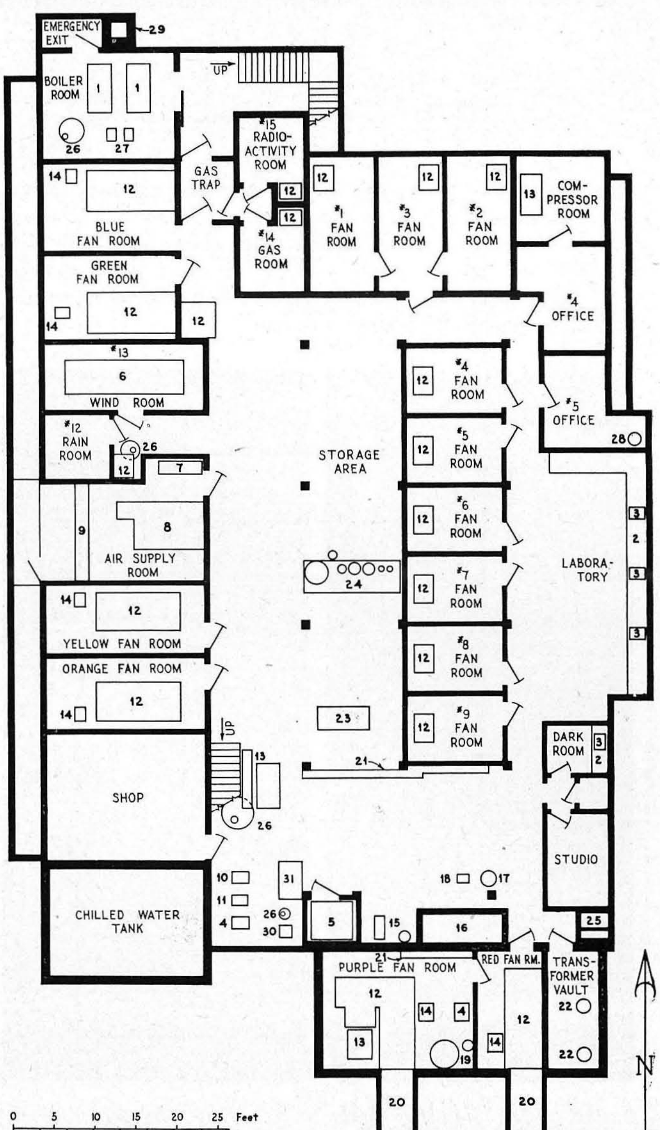
Photographic setup includes a prefocused camera, used to take pictures of all plants at regular intervals.

There are no fixed greenhouse benches in the building. All plants are placed on small wheeled tables, called trucks. These are made of steel, and galvanized, and they can be attached to each other with steel hooks, so that they can be pulled in trains by an electric tractor.

To show at a glance whether a group of trucks is in the proper greenhouse or light room at the proper time, a steel pipe is welded to one corner of each frame. A wooden dowel is inserted in this pipe and protrudes four inches. Around the dowel are placed metal rings of one inch in height, colored according to the greenhouse in which they have to be placed. The upper ring indicates the greenhouse from 0-17 centidays (8 a.m. - 12 noon), the next from 17-33 centidays, the third from 33-67, the lowest from 67-0 centidays. When the truck has to be in the yellow greenhouse from 8 a.m. - 4 p.m., and in the blue house from 4 p.m. - 8 a.m., the upper two rings will be yellow, the lower two blue.

Thus it is simple to see whether all trucks are in the proper greenhouses at any particular time. The warmest greenhouse is red, and in succession the coolor ones are orange, yellow, green, blue and purple. The darkrooms are indicated by a black ring with white number according to whether darkroom 1, 2, etc. to 9 is meant, and the light rooms are indicated by white rings with black numbers, with further indication of W, M, or E according to which compartment of the light rooms (West, Middle or East) is meant.

The plants are watered either from hoses suspended from the ceilings of the greenhouses, from tanks on wheels, or from five gallon bottles placed on shelves in the atrium. Each greenhouse or light and dark room has taps for de-ionized water and one for a nutrient



Basement floor plan indicates some of the complex equipment which is needed to maintain the Earhart Laboratory.

solution. The wheeled tanks, made of monel metal, contain special solutions used in large quantities; the five gallon bottles (30 of them) contain nutrient solutions with various deficiencies. In nutrition experiments the trucks with the plants to be fed with a special solution can be wheeled under the respective bottles and fed from a tube.

Sterility

Complete control over diseases and pests is of great importance in the phytotron. Immediately after completion of the construction and preliminary testing the entire building is to be fumigated, top to bottom, so as to kill all living organisms—at least all animals. To maintain this relative sterility, all air, water, sand, plant material, and personnel have to be made germ-free as far as it is practicable.

Air entering the building is sterilized by being passed through a Raytheon Electric precipitator, located in the filter room in the basement. Before passing through the precipitator air moves past an ionizing unit—a gridwork of thin metal wires charged to 13,000 volts, which impart a charge on all particles moving past them. The precipitator consists of 16 groups of 95 metal plates, placed parallel to each other and parallel to the air stream, of which alternating plates are charged with 6500 volts. This charge will cause all charged particles to be attracted to the plates and a thin oil film, sprayed onto the plates prior to the beginning of operation, will keep the particles attached to the plates until washed off by a periodic water washing.

A large squirrel-cage fan (10 HP. motor) with about 30,000 c.f.m. capacity blows this filtered air into the main fresh air supply duct of the building, from which all air conditioning systems draw their fresh air. The static pressure in this duct system is kept constant with a controller, which bleeds air out of the duct system back into the filter room.

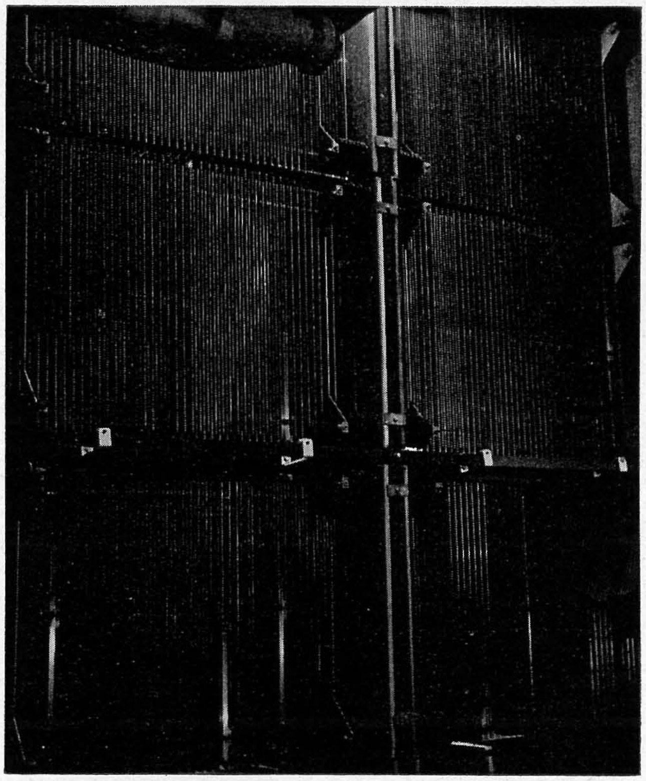
Sterilization and decontamination of soil, sand, pots, and plant material are accomplished in a preparation room. Three large bins, holding about 3, 3, and 2 cubic meters of material each, have two lids each sealed with neoprene, opening towards the outside and into the potting room. Trucks can dump sand or gravel in these bins. Before opening the bin on the inside the sand or gravel is sterilized *in situ* by steam, which issues from a slotted pipe in the bottom of each of the bins. This arrangement makes any intermediate moving of the material superfluous.

Visitors under cover

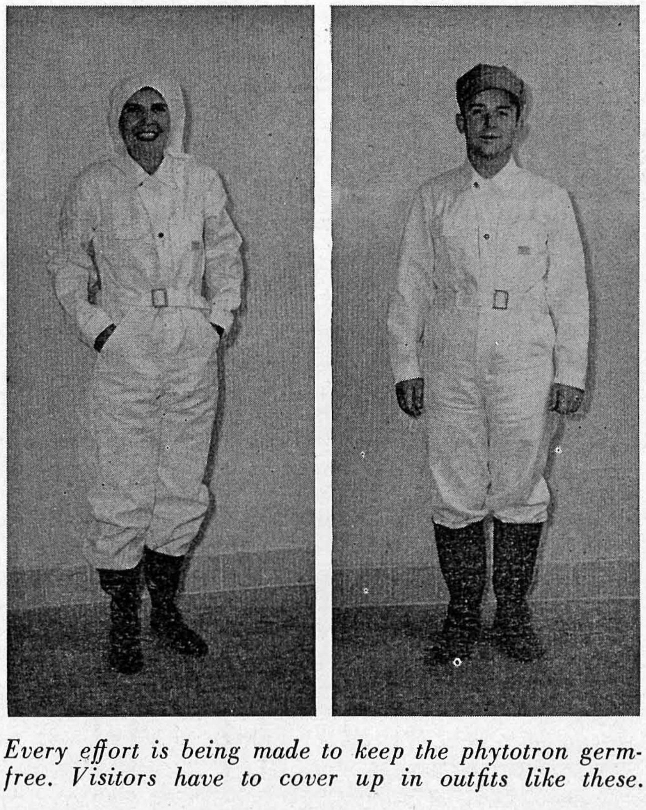
The entrance to the building is exclusively through two washrooms, which serve as decontamination units for personnel and visitors. All persons working regularly in the building have a change of clothes in lockers in the washrooms. Before they enter, their outer clothes and shoes are changed, a cap is put on, and hands are washed. Visitors have to don a coverall, boots, and a cap.

Unfortunately the number of visitors to the Earhart Plant Research Laboratory will have to be reduced to the minimum, because each entrant may be the unwitting carrier of a plant disease or pest. Even without considering the loss in research time, this would mean that a single infection might cost as much as $10,000 in operating expense.

The phytotron will go into operation sometime next month. Undoubtedly it will have a great influence on the future development of botany and of the applied plant sciences—horticulture and agriculture. And it will also certainly develop much-needed fundamental knowledge in the border fields between physics, chemistry, and botany. It is not unlikely, in fact, that methods developed in the phytotron for analyzing the complex interrelations between organisms and their environment, will be helpful in an analysis and better understanding of our social and economic system.



All air enters the greenhouses through this electric precipitator. Streaks of light, lower left, are sparks between plates, caused by insects being electrocuted.



Every effort is being made to keep the phytotron germ-free. Visitors have to cover up in outfits like these.

Wallflowers? Caltech undergraduates manage to stage as many as six social affairs a month in each student house.

TYPICAL TECH MAN

In a new survey a new picture emerges

MOST outsiders think of Caltech as a "tough" school, and its students as "grinds."

As a matter of fact, a lot of Caltech students think the same.

But a recent analysis of undergraduate activities shows that, though Caltech may be tough, its students are tougher. They work hard, all right. But they play pretty hard too. From the accumulated statistics, a new picture of the typical Caltech man is emerging.

Briefly, the picture shows this:

Instead of being grinds, Caltech students take part in almost twice as many extracurricular activities as average students in a typical state university.

Instead of being wallflowers, they stage about twice as many social affairs in their student houses as average students do in their fraternity houses.

Instead of being bookworms, they get into full-scale intercollegiate athletics at about 2½ times the rate of similar students at the average university; fully 3/5 of Caltech's intercollegiate athletes are honor students.

In fact, about the only part of the old picture that remains the same is the evidence of intellectual attainment: A higher fraction of Caltech men go on to win higher degrees than is found in any other college in the United States; and almost two times as many Caltech men win membership in honorary scholarship societies as was found in the average university chosen for study.

These findings and others were turned up in the course of a search for facts to put into a projected booklet to be sent to high school students. The results suggest a conclusion that has been indicated in more extensive studies made elsewhere: that there may be some connection between high intelligence and high general activity.

Herewith the facts and figures, with some notes on how they were obtained.

Extracurricular activities

To get a statistical picture of student activities, an analysis was made of the June, 1948, yearbooks of two institutions: Caltech and a typical state university. These yearbooks listed all the significant honors and activities of each student in the graduating class; therefore, it was possible to study the complete four-year record of each man.

It was, of course, recognized that exact comparisons between activities at the two institutions were not in all cases possible. Clearly, no two universities are exactly comparable in every respect. Drama Club may bulk larger on one campus than on another; student body president may be a less important office here than it is there. The sample chosen, however, was large enough for the irregularities to approximately cancel themselves out.

The results appear on the chart that follows. As used here, a *major activity* is defined as an activity which affects the student body as a whole. A *minor activity* is conceived as affecting a smaller section of the student body—a class or a special-interest group. *Honor societies* are defined here as purely scholastic groups, as Tau Beta Pi and Phi Beta Kappa; in this category there are none of the campus "honorary societies" in which student activities count. *Fraternities,* sororities and social clubs are not considered as "activities." *Athletics,* both major and minor, are fairly well defined in all colleges.

A COMPARISON OF EXTRACURRICULAR STUDENT ACTIVITIES
Caltech students of the class of 1948 compared with those of the same class in a typical state university

	State Total Students in class of 1948	State Total E & S majors in class of 1948	Caltech Total Students in class of 1948
Number of students	1690	130	194
A. Percentage in activities			
1. Per cent participating in major activities	12.2%	4.6%	28.4%
2. Per cent participating in minor activities	47.2%	53.8%	85.5%
3. Per cent participating in any activities	49.9%	58.1%	87.7%
4. Per cent not participating in any activity	50.1%	41.9%	12.3%
B. Activities per student (total "participations" divided by number of students)			
1. Number of major activities per student	.20	.05	.55
2. Number of minor activities per student	1.04	.85	2.20
C. Athletics			
1. Per cent participating in intercollegiate athletics	*	9.2%	25.8%
D. Honor students (scholastic only)			
1. Per cent belonging to an honor society	11.4%	12.3%	22.6%
2. Per cent belonging to an honor society and participating in major activities	*	2.3%	7.2%
3. Per cent belonging to an honor society and participating in minor activities.	*	9.2%	20.6%
4. Per cent belonging to an honor society and participating in any activity	9.8%	9.2%	21.1%
5. Per cent belonging to an honor society and not participating in any activity	1.6%	3.1%	1.5%
6. Per cent belonging to an honor society and participating in intercollegiate athletics	*	0%	15.4%

* No accurate figures available for State class as a whole; accurate figures available only for engineering and science men of the class.

Social activities

We have seen that in extracurricular activities and in athletics, Caltech students are more active than students at a typical state university that was chosen for study.

The same kind of point-for-point comparison is not possible in social activities. But enough facts are available to allow a fair estimate.

Social life can be described under two headings: (a) a place of living and (b) amount of entertainment.

"Place of living" can be described in tabular fashion. The following figures are approximate.

	CALTECH Per cent of total student body	STATE Per cent of total student body
Students living on campus in fraternity houses or equivalent Student Houses	53	8
Students living on campus in dormitories	0	2
Students living off-campus, but belonging to recreation and social club with permanent quarters on campus	18	0
Others	29	90
Total	100%	100%

As might be expected, more students live on campus at Caltech than do at State. More surprising—in view of the "social" reputation enjoyed by the large coeducational state universities—is the discovery that Caltech students appear to have *at least twice as many* parties and social affars as the students at State.

One type of party is given by State which is not given at Caltech. This is a large, university-sponsored monthly affair, given for the whole student body. It is attended chiefly by the "independent" students, who comprise about 90 per cent of the student body. They usually attend without dates.

This is the only category in which State is unique. In the other categories the two schools can usefully be compared. There are two such categories: (1) large official class or seasonal parties; and (2) private parties.

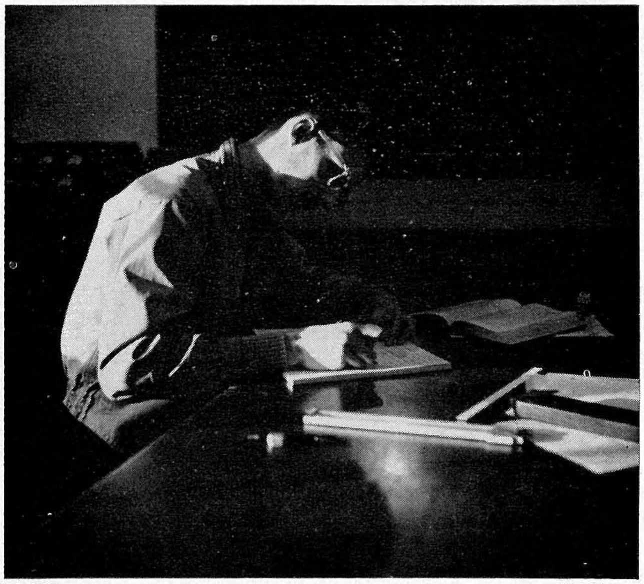
In the large official parties, such as Senior Ball, Junior Prom, etc., Caltech and State stand about equal. It is in the private, house-sponsored parties and dances, which constitute the fundamental social life of all universities, that the two schools differ.

The term "party," as used here, does not mean an impromptu event, but an organized affair, run by the house, for all its members, with dates. Commonest forms are: a formal, a record dance, a novelty or costume party, a picnic, beach party or snow party. These parties are given at State by the fraternity and sorority houses, and at Caltech by the Student Houses.

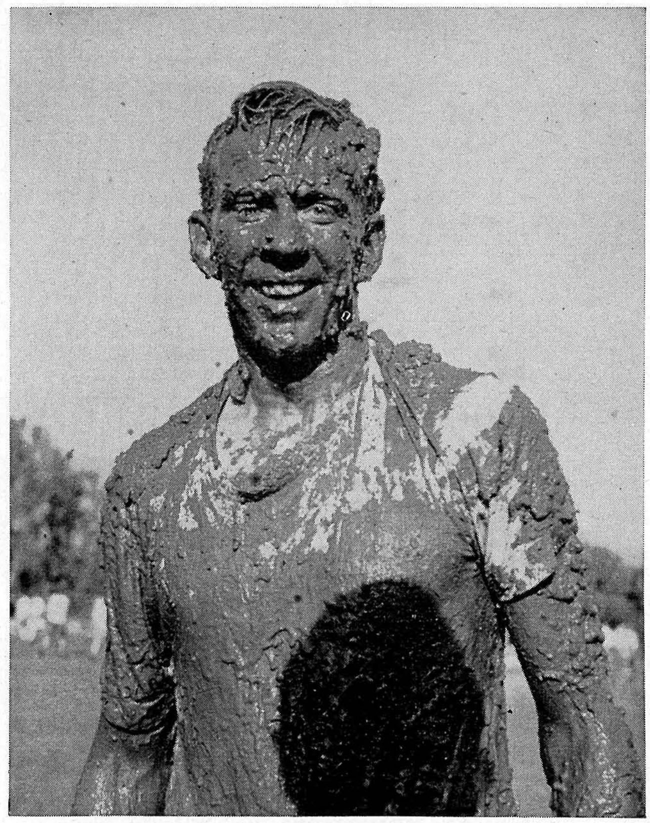
Six parties a month

All such parties are registered with the school administration, and hence can be tallied. Such a tally shows that at State, *each fraternity* gives about *three parties a month.* At Caltech, each Student House gives about *six parties a month.* This disparity is heightened when we count the actual numbers of students involved.

At State, only eight per cent of the students live in fraternity houses. At Caltech, 53 per cent live in the Student Houses. The entertainment offered the remaining 90 per cent at State is rather negligible. At Caltech, of the remaining 47 per cent, almost *half* belong to Throop Club, a social club with its own quarters on campus where members meet daily for luncheon. Throop Club gives over three parties a month—as many, in other words, as an average fraternity at State. Thus we see that at Caltech, 73 per cent of the students may



Grinds? Caltech students take part in almost twice as many extracurricular activities as average students in a typical state university. A case in point, right—Ralph Lovberg, president of ASCIT, involved in an extracurricular mudeo.



attend about 45 club parties a year; while at State, 90 per cent of the students are offered (apart from the class dances) only about nine non-date, all-university parties per year.

The greater numbers of parties at Caltech do not cost more. Instead, they cost considerably less. At Caltech, where the Student Houses give about six parties a month, each student pays a social assessment of $4 per quarter; or $12 per year. At State, where the fraternity houses give about three parties per month, each student pays an average social assessment of $10 per month, or $90 per year.

The Steelman Report

The study reported on these pages indicates that students at Caltech have at the very least as varied and active a life as those at a state university. In spite of this, further figures show that the scholastic level of our students holds higher than at most places. One suggestion of this fact is found in the high proportion of honor students here at Caltech. Another suggestion, not precisely along the same line but nevertheless related, is contained in *the number of undergraduates who go ahead to win higher degrees.* A nationwide study of this field was made by the National Research Council, and the findings were reported as follows in the so-called Steelman Report.

"*Institutions Producing Successful Candidates for Ph.D. in Sciences* (Data provided by the Office of Scientific Personnel of the National Research Council):

"This study of the collegiate origin of Ph.D's in American institutions shows a significant trend as to the effectiveness of the liberal arts college in stimulating an abiding interest of their students in the sciences.

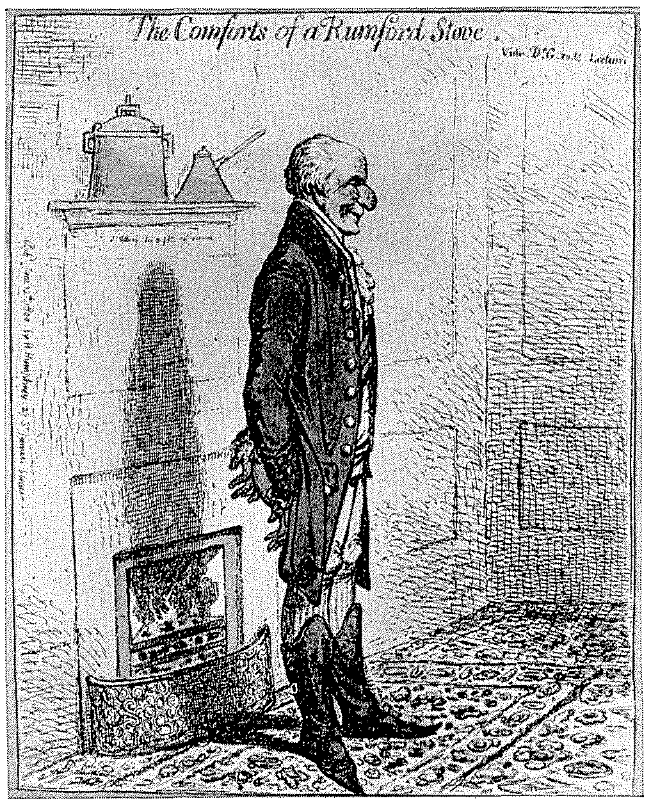
"The institutions are arranged in order of successful Ph.D. candidates per thousand students. Here are the first ten places:

COLLEGIATE ORIGIN OF PH.D.'S

Rank	Institution	Class	Ph.D.'s granted during the period 1936-45	Student population as of 1939-40	Ph.D.'s per 1,000 students
1	California Tech	T	120	921	130
2	Haverford	C	33	321	103
3	Oberlin	C	121	1,313	92
4	Kalamazoo	C	34	384	89
5	Reed	C	43	546	78
6	Swarthmore	C	51	733	70
7	Massachusetts State	C	84	1,208	70
8	Hope	C	35	525	67
9	DePauw	C	91	1,389	65
10	Massachusetts Institute of Technology	T	180	3,100	58

"The number of Ph.D's per thousand is reduced to 37 when we reach the forty-fourth rank. Of these 44 institutions 39 are colleges, 3 are universities (Chicago, Cornell, Princeton) and 2 are technical schools (California Tech; Massachusetts Institute of Technology)."

The above is a verbatim quotation. Members of the Class of '40 will probably recognize that the student population figure quoted includes graduate students as well as undergraduates, whereas figures for such schools as Kalamazoo and Reed are undoubtedly for undergraduates only. The index is still of value, however, as a relative indication.



Count Rumford, founder of the Royal Institution, profits by one of his own inventions in this Gillray caricature.

Count Rumford and the Royal Institution

by E. C. WATSON

THE Royal Institution of Great Britain, founded in 1799 by Benjamin Thompson, Count Rumford, for the purpose of "diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching by courses of philosophical lectures and experiments the application of science to the common purposes of life," has exerted an enormous influence upon the development of science through the original researches of Thomas Young, Humphry Davy, Michael Faraday, John Tyndall, James Dewar, John William Strutt, third Lord Rayleigh, William Bragg and others, which have been conducted in its laboratories. An account of the founding, the founders and the early years has been given by Henry Bence Jones, Secretary of the Institution from 1860 to 1873. As he points out, the "usefulness of science to the common purposes of life" gradually ceased to be the primary object; "the school for mechanics, the workshops, the models, the kitchen, and the journals died away and the laboratories, the lectures and the library became the life of the new Institution" and its purpose, "the diffusion and extension of useful knowledge in general."

"Lectures on scientific subjects, to be given in a lecture room with the most up-to-date facilities for experiment and demonstrations," were, however, a part of the original scheme. These have continued without interruption to the present day and, because of the abilities of the Institution's distinguished line of professors, have been just as influential in *diffusing* a knowledge of science and its methods as were the original researches of these men in *adding* to useful knowledge.

The picture on page 11 is a burlesque, by that incomparable caricaturist, James Gillray, of one of the early lectures. The lecture room and much of the apparatus are well portrayed and many of the figures in the audience can be identified as the more distinguished members of the Royal Institution. The names of many of these will be recognized even today. Thus the gentleman being experimented upon is the diplomat and politician, John Cox Hippisley, who in 1800 became one of the managers of the Institution. The lecturer is Thomas Garnett, the first professor. The lecture assistant (holding the bellows) is Humphry Davy, soon to become Garnett's successor and the most famous chemist of his age. In the upper right-hand portion of the print (to the left of Davy) Count Rumford is easily recognized; and in the circle beginning with him are Isaac Disraeli (in spectacles), Earl Gower (afterwards Marquis of Stafford), Lord Stanhope (in top-boots and leaning on a stick), Earl Pomfert, Sir Henry Englefield, Miss Lock (afterwards Mrs. Angerstein), Lady Charlotte Denys and her daughter, Mr. Sotheby (with cane), Mr. Denys

Another famous Gillray caricature—A lecture at the Royal Institution on "Pneumaticks! or the Powers of Air."

(in spectacles) with his son, Mr. Tholdal (a German attaché), and others who cannot be identified at this date. On the seat near Lord Stanhope is an open pamphlet entitled, "Hints on the nature of air required for the new French diving-boat." This probably refers to the *Nautilus*, the submarine which Robert Fulton built in 1800 with funds provided by Napoleon and with which he carried out successful tests in the Seine and at Brest.

Count Rumford, founder of the Royal Institution, himself made "useful mechanical improvements" in the construction of fireplaces, chimney flues, and kitchen utensils—a field of research which he shared with his contemporary, Benjamin Franklin. His attention was first directed to such matters by his organization of relief work among the poor in Munich and his attempts to produce cheap and nutritious food. Many of the devices and conveniences now employed in our kitchens owe their origin to him. So great, indeed, was his interest in these and allied subjects that he devoted five of his eighteen *Essays, Political, Economical, and Philosophical* to them. These five essays occupy nearly 600 pages in his *Complete Works* and make most interesting reading. He reports, for example, that at one time he had not less than 500 smoky chimneys on his hands, and proceeds to give very simple and intelligible information about the philosophic principles of combustion, ventilation and draughts and to prepare careful diagrams showing the proper measurements, disposal and arrangements of all parts of a fireplace and flue. His aid and advice were always ready and were given indiscriminately to all sorts and conditions of men. The immediate fame which this type of work brought Rumford has been recorded by Peter Pindar as follows:

Muse, at the sound of "Rumford" *raise* thy voice,
And bid our Kitchen-furniture rejoice.—
Though scant our store, a hempen String (alack!
The simple substitute for spit and jack),
A Knife and Fork, a Dish, a Spoon, and Platter,
Shall stir their stumps, and make a jovial clatter;
The Broom shall hop, as merry as a grig;
And, pleased, the dainty Dishclout dance a jig;
Expressing thus in *gratitude* their souls
To him whose wisdom saves us *pecks* of coals,
And means (for Pitt's damn'd taxes this require)
To teach us soon to roast *without a fire* . . .

Knight of the Dishclout, whereso'er I walk,
I hear thee, Rumford, all the kitchen-talk:
Note of melodious cadence on the ear,
Loud echoes "Rumford" here and "Rumford," there.
Lo, every parlour, drawing-room, I see,
Boasts of thy stoves, and talks of naught but thee.
Yet not alone my Lady and young Misses,
The Cooks themselves could smother thee with kisses:
Yes; Mistress Cook would spoil a goose, or steak,
To twine her greasy arms around thy neck.
Through Newspaper, through Magazine, Review,
Happy mine eyes thy splended track pursue;
Thy sage Opinion in each Journal read,
A vein of Silver 'midst a load of Lead.

The amusing caricature on page 10, also by James Gillray, tells the same story.

THE MONTH AT CALTECH

New Physics Chairman

Dr. Robert F. Bacher, 43, resigned from the U. S. Atomic Energy Commission last month to become Professor of Physics and Chairman of the Division of Physics, Mathematics, and Astronomy at Caltech. He succeeds Prof. Earnest C. Watson, who for three years has carried a double administrative load as Chairman of the Division of Physics and as Dean of the Faculty.

Dr. Bacher will also carry the title of Director of the Norman Bridge Laboratory of Physics, succeeding Dr. R. A. Millikan, who held the title from 1921, when he first came to the Institute, until his retirement in 1945.

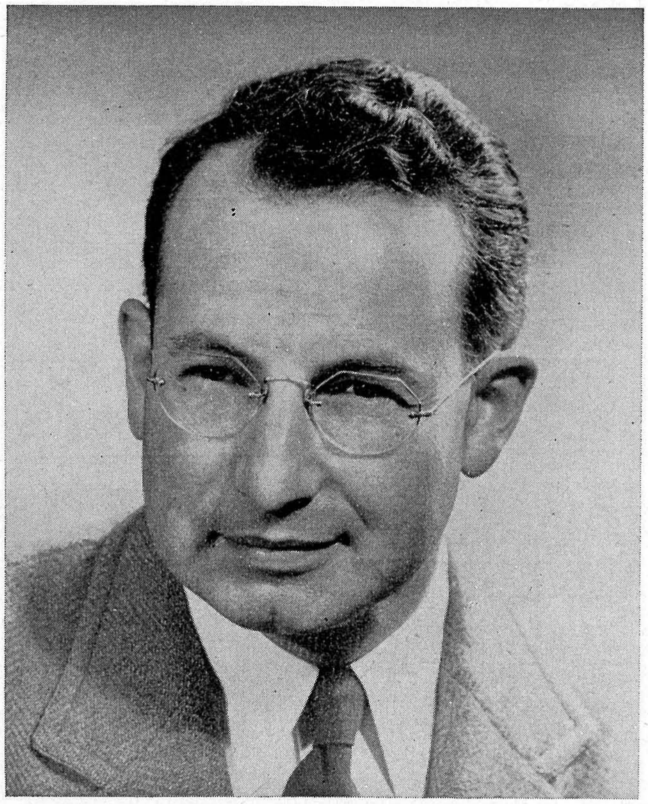
One of the country's leading physicists, Dr. Bacher was Professor of Physics at Cornell University before the war. In 1941 he joined the Radiation Laboratory at M.I.T.—headed by Dr. L. A. DuBridge—and, as chief of one of the large divisions of the laboratory, made a number of important contributions to the development of military radar equipment.

In 1943 the Radiation Laboratory released him to become Chairman of the Bomb Physics Division of the Los Alamos Laboratory. Here he supervised the development of the nuclear component of the bomb, and personally assembled this component for the first test bomb fired at Alamogordo in July, 1945.

At the end of the war Dr. Bacher returned to Cornell, as Professor of Physics and Director of the Nuclear Physics Laboratory, until he was called to serve on the Atomic Energy Commission in 1946. The only scientist on the five-man commission from 1947 until his retirement, Dr. Bacher has been replaced on the AEC by Henry DeWolf Smyth, Chairman of the Department of Physics at Princeton, and author of the "Smyth Report" on atomic energy.

"The California Institute of Technology had sought the services of Dr. Bacher before he was appointed to the Commission in 1946," said Dr. DuBridge, "but his call to this important post caused the Caltech offer to him to be held in abeyance until his term of service with the Commission had been completed."

No stranger to Caltech, Dr. Bacher spent a year here as a National Research Council Fellow in 1930-31, after receiving his Ph.D. from the University of Michigan. In 1946 he was awarded the Presidential Medal for Merit in recognition of his outstanding work with the atomic bomb project, and in 1947 he was elected to membership in the National Academy of Sciences.



Dr. Robert F. Bacher is the new Chairman of the Division of Physics and Director of the Norman Bridge Laboratory.

Smog and Agriculture

Each month Caltech gets more involved in the smog problem. In rapid succession Biology's Dr. Haagen-Smit has begun his study of local air samples to determine the basic components of smog (E & S, March '49); Dr. E. P. Hubble of the Mt. Wilson and Palomar Observatories has announced the organization of a citizens Pure Air Council to speed action on the smog situation (E & S, May '49); and now Dr. Frits Went, Professor of Plant Physiology, has joined the fight—to discover the effect of smog on agriculture.

This spring, crops in the Rosemead-Puente-El Monte area began to suffer from a strange ailment. Plant leaves assumed a silvery, metallic appearance, then dried up. Beets, endive, spinach, romaine, alfalfa and oats seemed to be particularly hard hit. Though the damage was only partial, and the plants later produced healthy new leaves, Dr. Louis C. McCabe, Director of the Air Pollution Control District, put his staff on the case. They soon came up with a possible relationship between periods of intense smog concentration and crop damage. From two to four days after heavy smog (specifically, March 14-16, April 10, 21, and 22), staff chemists discovered "damage which appeared to be caused by a gas."

At this point Dr. McCabe called in Dr. Went and the agricultural experts of the Riverside Citrus Experiment Station. Together, the scientists mapped out an ideal program of research, designed to confirm or disprove the deductions that smog is the villain in the case. The study may well be one of the very first to get underway in the new Earhart Plant Research Laboratory—of which there is more on page 3.

Jet Propulsion Fellows

The first annual fellowships at Caltech's Guggenheim Jet Propulsion Center were announced last month, following a nationwide search for the best available candidates. The Daniel and Florence Guggenheim Jet Propulsion Fellowships went to three graduate students—John McNamara of Hanover, New Hampshire; Robert Meghreblian of Los Angeles; and Hugh Wahlin of Madison, Wisconsin. Each fellowship is for one year, starting in September, 1949. All three men will be working for an M.S. degree in Aeronautics, with Jet Propulsion their major field.

McNamara, 27, is a graduate in mechanical engineering from Dartmouth College and is now working toward a master's degree at the Thayer School of Engineering, a Dartmouth associated school.

Meghreblian, 26, was born in Cairo, Egypt. He received his Bachelor of Aeronautical Engineering degree from Rensselaer Polytechnic Institute in 1943 and is currently an assistant project engineer for missile development at Caltech's Jet Propulsion Laboratory.

Wahlin, 24, is the son of Professor H. B. Wahlin of the University of Wisconsin's Physics Department. He will receive his B.S. degree in Mechanical Engineering from Wisconsin this year.

The Jet Propulsion Center at Caltech is one of two set up in this country by the Guggenheim Foundation. The other is at Princeton University, where fellowships were awarded to Frank W. Bailey of Newport, Vermont; Sin-I Cheng of Ann Arbor, Michigan; and Frank Kreith of Los Angeles, who is currently a senior research engineer at Caltech's Jet Propulsion Laboratory.

Earthquake Research

Since 1947 George W. Housner, Assistant Professor of Applied Mechanics and R. R. Martel, Professor of Structural Engineering, have been serving on the Advisory Committee of Engineering Seismology. Originally set up by the U. S. Coast and Geodetic Survey to advise it on such problems as how to make seismic measurements, and what instruments to use, the committee has now gathered such a mass of data on engineering seismology that its services can be extended far beyond an advisory capacity.

As a result, the 13 members of the committee have established an independent, non-profit organization known as the Earthquake Engineering Research Institute. This organization, which will attempt to bridge the gap between the science of seismology and actual building design and construction will collect, compile, correlate and distribute seismic data and make experimental and theoretical analyses with the specific objective of developing safe and economically feasible methods of earthquake construction and design. Working through research contracts, subscriptions, and grants the Institute ultimately expects to have the staff and equipment to carry on a full research program.

Dinner for Three

Professor Clinton K. Judy, retiring head of the Division of Humanities, was honored at a dinner in the Athenaeum on May 26 by staff and faculty members. Professor Judy, who came to Throop Polytechnic Institute in 1909, is the oldest Caltech faculty member in point of service.

Honored on the same occasion were Dr. John Robertson Macarthur, Professor of Languages, Emeritus, who retired in 1945; and Mr. H. C. Van Buskirk, Professor of Mathematics, who retired in 1946. The pressure of wartime work prevented the Institute from formally honoring Dr. Macarthur and Prof. Van Buskirk upon the occasions of their respective retirements. Dr. Macarthur joined the faculty in 1920, served as Dean of Freshmen from 1923 to 1936, and again from 1943 to 1945. Prof. Van Buskirk came to Throop Polytechnic Institute in 1904, was Registrar from 1915 to 1935.

Honors from Norway

Just a few months ago, Dr. Linus Pauling, Chairman of the Division of Chemistry and Chemical Engineering, was elected a corresponding member of the Academy of Sciences of the Institute of France, not for his considerable achievements in the field of chemistry, but for his work in the field of mineralogy. Last month Dr. Pauling received word that he had been elected a foreign member of the Norwegian Academy of Science and Letters in Oslo—not, again, for his work in chemistry, but for his "attainments in the field of mathematics and physics."

Dr. Pauling's membership diploma was presented—by proxy—at a dinner in Oslo on May 3, attended by His Majesty, King Haakon VII, and His Royal Highness, Crown Prince Olav. Other diplomas went to the Danish architect Dyggve, and to Mr. Winston Churchill, for attainments in history and philosophy.

Big Chief *Franklin Thomas who already carries the titles of Professor of Civil Engineering, Dean of Students, and President of the ASCE, has now added Master of Nature's Resources to the list. Or, as Dean Thomas's Indian brothers say it, the title is Mau Gau Tah To Keah.*

This all came about at the recent ASCE spring meeting in Oklahoma City when Dean Thomas was, of all things, inducted into the Kiowa Indian Tribe, which has a reservation at Anadarko, Okla. The historic moment is captured in the picture at the right—and we've got to admit that the Dean makes the unlikeliest-looking Indian we've seen since Calvin Coolidge.

BEAVER'S

MONTH

WITH a certain sigh of futility the Beaver tore up the carefully planned budget he had labored over at the first of the month and gently deposited the pieces in the wastebasket. He was painfully aware it was an old story as he peered into the dark and dusty interior of his wallet and wondered about the Gym Fund dance that was coming up Saturday—in fact coming up much sooner than the next green check from the Veterans Administration.

He turned and touched his patient roommate on the shoulder. "How much and when do I get it back?" Roommate didn't even look up from his busy slide rule. An old story. The Beaver pocketed the lovely five and wandered out into the court in high spirits. Now he could phone Nancy and go to the Gym Fund dance.

He had heard about the plans for the new gym they were raising money for. Maybe in three years it might be standing proudly in Tournament Park, but it came as a mild shock that he wouldn't be around to make much use of it. He wasn't ready to believe that the Institute could go right on functioning after he graduated. Well, anyway, this Saturday was the dance and the reckoning with roommate seemed very remote. Next year he would follow his budgets with grim fortitude.

An academic year is a funny thing. You enter it in the fall overflowing with enthusiasm, good intentions, and a fine suntan, and go through it at a mad pace, filling reams of paper and never seeing over the top of the immediate week's calendar. Nothing significant seems to happen to stand out from the pell-mell parade of weekday assignments and weekend good intentions shot to hell. Then at the end of the spring term you suddenly push away your papers and sanskrit math scratchings, and lean back in your chair to look back over it all.

Spring thoughts from a chair

The Beaver leaned back in his chair, lit a cigarette, and looked back over it all. It's been a pretty good year, he told himself—as he did about this time of May every year. Not that anything earth-shaking had happened, of course, but he began to see a lot of events in a new perspective. He wondered just what things in the year he would pick out to recount to his friends over future beers.

Last fall he had watched with a fatherly superiority the entrance of a Freshman class that was satisfactorily callow and peach-faced. They had put up with enormous bow-ties and derogatory name-cards, as Frosh should, and had been well splashed with raw eggs and well soaked in the showers by enthusiastic upperclassmen. But as the year wore on he had watched them enter the swing of activities with commendable energy. The Beaver peered out of his window at the mountains and noted with satisfaction that the "T" looked well-scrubbed for the first time in several years.

The fall sports season had had a familiar look. The Engineers dropped heartbreaker after heartbreaker on the Conference grid and wound up at the annual Varsity Awards Banquet with the coaches' consolation speeches on how the season had "built character." The Beaver remembered with a faint grin that the cross-country coach had got up that night to say his team hadn't built any character but had "damn well won the Conference championship."

The Pajamarino stood out in his memory. He had sacked his limited wardrobe for a red-flannel nightshirt or a green derby, but eventually had pulled his rumpled pajamas over a set of khakis and gone out to marvel at the great pyramid of orange crates and the perennial little house that crowned it, symbolically painted: "OXY." He had hiked through Pasadena in the yelling throng, honking horns and happy to shock the natives with his flagrant pajamas, and had returned to bed with aching feet and an unshakable confidence in the morrow's victory. At any rate it was a good game despite the score, he mused.

Social life of a lowbrow

Of all the social events of the year the Beaver had the warmest place in his heart for the barn dances. Something about the endless kegs of foamy beer, the rustic wooden lodge, and the noisy music and noisier couples seemed to make barn dances the finest of all possible entertainment. He was undoubtedly an incurable lowbrow, but then so were a lot of other people. All his friends, he decided.

Barn dances were the playing fields for that hallowed athletic event, the crew race. Many times he had stripped to his T-shirt and valiantly downed the 12-ounce bottle of beer in the ten-man drinking relay. But his house had lost to Dabney, who had crew members that could empty a bottle of brew into their ironclad stomachs in five seconds time. The Beaver gazed longingly at the Eternal Acme Crew Race Trophy on the Dabney mantel and thought: Next year it will be Different.

The builders of the student houses, wise in the ways of collegians, had certainly made waterproof structures, the Beaver decided, as the splashing sounds of water-battle disturbed his reveries. He swung his feet off the desk and walked cautiously out into the court. Waterfights were strange phenomena: they always erupted spontaneously, without cause or warning, and developed amazingly fast into highly organized and efficient platoon tactics.

Out into the torrent-drenched court marched the house band, clad in bathing suits, to rally the troops with an enthusiastically dissonant chorus—only the tuba gurgling ineffectually, and rapidly filling with water. The air was full of victory cries and water, as opposing armies cheerfully inundated each other. Hoses and stirrup pumps appeared miraculously, as did the Resident Associates eventually. The Beaver looked disconsolately at his drenched pant-legs and returned to his dry room. He made a mental note to add water fights to his cherished memories of 1948-49.

Ten minutes to one and time for class again. The Beaver squashed his cigarette in the ashtray and got up off the bed feeling much too tired to undergo the three-hour rigor of afternoon lab. He decided he wasn't getting enough sleep.

On the olive walk he passed a couple of professors and noted with dismay that, with the end of the year approaching, he was feeling warm and forgiving sentiments toward them. Seniors went by him solemnly, unbelievably dressed in suits. He knew they were going in for interviews to get jobs after graduation. In a few weeks they would receive their parchments, take a last look around, and plunge into the ice-water of outside life. Some of them he knew were getting married. It would seem strange not to have them around in the fall. It seemed strange that way every spring, but in the fall everything seemed to go on all right without them. The Beaver wondered what all the disappearing seniors did in years to come with the thousands of dog-eared lab notebooks like the one under his arm.

As he entered the lab, he was confronted by his roommate, who wanted the five back. Muttering bitterly, he decided to borrow it from the "Y." He had done it before. It certainly was an old story.

—*Jim Hendrickson '50*

BOOKS: A challenge to complacency

CRISIS IN EDUCATION

by Bernard Iddings Bell

Whittlesey House, New York, 230 pp. $3

Reviewed by L. Winchester Jones
Dean of Admissions

THE sub-title of Dr. Bell's little book—*A Challenge to American Complacency*—places it in a class with a significant number of other volumes which have appeared in the last ten years, all written by men experienced in the field of education and all intended to warn the layman that his pride in the American school system may not be entirely justified in the light of what is actually being produced.

Most of these books concentrate more or less on one division of the system—primary, secondary, collegiate—and stick pretty close to matters related to pedagogy. Dr. Bell does not so limit himself. In his attempt to get at the fundamental weaknesses he includes a keen if somewhat devastating analysis of the contemporary American, the product of a school and home influence which has failed to teach him any knowledge but facts, any morality other than expediency, any purpose in life except acquiring goods, or any method of self expression except spending in a wild scramble to buy pleasure. Uncertain of himself, fearful in his heart that perhaps the goals he is attempting to reach are not after all shining castles but rather dingy tenements housing more frustration, he covers his fear with boasting and his uncertainty by an attempt to impose his systems on the rest of the world.

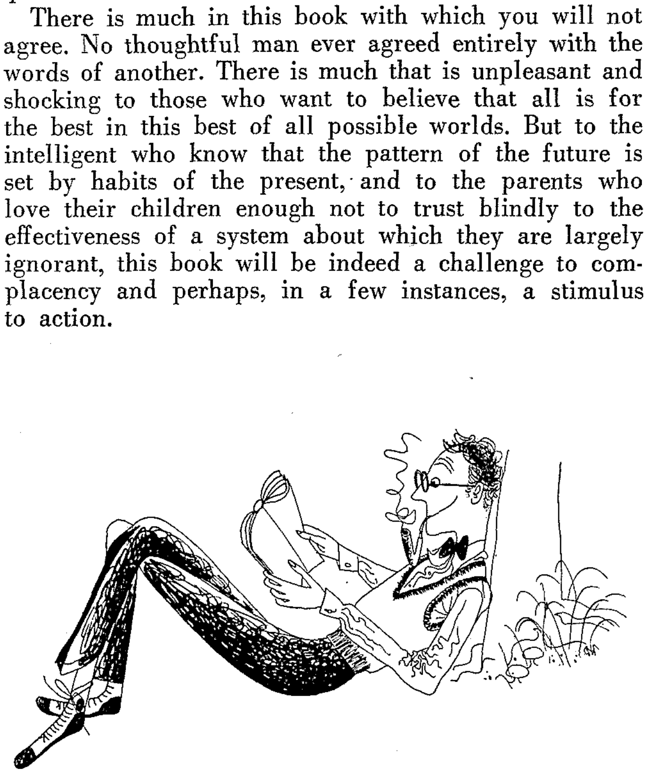
A matter of balance

Dr. Bell is not concerned with any particular level of education or with any particular system. He is interested in training men and women to meet the problems and the challenges of today, and he believes that such training, at whatever level and by whatever system, must contain certain basic disciplines *in balance*. "An education involves developing and increasing expertness in . . . science, appreciation of the nature of things, creative art, social relationships, religion . . . Omit any one or leave it in an embryonic state, and the pupil becomes quite literally unbalanced."

Nor is it enough that these things be offered. They must be learned, and they cannot be learned without effort, without discipline, by letting the pupil play at what he likes on the theory that he will absorb more easily when the process is painless. Without effort there is little absorption, only a superficial wetting that soon dries off. "The business of the school, the home, and the church is to feed the lambs, not to amuse the young goats."

Chapter 10, Education and Stateism, is worth reading for itself. Few laymen are aware of how very close we are to Federally dictated educational policies. That education can be used to keep one class or group in power has been all too clearly illustrated by the experiences of the past twenty-five years in Europe. Never in history has our school system needed so much money to do its job properly. Only the Federal government can supply the sums that are needed. In the long run the man who pays the piper calls the tune. Only by awareness and vigilance on the part of each one of us can American education avoid becoming, as Dr. Bell says, an instrument for "keeping the general public quiet and tractable."

There is much in this book with which you will not agree. No thoughtful man ever agreed entirely with the words of another. There is much that is unpleasant and shocking to those who want to believe that all is for the best in this best of all possible worlds. But to the intelligent who know that the pattern of the future is set by habits of the present, and to the parents who love their children enough not to trust blindly to the effectiveness of a system about which they are largely ignorant, this book will be indeed a challenge to complacency and perhaps, in a few instances, a stimulus to action.



"SCIENCE IN PROGRESS": *The sixth volume in Sigma Xi's biennial series provides a permanent record of significant research programs in progress throughout the country and points up the fact that traditional boundaries between fields of knowledge have practically ceased to exist.*

EVERY two years the Society of the Sigma Xi publishes its "Science in Progress," a volume which brings to layman and scientist alike authoritative accounts of significant research programs under way in the country. The sixth in this series (Yale University Press, New Haven, $5) contains eleven chapters covering work in nuclear physics, chemistry, biology, medicine and soil science. Most of the chapters are based upon manuscripts originally prepared as Sigma Xi National Lectureships during 1947 and 1948. The remainder are based upon Silliman Lectures presented at Yale in October, 1947, at the Centennial of the Sheffield Scientific School.

The Sigma Xi lectures in the present volume include "From X-rays to Nuclear Fission" by H. D. Smyth of Princeton University; "Elementary Particle Physics" by John A. Wheeler, also of Princeton; "The Eight New Synthetic Elements" by Glenn T. Seaborg of the University of California; "Chromatography and Spectroscopy in Organic Chemistry and Stereochemistry" by L. Zechmeister of Caltech; "The Tubercle Bacillus and Tuberculosis" by Rene J. Dubos of the Rockefeller Institute for Medical Research; "The Evolution and Function of Genes" by A. H. Sturtevant of Caltech; and "Modern Soil Science" by Charles E. Kellogg, of the United States Department of Agriculture.

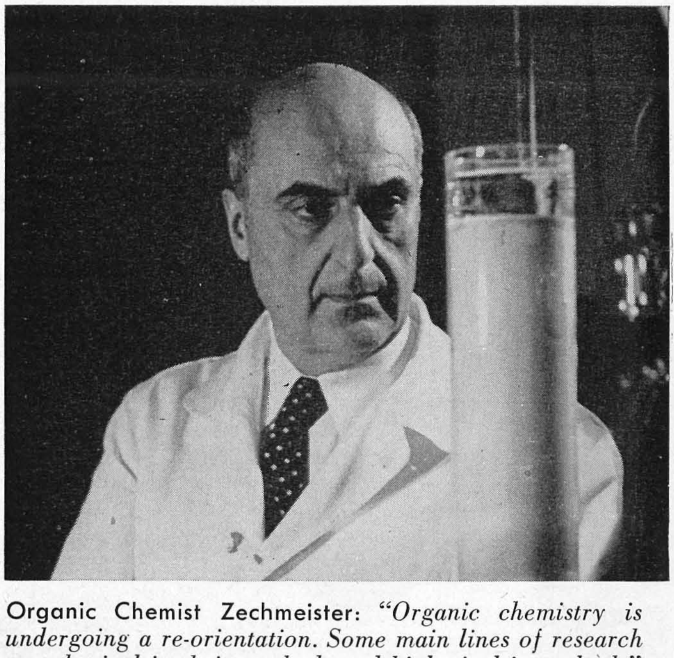
The Silliman lecturers were Ernest O. Lawrence of the University of California, who spoke on "High Energy Physics"; Linus Pauling of Caltech, "Chemical Achievement and Hope for the Future"; W. M. Stanley, now at the University of California, "Virus Research: Achievement and Promise"; and George W. Beadle of Caltech, "Genes and Biological Enigmas."

In commenting on the book's contents, Dr. George Baitsell, Editor and Executive Secretary of Sigma Xi, says, "Creative thinking flourishes in the no man's land between what were once separate systems of ideas; both facts and methods are freely transferred across frontiers of rapidly diminishing significance. In an age of heightening interdependence between fields of scientific investigation and also between science and statesmanship, the sphere of the individual scientist is becoming increasingly the province of every other scientist, indeed of every intelligent person."

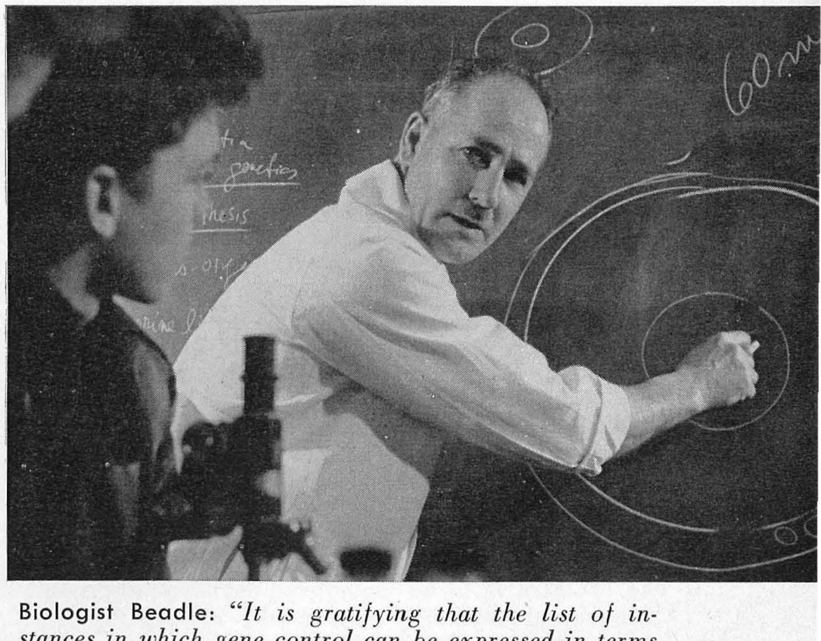
The interdependence of which Dr. Baitsell speaks is evident in almost any of the book's chapters. But it is most striking, perhaps, in the four written by Caltech scientists: Linus Pauling, who heads the Chemistry Division; L. Zechmeister, Professor of Organic Chemistry; George W. Beadle, Chairman of the Biology Division; and A. H. Sturtevant, Professor of Genetics.

Linus Pauling came to his present job at Caltech with a background in theoretical physics and physical chemistry and a strong interest in structural chemistry— in what makes atoms join molecules and molecules react with one another. For Sigma Xi's anthology, Dr. Pauling surveys the progress of chemical science through the past century, then plunges into his favorite subject: the structural basis of immunological and chemotherapeutical reactions.

Immunologists, concerned with the way in which antibodies and their homologous antigens combine, have



Organic Chemist Zechmeister: *"Organic chemistry is undergoing a re-orientation. Some main lines of research are physical in their methods and biological in outlook."*



Biologist Beadle: *"It is gratifying that the list of instances in which gene control can be expressed in terms of specific chemical reactions is growing rapidly . . . "*

been faced with two great questions: what are the forces between antibody and antigen which lead to the power of selective combination; and what is the mechanism by which the antibody is made and endowed with this power. Dr. Pauling's answer: this specificity is the result of detailed complementariness in structure. When the surfaces of bulky, complex antibody and antigen molecules are brought together, the fit is a close one indeed.

Dr. Pauling then goes on to describe how enzyme action, too, is dependent on complementariness of structure. For him the very nature of enzyme action means a rosy future for chemotherapeutics; for every enzyme (and in particular every enzyme essential for bacterial growth) the chemist ought to be able to find an inhibiting molecule more closely complementary in structure to the enzyme than the substrate itself. For example: the chemist could perhaps synthesize a molecule which would combine with penicillinase, an enzyme which inhibits pencillin's action. The new substance could then be given to a patient along with penicillin to increase its bacteriostatic action.

The preparation of very pure samples of compounds for the structural chemist's study is becoming an increasingly important job for the organic chemist. And in his chapter, Dr. Zechmeister describes an increasingly important technique for doing just that. This technique is known as chromatography, and it is a field in which Dr. Zechmeister is an international leader.

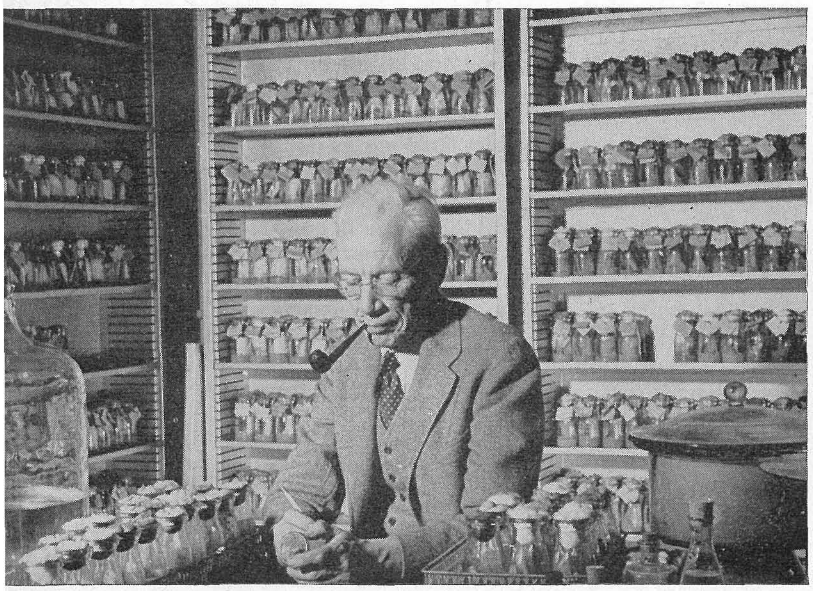
A chromatographic column is a tall glass tube filled with absorbent material; in the photo below, Dr. Zechmeister is standing beside one. When a solution is poured through the column, its respective compounds take their places in chronological order, depending on the adsorption affinity of their molecules. Sometimes the compounds form different colored layers and so can be readily separated. If they are colorless, the chemist bathes them in ultraviolet light to distinguish them by fluorescence.

Dr. Zechmeister describes the development of the chromatographic art, and his own experiments, which have been mainly on carotenoids, and through these, on vitamin A. Because adsorption has to do with the shape of the molecule and the presence or absence of certain atom groupings in the compounds, the chromatographer has been led into steriochemistry—the study of spatial configurations of atoms within a molecule, and of sterioisomers—forms of the same molecule with different spatial arrangements. Dr. Zechmeister winds up his article with an account of some recent experiments in which chromatography and steriochemistry were used to help a geneticist solve a problem in yeast mutation.

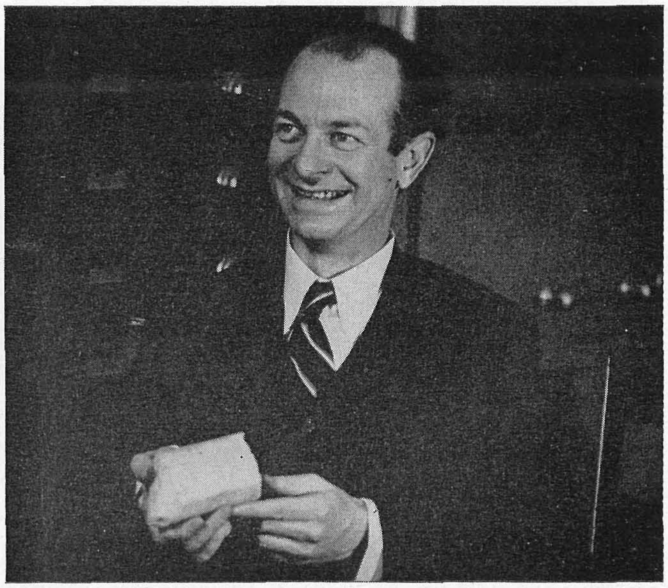
The close ties that exist between geneticist and chemist are even more strongly brought out by Dr. Beadle, who came to Caltech from Stanford, where for ten years he had been working in genetics. There he and E. L. Tatum developed their now-famous technique for using *Neurospora*, or red bread mold, to show how chemical reactions involved in nutritional processes are gene directed.

In "Genes and Biological Enigmas," Dr. Beadle reviews the evidence which has led scientists to believe that genes are the basic templates from which new generations of organisms are built, and that genes are composed of nucleoproteins. As for the enigmas—Dr. Beadle points out that it is impossible for the biologist to understand how a gene directs the synthesis of a copy of itself until he first knows how simple proteins and nucleic acids are synthesized in living cells. When chemists and geneticists and biologists understand that, they can go on to answer some other enigmas: the nature of gene mutation, more details of the origin of living systems and the evolutionary process, and the riddle of differentiation: what it is that makes some cells form skin while others turn into nervous tissue.

Dr. A. H. Sturtevant, who succeeds the late Thomas Hunt Morgan as the "Dean of *Drosophila* Genetics," goes into the problem of differentiation in some detail. He reviews the present state of genetic knowledge as seen through years of careful experiments with fruit flies and discusses the reasons for the geneticist's belief that related species have essentially the same sets of genes. With his colleagues, Dr. Sturtevant looks to other fields for help—to the chemists and biologists who may, through their studies of the basic life-stuff protein, come up with some answers to unsolved genetic problems.



Geneticist Sturtevant: *"The geneticist may expect help from other biologists concerned with protein specificities —such groups as enzyme chemists and immunologists."*



Chemist Pauling: " . . . *with knowledge of atomic structure of biological substances we may hope for a more effective attack on problems of biology and medicine."*

How does the British system of engineering education stack up against ours? A report on what's good, bad, or different about

THE BRITISH WAY

by Charles Susskind '48

A RECURRENT theme of the report published last year by the President's Commission on Higher Education is the recommendation that education on the professional level should be made available to a greater number of students. Such a policy, as applied to engineering education in America, has been subjected to criticism ever since the engineering college ceased to be a "school of the industrial vocations" and adopted the collegiate plan of organization. It may be of interest to examine the merits and shortcomings of a system of engineering education apparently based on the opposite policy: the British system.

To realize the vast difference between American and British university attendance figures, it should be borne in mind that in 1947 there were only 2,000 full-time engineering students registered in all the universities of England and Wales; the figure for Scotland, though higher in proportion to population, was of the same order of magnitude.

The American educator may well ask how a highly industrialized country, with a population one-third that of the United States, can get along with an engineering-college population roughly one-hundredth that of the United States? The answer is that British universities supply only a small fraction of the technological personnel needed by industry. The bulk is trained by technical "colleges," in part-time and evening classes, and through correspondence courses.

The technical colleges afford a wide variety of courses for the industrial vocations, as well as for the trades. They resemble the type of school which in America usually evolves into a four-year college sooner or later —like Pratt, Armour, and our own Throop Polytechnic Institute. The British technical colleges differ from the universities mainly in that they do not confer degrees. Their entrance requirements are consequently somewhat lower and they can accommodate many students who, from economic considerations or otherwise, could not remain in secondary schools long enough to reach the matriculation standard. Part-time and evening attendance (not feasible at most universities), as well as the lower tuition costs, combine to provide educational opportunities for many young men who would otherwise leave school for good at 15 or 16. The attainment level of some of these institutions compares favorably with that of many American universities

In some cities the technical schools are tied more or less informally to the local universities, and the exceptional student is often encouraged to proceed toward a degree. For instance, some of the excellent Polytechnic Institutes managed by the London County Council have university-approved teachers, and students may take the "internal" bachelor's degree of the University of London; whereas in Scotland, most of the courses given by the technical colleges may be credited toward a university degree. For other students there is a complex system of "leaving certificates" to show the work done; among others, the so-called National Certificates in the various branches of engineering and the Diplomas for examinations administered by the City and Guilds of London Institute, are widely recognized.

Another standard of attainment is membership in one or more of the professional societies. A measure of the role played by such bodies in British life is the fact that most students of law, medicine, and other well-established professions qualify (i.e., earn the right to practice) by passing the examinations of their respective professional societies, without ever having obtained a university degree at all! This system, an outgrowth of the old pupilage scheme, has quite naturally extended to the younger engineering profession. The various grades of membership—Associate, Associate Member, Member, Fellow—can be attained only after rigorous examinations which are quite often on a par with university standards; this fact accounts for the usual profusion of abbreviations and initials signifying the various memberships whenever the name of a British engineer or scientist appears in print.

Four groups of British universities

British universities may be divided into four groups, each group catering to approximately the same number of students. The ancient Universities of Oxford and Cambridge form one group; London University, with its many colleges and affiliated institutions, the second; the eight more recently founded civic universities located in the large cities of England are the third group; and the fourth comprises the four Scottish universities, as well as one each in Wales and Northern Ireland.

With one exception, each university has a faculty of Engineering, mostly quite small, averaging less than 200 students. The usual residence requirement for the ordinary B.Sc.(Eng.) degree is three years; this period is comparable to the customary four-year requirement in America if it is remembered that virtually all humanistic studies are excluded from the British curriculum on the principle that they should have been concluded in secondary school.

The Honours degree, which requires a more extensive or, at some universities, a more extended period of study, has a much higher standing than the ordinary degree; unlike his American counterpart, the British "honours" student is from the outset placed in a separate category and arranges his plan of study accordingly. The honours degree is almost invariably the prerequisite for more advanced degrees, which are awarded mostly on the basis of research, theses, and practical experience; graduate study in our sense of the word, with students attending classes, is quite rare.

Instruction in British universities bears a marked intellectual emphasis. There is little reliance on textbooks; instead, the student is expected to do a good deal of outside reading on his own. Examinations are usually comprehensive, rather than detailed, in character; the students are expected to obtain practical experience by working in factories during vacations or, at some universities, through the sandwich (cooperative) plan of alternating study with industrial apprenticeship.

As can be expected, British universities are highly selective. Efforts are constantly being made, especially through increased scholarships (the number of which has been trebled since 1939), to ensure that the selection is determined by scholastic standards alone, rather than by the student's means. It is the proud claim of British educators that no student, if he only has the ability, need be prevented from attending a university by pecuniary conditions. Nevertheless many families cannot spare the son's earnings for the long period of study, and a tendency toward social stratification persists.

It remains to be seen whether the system of grants for veterans, introduced as a result of a postwar scheme somewhat akin to the G. I. Bill of Rights, will be extended in scope. If such a plan is adopted, British university education will be rid of the main disadvantage from which it suffers in comparison with the American system: limited availability. For various reasons—academic, social, and economic—it has never been feasible for the British student to "work his way through college"; a greater accessibility of higher education could probably be achieved only by means of cash subsistence grants to needy students.

Even if the British university is gradually made available to a wider section of the population, it is doubtful whether the over-all enrollment will be increased. A survey made for the Ministry of Education in 1945 speaks of maintaining the wartime attendance figures, but not of increasing them. British industry and government are well satisfied with the dual system of engineering education. They are content to allow the universities to continue in their leisurely, unhurried task of producing the type of man who will find his place in research, education, government, and the planning side of industry. Technicians for the operating side of industry are more profitably prepared at the technical institutions having curricula which are readily adaptable to industry's local needs, and generally show a decidedly more practical (i.e., vocational) approach to engineering. The universities, for their part, remain free from the necessity of mass production and can devote themselves more fully to intellectual, scholarly pursuits.

Other aspects of the British system of interest to American educators and engineers are: (1) abundant provision for the education of sub-professional personnel, both for industry and the trades; (2) the far-reaching influence of engineering societies on curricula by means of the nationwide standards imposed by membership examinations; and (3) formal recognition of nongraduate attainment by various credentials.

The last of these items should be of particular interest to us: many observers fear that the value of the American bachelor's degree threatens to become inflated to the point of being rendered meaningless. It is here that the private, small colleges find their ultimate justification: by keeping enrollments low and requirements high, they can force the larger, publicly owned universities to maintain higher standards in accordance with a spirit of healthy competition. As for the training of technicians, other provisions must be made. The granting of diplomas of "Associate" at the conclusion of a two-year terminal program, as practiced at the University of Nebraska, is a step in the right direction; so is the Junior College (4-4-4) plan adopted in California. We should realize that the many undergraduates who leave our universities after one or two years, at an educational level which is neither useful nor recognized, represent a terrible waste of effort—both for the individual and for the school. Not until some definite provision for the education and formal recognition of engineering technicians is made will this waste be avoided.

ALUMNI NEWS

The Lady Who Licked John L. Lewis

In *Collier's* for June 4, 1949, Sam Stavisky, labor writer for the Washington *Post*, has an article on "The Lady Who Licked John L. Lewis"—Ruth Brown Boyd, wife of Jim Boyd '27. It's the story of how, and why, the Boyds stuck it out, through 15 payless months, until Jim finally won Senate confirmation of his appointment as Director of the Bureau of Mines (E & S, April '49).

"There never was any question in our minds as to what we ought to do," says Ruth Boyd. "You just don't step out in the middle of a fight. Sure, Jim was offered an easy way out, and a higher paying job (with the Atomic Energy Commission), but money isn't the only thing you work for. You've got to live with yourself, and with your children. The children must learn by example the decent thing to do, and what integrity stands for."

George Felbeck's Award

Dr. George T. Felbeck, Ph.D. '43, Vice-President of Carbide and Carbon Chemicals Corp., New York, last month won the 1948 John Wesley Hyatt Award for outstanding achievement in the plastics industry.

The annual award, consisting of a gold medal and $1,000, went to Dr. Felbeck for engineering developments leading to the large-scale manufacture of polyethylene resins and plastics. His work was primarily instrumental in relieving a wartime national emergency—the procurement by the United States Navy of polyethylene insulation in sufficient quantity to complete its vital radar installations. The Navy needed polyethylene for the production of coaxial cable and other components used in radar equipment. Other materials had failed in this job; polyethylene could do it, but was available only in small quantities.

Dr. Felbeck directed the design of the plant and the high-pressure equipment for the polymerization of ethylene on a large scale and in a continuous process. This wartime accomplishment has helped to establish a new branch of the peacetime plastics industry. The plastic has already become a major raw material for electrical utilities, electrical manufacturing, packaging, household accessories, and communications.

Dr. Felbeck, who was placed in complete charge of operation of the K-25 Gaseous Diffusion Plant project at Oak Ridge in 1943, now supervises—in addition—the Y-12 Electromagnetic Plant and the Oak Ridge National Laboratory. All three of these installations at Oak Ridge are operated for the Atomic Energy Commission by the Carbide and Carbon Chemicals Corp. Dr. Felbeck's other responsibilities are primarily in new process development for Carbide and Carbon.

Frank Jewett: Un-Retiring

Since his retirement as Vice-President of the American Telephone & Telegraph Co., President of the Bell Telephone Laboratories, and President of the National Academy of Sciences, Frank B. Jewett '98, of Short Hills, N. J., has been resigning many of his trusteeships and directorships. One of the Institute's oldest living graduates, Frank Jewett has served as officer, director, or trustee of such impressive institutions as Princeton University, the Carnegie Institution of Washington, the Woods Hole Oceanographic Institute, Tabor Academy, and the New York Museum of Science & Industry.

Recently, however, Mr. Jewett reversed the retiring process and *added* another trusteeship—at the Battelle Memorial Institute, Columbus, Ohio. His most recent honorary degree—speaking of honors—was a 1948 LL.D. from the University of California.

Alumni Fund Dance

The Spring Sport Dance sponsored by the Alumni Association, and co-sponsored by the Associated Students, brought a whopping turnout of 500 to the Altadena Country Club on May 21. Highlight of the evening was a short ceremony in which the Class of 1949 donated $500 to the Alumni Fund. President Chuck Forester made the presentation for the class, and President Howard Lewis accepted for the Alumni Association. Dr. DuBridge was on hand to express the appreciation of the Institute.

PERSONALS

1916

Max H. Carson reports from Honolulu that he is still District Engineer for the U. S. Geological Survey in Hawaii, doing stream-gaging work. His oldest son, Arthur, graduated from Caltech in 1944; his other two children are grown-up—"as happens to us all," he adds philosophically.

1922

Harold S. Ogden is holding the same job he's had for many years with G. E. in Erie, Penna., but his department has a new name—"Control Division of the Locomotive & Car Equipment Divisions." He is working on straight electric locos, mostly of the A. C. variety. Ogden has a wife, a son, 12, and a daughter, 10.

Bryant Essick and his Essick Manufacturing Co., have recently purchased control of the T. L. Smith Co. of Milwaukee, one of the largest and oldest manufacturers of concrete mixers in the country. Bryant now spends most of his time commuting by air between the Essick plants in Los Angeles and Little Rock, and the Smith plant.

1924

William C. Dreyer writes that his life is uneventful but agreeable. "I retired into Westinghouse almost 25 years ago," he says, "and live a very comfortable life with my wife and daughter in Houston, as manager of the Westinghouse Engineering and Service Department in Texas."

From **Doug Tellwright**: "I very seldom have anything of interest to report. But today is different. Our first grandson, Douglas Henry Austin, was born April 23. He has already decided he wants to go to Caltech. I am afraid his older sister (our first grandchild, born February 16, 1947) will probably want to go to Oxy or Pomona. Don't suppose there are very many grandchildren in the Class of '24 so far." Any challengers?

1925

Commander Clarence A. Burmister is Chief of the Radio-sonic Laboratory of the U. S. Coast and Geodetic Survey. His work involves the design and engineering of a special long-distance electronic navigational system, using pulse technique. The system is used in ship location in hydrographic surveys.

Michael B. Karelitz announces the arrival of a new son, George Michael, on January 14, 1949. Mike is with the General Precision Lab in Chappaqua, N.Y.

Frank Clayton, Chief Plant Engineer of Consolidated Vultee Aircraft Corp., is serving as President, for 1949, of the Fort Worth Chapter, Texas Society of Professional Engineers.

1926

After spending 1946 and 1947 in Sao Paulo, Brazil, running his own aviation sales business, **Ted Coleman** returned to the States and is now settled in Palo Alto. His new job: Assistant Treasurer of the Standard Oil Co. of Calif.

1927

Lt. Col. Vernon P. Jaeger is Senior Hospital Chaplain at Madigan General Hospital in Tacoma, Washington. Recently he returned from the Army Chaplain School at Carlisle Barracks, Penna., where he attended an advanced class in the latest psychiatric techniques in counseling.

1928

R. G. Folsom, M.S. '29, Ph.D. '32, was appointed Chairman of the Division of Mechanical Engineering at the University of California, Berkeley, in March. He's in charge of research work in supersonic flow phenomena at very low pressures. Folsom has three children, two girls and a boy (none of whom are engineers) and says his hobby is taking back-pack fishing trips into the Sierras.

1929

Charles A. Bosserman is busy up in Seattle making production changes in the hydraulics and plumbing of Boeing's B-50 Super-Flying Fortress, successor to the famous wartime B-17 and B-29. Just now they're installing "Single Point" Refueling in B-50-D's, which his group designed with the assistance of Staff Units. Bosserman has three children: Charles, 18, a college freshman with a scholarship in journalism at St. Martin's, Olympia, Washington; Peter, 16, a high school sophomore, also at St. Martin's; and Ann, 13.

1930

L. Sprague de Camp brings us up-to-date on his activities since August 12, 1939, when he married Catherine A. Crook of New York City. He had a son born in January, 1941, and in 1942 was commissioned Lieutenant in the USNR, assigned to duty at the Naval Aircraft Factory in Philadelphia. There he did test and development work on naval aircraft parts, materials, and accessories. He was promoted to Lieutenant Commander in 1944. In 1946 he went on inactive duty, but remains active in the Reserve. Returning to free-lance writing after the war, Sprague has been turning out books at the rate of two a year: *(Inventions and Their Management,* second edition, with A. K. Berle; *The Carnelian Cube,* with Fletcher Pratt; *Divide and Rule; The Wheels of If; Lest Darkness Fall,* second edition; *The Evolution of Naval Weapons)* as well as pulp fiction, book reviews, ghost-writing, and radio scripts, including some for Voice of America.

Orrin Elliott has been Water Conditioning Engineer of the Sun Oil Co. of Philadelphia for 15 years. During this time he has built three water treating plants at the company's Marcus Hook Refinery in Penna., one at the Toledo Refinery, one at the Delhi, La., Refinery, one at Willow Slough, Texas, and is just finishing up his seventh in Starr County, Texas.

1931

Arthur C. Brooks is still Chaplain of the Asheville School in North Carolina. He teaches mathematics and religion.

Aubrey Horn, with wife Peggy and daughters Pamela (7) and Valerie (3), recently returned to Oregon after three months vacation in southern California. Aub is Project Engineer at Dorena Dam near Cottage Grove, Ore. When construction work is completed this fall, the Horns will be back in their home in South Pasadena.

Perry M. Boothe, Commander, Civil Engineer Corps, U.S.N., has been assigned for the past year to the Munitions Board as Chief of the Industrial Security Division. The job consists of determining the necessary industrial resources in the event of industrial mobilization, and the protective measures needed to insure productivity of those resources. It's very interesting and very complex, Perry says—and we believe him.

He is married and has two children, a son, 12, and a daughter, 7. Recently he succeeded **Harry Cunningham,** '26, as President of the P.T.A. at their children's school. Perry also reports that **Ben Holzman** is a Colonel in the Air Force, married, and has a daughter.

Herbert Ingham is still with Metallizing Engineering Co. in Long Island City, N.Y. His son, Herbert, Jr., won Honorable Mention in the Westinghouse Science Talent Search Contest this year. He will enter Rensselaer Polytechnic Institute in Troy, N.Y. this fall, majoring in physics.

1932

J. V. Chambers has been Treasurer of Industrial Indemnity, a California Workmen's Compensation Insurance company in San Francisco, since 1945. He has three children and lives in Kent Woodlands, Marin County.

Edward C. Keachie is an Associate Professor at the Los Angeles State College.

J. D. Cobine, M.S., Ph.D. '34, was awarded an Army-Navy Certificate of Appreciation in ceremonies at Rensselaer Polytechnic Institute last December. He was cited for "services at the Radio Research Laboratory, Harvard University, in directing the activities of the noise graph in basic research in physics and electronics for radar counter-measure applications." Cobine is now Research Physicist at General Electric Research Laboratory in Schenectady.

Charles D. Coryell, Ph.D. '35, has been Professor of Chemistry at M.I.T. since 1946. During the war he was first at the Metallurgical Laboratory of the University of Chicago, in charge of studies of the chemistry of the products of uranium fission, and later at Oak Ridge, carrying on the same type of work.

1933

Rene Engel, Ph.D., recently became associated with **Florent H. Bailly,** '27, President of Oil Properties Consultants, Inc., and Petroleum Engineering Associates, Inc., both of Pasadena. Under the names of Petroleum Industry Consultants-Cuba and Petroleum Industry Consultants-Venezuela, this association is extending its services from branches respectively located in Havana and Caracas. Dr. Engel still retains his position as curator of mineralogy and petrology at the Los Angeles County Museum.

Phillip C. Effromson, since January, 1948, has been a partner in the Calidyne Company, in Mass. It's a new engineering and manufacturing firm, specializing in vibration and general dynamic measurements. Phil says he's contaminably close to M.I.T., but surprisingly enough finds some good fellows there too.

1935

Bob Stanley's new (nine-months-old) Stanley Aviation Corp., of Buffalo, has completed $200,000 in orders for the U. S. Air Force and Navy and has a backlog of $100,000 in unfilled orders, according to a recent issue of *Aviation Week.* Navy orders are for guided missile equipment; Air Force contracts include photo and guided missile equipment and instrument training devices.

Bob was previously with Bell Aircraft, where he was Chief Test Pilot from 1940 to 1944. He was in charge of all flight research activities, including the development of radio controlled flight testing, and was the first pilot to fly jet aircraft in this country. For the next three years he was Chief Engineer, responsible for, among other things, design and development, experimental construction shop, and the flight test program of the super-sonic jets, XS-1 and XS-2. In June, 1947, he was made Vice-President of Bell, in charge of engineering.

Allen A. Ray announces the formation of a new firm—Ray Products Company, of

Alhambra, specializing in acrylic fabrication and, more specifically, plastic bassinets.

Oliver C. Dunbar, Major in the Army Signal Corps, was married to Miss Anna Elizabeth Pritchard of Montclair, N.J., on May 27.

1936

T. E. Browne, Jr., Ph.D., reports the following acquisitions: 1936, a job (with Westinghouse Research Lab in Pittsburgh); 1938, a wife (Edna Strom); 1939, a son (Thomas Everett, III); 1941, another son (Joseph Niel); 1943, yet another son (Charles Edwin); 1946, a daughter (Mary Ann Farrar).

Donald F. Folland, M.S., is now Senior Project Engineer, in charge of instrument landing development, for the Sperry Gyroscope Co. in Great Neck, N. Y. In February of this year his second son was born, bringing the count to two boys and one girl.

1937

Martin H. Webster and two fellow-graduates of the Harvard Law School have gone into business in Los Angeles as Webster, Horgan & Kline. The firm will engage in general practice, Webster specializing in tax and business law.

Irving Berler, M.S., is Research Aerodynamicist at the Cornell Aeronautical Laboratory in Buffalo.

Martin J. Poggi moved from Seattle to Fort Worth last January to open an office for Airsupply Co. As Installation Engineer, Martin works with Chance Vought, Convair and Temco on engineering problems encountered in the installation, testing and service of accessories sold to these companies by the manufacturers Airsupply represents. This is the same type of work he has been doing for the past four years at Boeing in Seattle. With him in Fort Worth are his wife and two daughters, Virginia, 2½, and Carol, 7 months.

Harold J. Alwart, M.S., was made Chief Engineer of Clayton Mark & Co., Evanston, Ill., the first of the year. In his spare time he is learning how to run his 80-acre farm. Alwart has two children, Sharon Jo, 6, and Stephen John, 4.

Robert M. Mahoney has recently moved his headquarters from Henderson, Nevada, to Bishop, California. He's still with United States Vanadium Corporation, as Manager of Industrial Relations.

Phil Ives, Ph.D., writes: "The Ives family now consists of boy-girl-boy-girl, just like that. Spring is beautiful, and the trout are biting nicely. The children's names? Richard — Elinor — Donald — and Carolyn. The aging father is still Research Associate in Biology at Amherst College, engaged in Drosophila work, primarily."

1939

C. H. Townes, Ph.D., Associate Professor of Physics at Columbia University, has been appointed consultant to the Microwave Standards Laboratory of the National Bureau of Standards, where he will be available for consultation on microwave absorption spectroscopy and atomic beam equipment for use as frequency and time standards. Before joining Columbia in 1947, Dr. Townes was on the staff of the Bell Telephone Laboratories.

1940

Bob Cox, whose construction of a Florida yacht basin, the Lauderdale Marina, was written up in our October issue, sends the following follow-up: "The only thing I can really add, since your publishing of a letter from my wife, is that my job has changed to longer hours and less pay.

"I will say one thing, however. We probably have more fun in our Marina than the average engineer. I have developed some accomplishments which scarcely go with my sheepskin. I can now run a dragline, piledriver, bulldozer and assorted other equipment. I can qualify somewhat as a civil engineer, without mathematics, on the subject of bulkheading, dredging, and filling. In addition to all this we have learned a lot about such mundane things as electrical work and plumbing and what kind of trees will grow next to salt water.

"The Lauderdale Marina has had a nice season in spite of the fact that we are not as far along as we would have liked. However, the picture you published is still our aim, and surprisingly enough, we are not too far from it."

1941

George H. Bramhall is working on General Electric vacuum cleaners in Cleveland. He says he is known professionally as a "line engineer in charge of domestic upright floor cleaners." In his leisure moments George is building a house in Chagrin Falls, 17 miles from his job. He's contracting it himself, letting out subcontracts, and plans to do his own finishing work. He is spurred on by his wife Elizabeth and his nearly-year-old son Mark Hardy.

1942

Robert E. Anderson is doing geology for the Signal Oil and Gas Co. in Los Angeles. He was married a year ago to Ruthelen List (Stanford '41).

Emerson L. Kumm married Bettie Miles in November, 1948. He's at North American's Downey Plant, as Research Engineer on Combustion, Ram-Jets, Test Design.

1943

Leonard Alpert, who was married to Elinor Witz of Alhambra last August, is now working in the plant engineering department of Shell Chemical's Ammonia plant, in Pittsburg, Calif.

Douglas C. Reid, M.S. '47, and Marion Cornelia Paul were married May 7 at the Church of the Wayfarer in Carmel. Reid is with Standard Oil in Richmond.

1944

Ronald S. Johnson reports that he is still in the "long grind" towards a Ph.D. at the University of Michigan, and that for the past two semesters he has been instructor of graduate courses in business statistics. He and his wife Roberta have bought a house in Ann Arbor and invite itinerant alumni to look them up.

Buzz Bussard writes to say that he enjoys his work at DuPont's new nylon plant at Chattanooga, and that **Bill Olenbush** is now with DuPont's Ammonia Department at Sabina River Works, Orange, Texas.

J. Stewart Martin, M.S. '47, left Tidewater-Associated last October to join Intex Oil Co. of Texas as Petroleum Geologist. He's now living in Abilene, as yet unmarried.

Bob Freeman is a Lecturer in Electrical Engineering at the University of California, Berkeley. Robert Jeffery Freeman was born July 3, 1948.

Kenneth Brown, Jr., is Arizona Superintendent of the Roscoe Moss Co., a firm of water well contractors. He has three nicely-spaced boys—3, 1½ and 3 months.

Thomas N. Norsworthy, another bachelor, is Vice-President of J. B. Taylor, Inc., a Dallas advertising agency.

Elmer S. Hall writes from Hyattsville, Maryland: "Last July my wife gave birth to a baby boy, Douglas Scott Hall, who is just about ready to get into a lot of mischief now.

"I have been employed by television station WMAL-TV, Washington, D. C., channel 7, for the past year and a half, and have had a part in many television 'firsts' —such as looking at the moon and planets through a telescope with a TV camera, as well as looking at cancerous cells through a microscope. We also televise many Washington dignitaries, including H. S. Truman."

1945

R. J. Kieckhefer is Chief Engineer of the American Lace Paper Co. of Milwaukee, and has recently been commissioned Ensign in the Civil Engineer Corps of the Naval Reserve. He flies his own plane, and hopes to come west soon to renew acquaintances.

F. Miles Day is Sales Engineer for Sales Corp. of America (gas-fired automatic special machinery) in Philadelphia. Saturdays, he's an apprentice auto mechanic, inspired thereto by Tech's Peter Kyropoulos. Sundays—summer ones, that is—he spends on the Jersey beaches with wife, beer and chiggers. "No children, just one handful of dog."

L. H. Davy writes from San Francisco that he is now working with Headman, Ferguson & Carallo of Phoenix, in Emeryville, on Paraffine Company's new plant—to be installed in New Jersey.

1946

Howard R. Woods and Sonya Gray, of Denver, were married this spring in Covina, Calif. Mrs. Woods is a graduate of Scripps.

Charles E. Burdg is at General Electric's Erie plant, working in the Refrigerator Works Lab, where most of the electronic measuring and testing devices are designed and constructed. He's on a six months "signup" as Test Engineer, will move on about August 1.

Richard Davis has spent the past year in Scotland at the University of Edinburgh, writing his thesis for his Ph.D.

Theodore R. Goodman, M.S., is an aerodynamacist at the Cornell Aeronautical Laboratory in Buffalo. He'll have a paper published soon in the Aeronautical Sciences Journal.

George Huffard got an MSEE at the University of Washington and is now working for the Central Radio Propogation Laboratory at the National Bureau of Standards, making theoretical analyses of tropospheric phenomena.

Walter Bonner, Ph.D., writes: "For the past three years I have been a Research Fellow in Biology at Harvard University. During this time our family was enlarged by one son, born November, 1947. I now plan to spend the following year, until August, 1950, in Cambridge, England, having recently been offered a fellowship by the Committee on Growth of the National Research Council, acting for the American Cancer Society."

Ted Dehnke, who is still with Dow Chemical in Midland, Mich., reports the birth of a son last February.

1947

Richard A. Boettcher, M.S., is with the Arabian American Oil Company in Dhahran, Saudi Arabia. His family, including a baby girl born January, 1948, joined him in May.

Fernand de Percin, M.S., is a Climatologist in the Office of the Quartermaster General in Washington. He was previously an Instructor in the School of Mineral Industries, Pennsylvania State College. His son, Fernand, Jr., was born March, 1947.

R. M. Clock, M.S., is in the Mechanics Department of the U. S. Military Academy at West Point.

Richard L. Felberg is the father of a baby girl born April 13. Felberg is with the Water Department in Earp, Calif.

John W. Bennett, M.S., was promoted to Captain in the U. S. Air Force last October, and is now stationed at Elgin AF Base, Florida. He's in the Proof Test Division, conducting operational suitability tests on USAF aircraft and allied equipment.

Bob Ilfeld joined the General Electric Co. after leaving Caltech, and is now Sales Engineer in their Special Products Division. He and his wife Winona have bought a house in Schenectady and expect to settle down there. Bob is active in the Edison (Country) Club, the Physics Program Alumni, and the church. Mrs. Bob is a leader in the American Association of University Women.

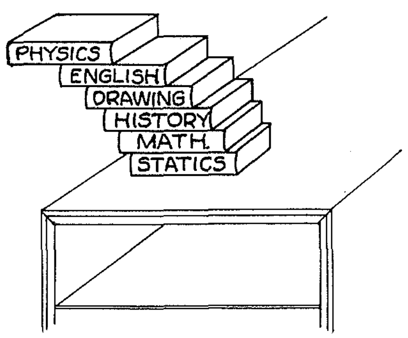
1948

Conway W. Snyder, Ph.D., joined Fairchild Engine and Airplane Corp., in Lexington, Ky., this spring, working on their NEPA (Nuclear Energy Propulsion of Aircraft) Project. He's setting up a research program, using the electrostatic accelerator of the University of Kentucky, to measure inelastic scattering cross sections of neutrons in heavy elements to obtain basic information required for reactor and shielding calculations. Formerly Snyder was with the Nuclear Physics Branch of the Office of Naval Research.

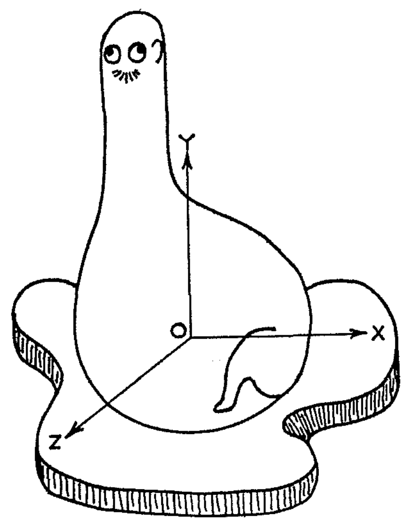
LETTERS CONTINUED FROM PAGE 2

year—for his class in Applied Mechanics 1a. Blair drew the pictures too.

One of the girls in the Bookstore was a bit careless in handing out a stack of books with the result shown. If the stack is in equilibrium and each book is equal in size and weight and overhangs the one below by the maximum possible distance, by how much does the Math book overhang the Statics book?



The shmoo is sitting on a flat rock and thinking. His center of gravity is at 0. With reference to a set of coordinate axes through 0, the equation of his bottom is $2x^2 + 3y^2 + 2z^2 = 12$. *The shmoo is in equilibrium in his present position. If he is jostled slightly, will he fall over, remain in the displaced position, or return to a vertical position? Why?*



Incidentally, the shmoo has been thinking about this problem for several days instead of providing Grade A milk and eggs, so help him out.

Caltech — R. R. Martel
Professor of Structural Engineering

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SIRS: At present I am attending UCLA, taking courses in Business Administration with a Production Management major. It seems to me that many of the courses under this major should be given to all engineers. It would not only help them in their work; it would help them get ahead in the field. These courses, offered at UCLA, include Production Control, Time and Motion Study, Purchasing, and other phases that an engineer too often knows little about. I would like to recommend that a course or two be set up for future students so that at least a survey as to what should be known is given the engineer. These are now offered to the engineer at UCLA and Cal.

Pasadena — Richard A. B. Knudsen, '44

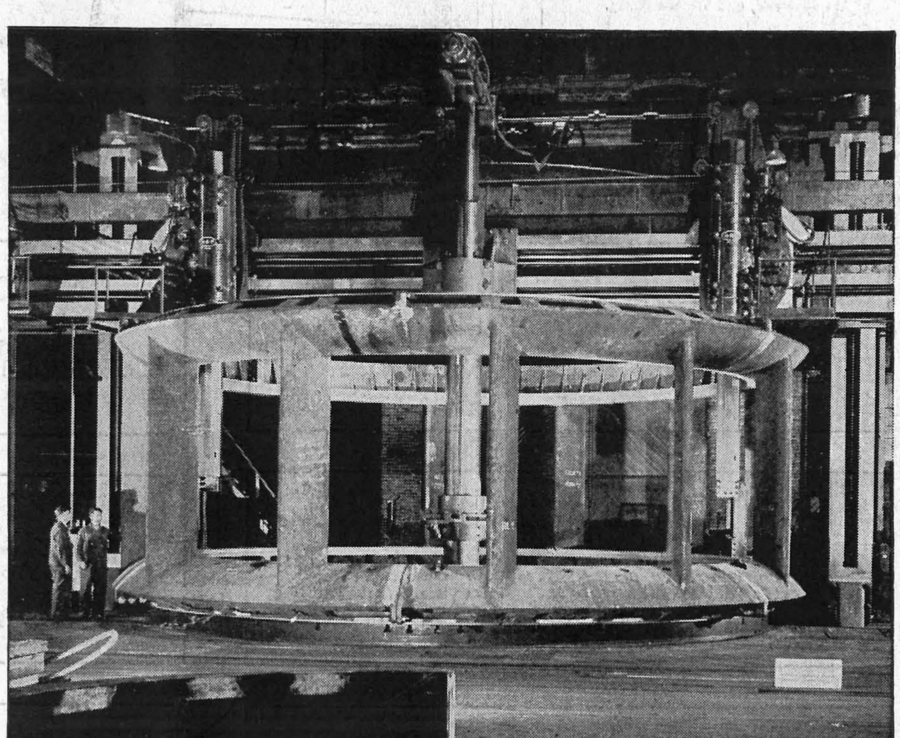
POSTMASTER: Return postage guaranteed.

BUILD the basic machines of an industrial world!

by CARL MALMBERG
Superintendent, Tank and Plate Shop
ALLIS-CHALMERS MANUFACTURING CO.
WEST ALLIS WORKS
(Graduate Training Course—1930)

PRODUCTION METHODS have become a good deal more technical and complicated in the last few years. There is a big difference between the way we do things now and the way we did them when I left the Allis-Chalmers Graduate Training Course to work in the machine shop in 1930. That is why there are more and more opportunities in the manufacturing end of the business for young engineers who get a thrill from watching a project grow from a roll of blueprints to a big electric power installation or machinerv for a giant processing plant.

CARL MALMBERG



Machining speed ring for a 55,000 hp turbine on a 40' boring mill, one of the largest in the country. Many A-C machines and methods are unique because of the tremendous size of work pieces and wide variety of operations required in building the world's greatest range of industrial equipment.

Close Coordination

In my section of the shop we specialize in fabricating machines and parts from sheet and plate steel. We work closely with the design engineers to develop the most economical way of producing their designs and we do much designing on our own. We work closely with every other manufacturing department, because more and more Allis-Chalmers products are being designed to replace cast members with welded members, and in my work we do the welding for the whole plant.

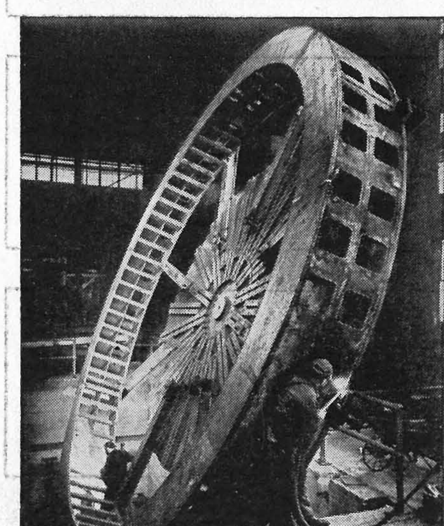
One recent interesting project was the fabrication of stainless steel buckets for impulse-type hydraulic turbines to replace the old cast-type buckets. Working with design engineers and hydraulic engineers, our tank and plate specialists developed a design and method of manufacturing that produced buckets with several times the life of the old type.

Opportunities Everywhere

New developments in every department mean almost endless opportunities for young engineers. Right now, the erection shop is building a big crusher for processing taconite in the Mesabi range, and we are supplying most of the other ore processing equipment for this gigantic plant, too. At our Norwood plant, engineers have completely rebuilt the production system on motors and small pumps for greater efficiency and lower costs.

In fact, here at Allis-Chalmers there are big opportunities for young engineers in all phases of engineering work—design, research and development, manufacturing, sales and erection—in nearly any industry you can name. For Allis-Chalmers builds primary equipment for electric power . . . mining and ore processing . . . pulp and wood products . . . flour milling . . . steel . . . agriculture . . . public works . . . for *every* basic industry.

The thing that influenced me most when I left the University of Illinois to join Allis-Chalmers, was the tremendous breadth of opportunity. Some of my friends from that GTC class of 1930 are sales engineers now, some are design engineers, some have traveled around the world with erection crews. I chose manufacturing because I like to see things take shape before my eyes. I tried a good many things before I made my choice and my choice has been good.



Welding stator yoke on 38,889 kva hydraulic turbine-driven generator.

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

ALLIS-CHALMERS

A-C ALLIS-CHALMERS