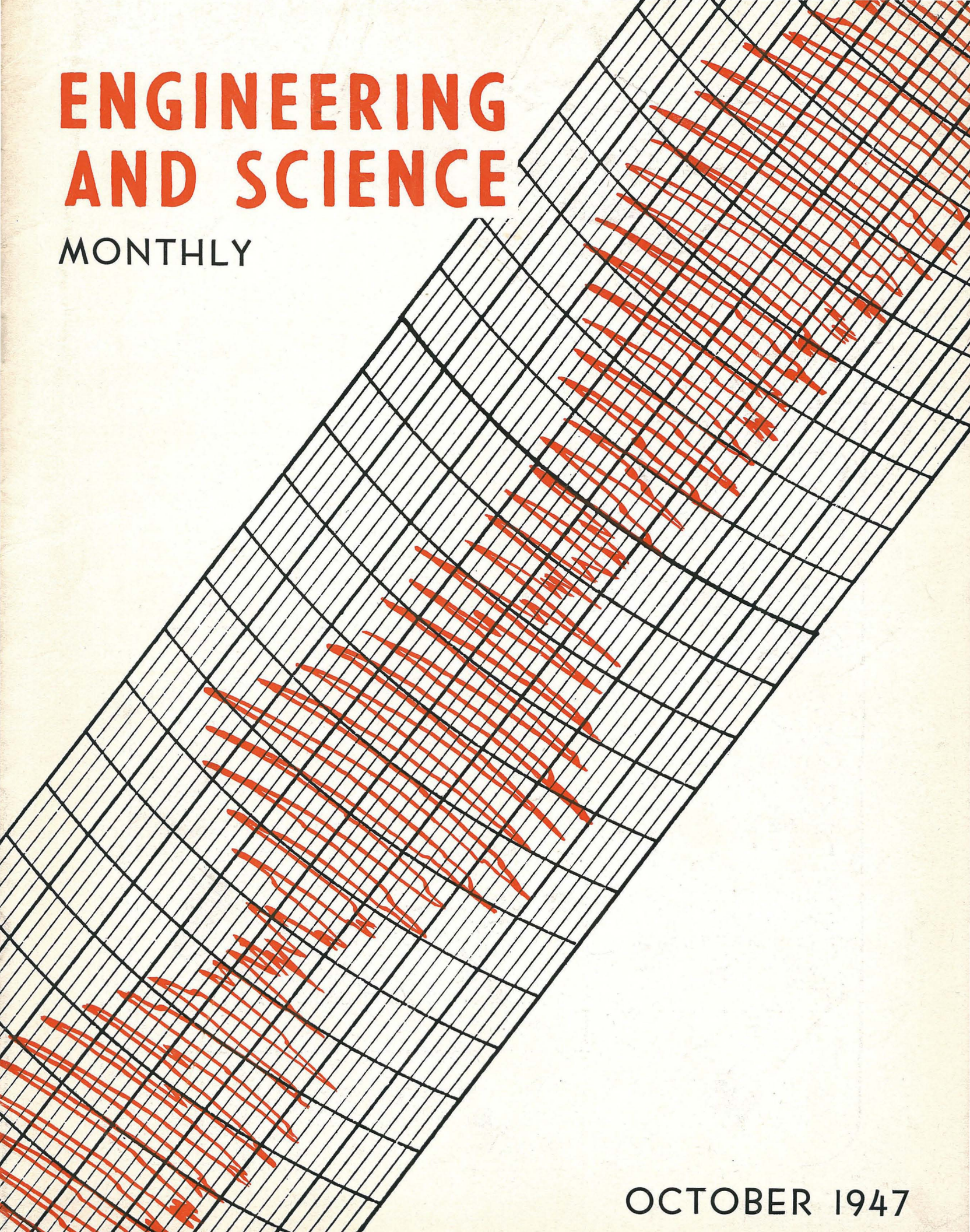
ENGINEERING AND SCIENCE

MONTHLY

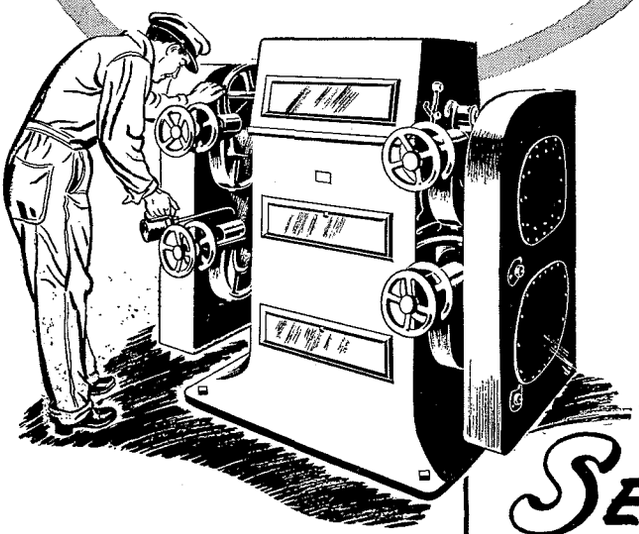


OCTOBER 1947

PUBLISHED BY CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION

THE MARCH OF SCIENCE

UNLOCKING SECRETS OF THE SOY BEAN..



THE SOY BEAN, ONCE PLANTED ONLY AS A ROTATION CROP, WAS PLOWED UNDER TO INCREASE THE FERTILITY OF THE SOIL.

THEN SCIENCE DISCOVERED THAT SOY BEAN FLOUR IS WHOLESOME ...THE OIL MAKES GOOD PAINTS AND SALAD DRESSING...THE MEAL IS GOOD CATTLE FEED... THE FIBRE MAKES PLASTICS.. BUT FIRST EXTRACTION METHODS DIDN'T GET ALL THE OIL...ONLY PARTIALLY SEPARATED THE OTHER INGREDIENTS.

SENSATIONAL NEW OIL EXTRACTION METHOD DEVELOPED BY A-C SCIENTISTS

REVOLUTIONARY SOLVENT EXTRACTION MACHINERY NOW SEPARATES SOY BEAN OIL, PULP AND MEAL EFFICIENTLY—AT LOW COST AND EXTENDED USE OF THIS EQUIPMENT IS INCREASING THE YIELD FROM OTHER OIL-BEARING MATERIALS SUCH AS FLAXSEED, COTTON SEED, COPRA, PALM KERNELS, PEANUTS AND MEAT SCRAPS.....

90% OF ALL SOY BEAN MILLING TODAY IS DONE WITH A-C EQUIPMENT. THIS WORK THAT ALLIS-CHALMERS HAS DONE WITH SOY BEANS GOES ALL THE WAY FROM PLANTING AND HARVESTING THROUGH MILLING AND PROCESSING. IT IS TYPICAL OF THE ENGINEERING AID A-C OFFERS TO EVERY BASIC U.S. INDUSTRY.

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ONE OF THE BIG 3 IN ELECTRIC POWER EQUIPMENT
BIGGEST OF ALL IN RANGE OF INDUSTRIAL PRODUCTS

BY-LINES

MARTIN H. WEBSTER

Martin H. Webster graduated from the California Institute in 1937 and then went to Harvard Law School in Cambridge, Massachusetts. After graduating in 1940, Mr. Webster was associated with a Los Angeles law firm until September 1942, when he joined the U. S. Army. After discharge as a lieutenant in February 1946, he opened his own offices in Los Angeles.

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IRA C. BECHTOLD

Ira C. Bechtold is director of process engineering for the Fluor Corporation of Los Angeles. A native Californian, Bechtold was born in Pasadena, and while he numbers several states among his early residences, he returned to California to complete his education at UCLA and CalTech, where he received his B.S. in chemical engineering in 1930.

For several years he was associated with the McMillan Petroleum Corporation as a research chemist, and in a similar capacity served the California Portland Cement Company at Colton for several years. During this latter period, Bechtold was concerned with extensive preliminary research in connection with the cement work at Hoover Dam.

On the staff of the Bureau of Standards in Washington, D. C., he served as research associate for two years, returning once more to California in the summer of 1941 to join Fluor as a process engineer. It was at this time that plans for the building of a research laboratory at Fluor were formulated, and with its completion, the laboratory was operated as a part of the Process Department until early 1944. At that time it was made a separate department with Bechtold in charge. In 1946 he was named manager of the Process Engineering Department as well as head of the chemical engineering group.

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COVER CAPTION

See page 2.

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ENGINEERING AND SCIENCE
Monthly
The Truth Shall Make You Free

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ENGINEERING AND SCIENCE MONTHLY

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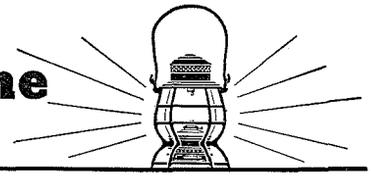
The Main Line



OCTOBER, 1947

Last month we suggested that you try an Indian Summer vacation for a change. Since then we've heard from resort people at many of the best vacation places. Everybody, it seems, agrees that now is the time to go.

In Southern Arizona, the "welcome mat" is already out. Apparently the resort people down there spent the summer building new accommodations like crazy. Around Phoenix alone, some 726 new units were built in 70 tourist courts. The same is true of Tucson. But that doesn't mean peak season reservations will be any easier to get. Present indications are that 1947-1948 will be the biggest year ever, and by New Year's Day, resort and guest ranch accommodations will be as hard to find as 50-yard line seats in the Rose Bowl.

Don't be discouraged, however. There are two excellent solutions to the reservation problem. If you really can't go any time except during the height of the winter season, then *make your reservations now*. You shouldn't have much trouble getting what you want if you act promptly.

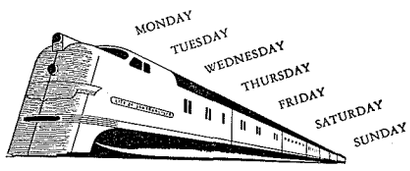
A much better plan, though, is to toss your toothbrush and extra sox into your suitcase and head for the sunny Southwest right away. You'll find the weather perfect, places uncrowded, and informality the watchword. Some of the resorts have special rates in the late fall and early winter.

Fifty years ago some eastern people discovered what a healthful place the sun picks to spend the winter—and they have been coming all the way out to Southern Arizona and Palm Springs in larger numbers every year since. For folks on the Pacific Coast, it is a much shorter and easier trip. Our Golden State and Sunset Route trains run through the heart of the sun country, making it little more than a day's jaunt from most points.

We have four fine trains serving this area every day. The *Golden State*, with all streamlined Pullmans and chair cars is the first one out every morning. It leaves Los Angeles at 11:15 a.m. At half past noon, the fast, comfortable *Sunset Limited* starts out. The *Sunset* carries modern, air-conditioned Pullmans and reclining chair cars. Then, at 2:45 p.m., the *Imperial* leaves. The *Imperial* (also called the *International Limited* because its fast schedule takes it on a 51-mile dip into Old Mexico) carries air-conditioned standard Pullmans, economical tourist sleeping cars and chair cars. If you prefer a night departure, you'll like the *Argonaut* or *Train #44*. The *Argonaut* leaves Los Angeles at 8:20 p. m., *Train #44* at 8:00 p. m.

With all these trains to choose from, and with reservations fairly easy at the moment, it certainly looks as if "now is the time for all good men to sun themselves in the Southwest."

(*P.S.* While we've been talking mostly about Southern Arizona, what we've said goes for the desert around Palm Springs, Imperial Valley and the sunshine sections of Texas and New Mexico as well.)



Please pardon us for feeling proud, but we think the new daily schedule of the *City of San Francisco* is just about the biggest thing since the World's Fair. Ever since this famous streamliner started running between San Francisco and Chicago, we simply haven't had enough Pullman space and chair car seats on it to go around. Now, while the daily *City* continues to be one of the nation's most popular trains, you can make your Pullman or chair car reservations as far in advance as you wish, and be sure of getting the accommodations you want.

Incidentally, the *San Francisco Overland* is on a new, faster schedule now—48 hours flat to Chicago from San Francisco. The *Overland* carries through Pullmans to New York, St. Louis and Salt Lake City, and shows you the rugged High Sierra by daylight both ways.

—R. G. BEAUMONT

S·P The friendly Southern Pacific

Index to Advertisers

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COVER CAPTION

This graph is an automatically traced record of the pressure variations in a discharge header receiving natural gas from three 800 hp angle-type compressors, discharging at 450 lb/in.^{2} gauge. The ordinate represents the deviation from the average pipe line pressure. Time is represented by the abcissa. The record was made by an apparatus consisting of a sensitive magneto-strictive type pickup which is inserted in the discharge pipe line and is actuated by variations in the pressure of the gas stream flowing in the pipe. The minute voltage developed by this detector is amplified and electronically integrated to convert it from a rate of change of pressure vs. time relationship to an amplitude vs. time relationship. This integrated voltage is again amplified and applied to a direct inking type oscillograph, the pen of which produces the trace. The chart is driven through the oscillograph at a constant velocity to produce the time axis.

Each longitudinal division of the chart represents 1/5 second of time. The higher frequency trace is seen to be nearly 10 cycles/sec, and is the fundamental pulse of one compressor.

The modulation of this frequency is caused by the alternate cancelling and reinforcing of the fundamental waves of the three machines as they drift slowly in speed, thus affecting the phasing. The peculiar twisting of the pattern is caused by a repetitive reversal of each cycle of the pulse pressure for a short period of time. This reversal drifts with respect to the predominant wave time and effects almost complete cancellation periodically. This pattern is peculiar to three or more compressors, that from only two being well rounded and without shadows.

A similar but much more symmetrically modulated wave has been produced in the laboratory by mixing three frequencies which were harmonically related but not held in phase.

With the Editor--

"YOU WON'T GET any reaction! We've given them an article that sounded like red propaganda, we've given them pure science, we've given them pure military engineering. Ninety-nine per cent never react!"

The managing editor was delivering an opinion on a short article submitted for publication. We had ventured the opinion that it contained some remarks which certain readers might violently dislike. Under consideration by the Publications Committee were a few possible changes.

"I doubt if they can write, they never show that they can. Go ahead, use this article as is. I'll bet you a $50 raise we don't get one letter!"

This sounded pretty strong to us and we glanced appealingly toward the others for help in denying such passivity among Tech alumni. Scenes of some of the heated discussions we had engaged in with other Tech men passed through our mind. Finally some one was going to speak. Help at last! But no, it was only a calm confirmation of the charges.

Frankly we were puzzled. It is our experience that Tech men are not complacent; that they can and do react, sometimes rather vehemently. We told the M.E. so, that Tech men could react violently and when they did he'd better run for cover. We explained to him that Tech men are very busy, that they haven't time to write commendatory letters, but that if the magazine displeased them they would howl. We admitted, however, that the magazine would have to be very bad to get a howl, because of the extreme tolerance of Tech men in this matter.*

—Well, what about the alumni? Have they all become so stodgy and dull that they take anything that's dished out? Don't they ever disagree with us? Maybe we could offer a lapel button labelled "Letter Writer" for the reader who will give us some constructive criticism on our variety of articles, length and number of stories, our handling of C.I.T. and ALUMNI NEWS, or our editorial policy. Maybe we should even offer a prize for the reader who can find the greatest number of editorial or typographical errors. After all, nothing keeps us alert more than fear of being raked over the coals by our readers. And authors like to hear when readers think they've done a good job, too.

Maybe the alumni fear to criticize lest they be asked to help — and maybe an excited correspondent would be. That's somewhat the route that landed us in our easy chair. But he could refuse.

Now here's a challenge. You alumni must have ideas or you wouldn't be alumni, and you must know how to express them or you couldn't afford to be members of the Association. Some readers may doubt the truth of these inferences. Help us show such skeptics that ye editor is nearer right than they are. Let's show our managing editor (he's a Pomona grad) that Tech men can and do write letters! We'll get a better magazine that way.

*It's the exception that proves the rule: Two letters HAVE been received. Readers will find two points of view presented on page 12.

ENGINEERING AND SCIENCE
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Vol. X, No. 7 October 1947

Registration of Engineers in California

By MARTIN H. WEBSTER

ON FEBRUARY 20, 1947, in the City of Los Angeles, a factory blew up. Property damage was estimated at $2,000,000, and at least 151 persons were injured and 15 killed. The explosion was caused by the mishandling of certain chemicals under the control and supervision of a man who posed as a chemical engineer. This tragedy emphasized, as no other occurrence could have, the responsibilities of engineers to the public. It is apparent that the man who builds a bridge or designs a steam turbine or installs a wiring circuit has responsibilities that extend beyond his immediate employ.

It is thus for the protection of the public health and safety that legislation has developed in this country requiring the registration and licensing of engineers. Wyoming was the first state to pass any such type of legislation. From the date of its enactment in 1907 through 1917, only three other states followed in Wyoming's footsteps. Since 1917 every state has in some measure or other sought to protect the public by the passage of acts regulating the engineering profession.

NEW ACT—ASSEMBLY BILL 1930

The latest such regulatory act was passed in the State of California on July 17, 1947 as Assembly Bill No. 1930 and became effective September 19. This bill was the culmination of the efforts of responsible California engineers who, as far back as 1925, had been successful in securing passage through the legislature of a Professional Engineering Registration Act. Through a clerical error, however, this Act was never signed by the Governor. In 1929 the so-called Civil Engineers' Act was passed, affecting only the practice of civil engineering. This Act has been administered successfully and to the overwhelming satisfaction of the civil engineers in this state. Continuous pressure has been brought to bear to extend such regulation to other branches of engineering. Finally, on February 3, 1947, Assembly Bill No. 1930 was introduced, rescinding the Civil Engineers' Act and substituting therefor a statute covering all branches of engineering. A fear arose in the mind of members of the civil engineering group, during discussion of this Bill as introduced, that in the event it was declared unconstitutional for any reason the benefits theretofore available to the civil engineers would automatically be removed. Accordingly, the civil engineering group asked for regulatory legislation to be passed as an amendment to the existing Act, thus leaving intact the 1929 Civil Engineers' Bill. The argument presented was persuasive and the Bill, as finally signed by Governor Warren, represents a two-headed compromise: first, that portion of the old Act which dealt with the regulatory board's powers was simply amended to include branches of engineering other than civil; and second, provisions dealing with registration of other than civil engineers were appended to the old Act by means of a new Article.

OLD ACT—CIVIL ENGINEERS' ACT

The Civil Engineers' Act provided, prior to its amendment, principally as follows:

It detailed the scope of the board's authority, made the practice of civil engineering illegal without proper registration, barred the use of the title of "Civil Engineer" to all but registered civil engineers, and prescribed the registration procedure for civil engineers, including the taking of examinations and paying of license fees, etc.

AMENDMENTS TO OLD ACT BY ASSEMBLY BILL 1930

The principal changes in the old Civil Engineers' Act effected by Assembly Bill No. 1930 are as follows:

1. The regulatory board is now called the State Board of Registration for Civil and Professional Engineers.

2. The number of members of the board is increased from three to seven.

3. The old board consisted of three civil engineers. The new board consists of three civil engineers, plus one mechanical engineer, one electrical engineer, one chemical engineer and one petroleum engineer.

4. The board's jurisdiction applies not only to civil engineers but to all other branches of engineering covered by the Act.

5. An entirely new article has been added, dealing with the registration of professional engineers in the

(Continued on page 12)

PULSATION PHENOMENA In Gas Compression Systems

By IRA C. BECHTOLD

WHEN gases are compressed by any of the usual methods now employed commercially, it is frequently found that several undesirable effects of pressure variation appear in the system associated with the compressor or in the compressor itself. All of these undesirable effects are connected in some manner with pulsation phenomena which appear as a result of the reciprocating action of the compressor. In certain systems where rotary or other types of compressors are employed, as contrasted with the reciprocating type, similar pulsation phenomena are evident. However, the present discussion will be confined to the phenomena which appear in systems utilizing reciprocating compressors, and in particular those which are employed in the compression of natural gas for transmission in pipelines, or for other purposes such as recycling or repressuring operations.

One of the most important difficulties which arise from pulsation phenomena is the effect of vibration which appears in the piping system or other equipment downstream of compressor plants. In such cases it frequently happens that pipelines, heat exchangers, scrubbers, processing vessels and even buildings are caused to vibrate to an extent which may have very serious consequences. These vibrations have been known to tear away anchor bolts and, in some instances, pipelines have been broken at welded joints. A frequent occurrence is that of breaking screwed fittings on small lines such as instrument air systems. Under severe conditions of pulsating flow the vibration is frequently accompanied by considerable noise, which appears to radiate from the piping itself and will be heard to travel long distances through the system. This is sometimes described as being an effect similar to that which would be produced by "rocks rolling through the pipe." Of course, there is also the accompanying rattle of piping and other metallic surfaces striking each other. In general, these effects occur with the most spectacular results in systems operating at relatively high pressure. For example, certain compressor installations whose purpose is to compress natural gas for recycling operations in the production of petroleum may operate at pressures as high as 4000 lb/in.^{2} In cases where large quantities of gas are being compressed to high pressures the destructive effects of vibration may be considerably more pronounced than would be the case in systems operating

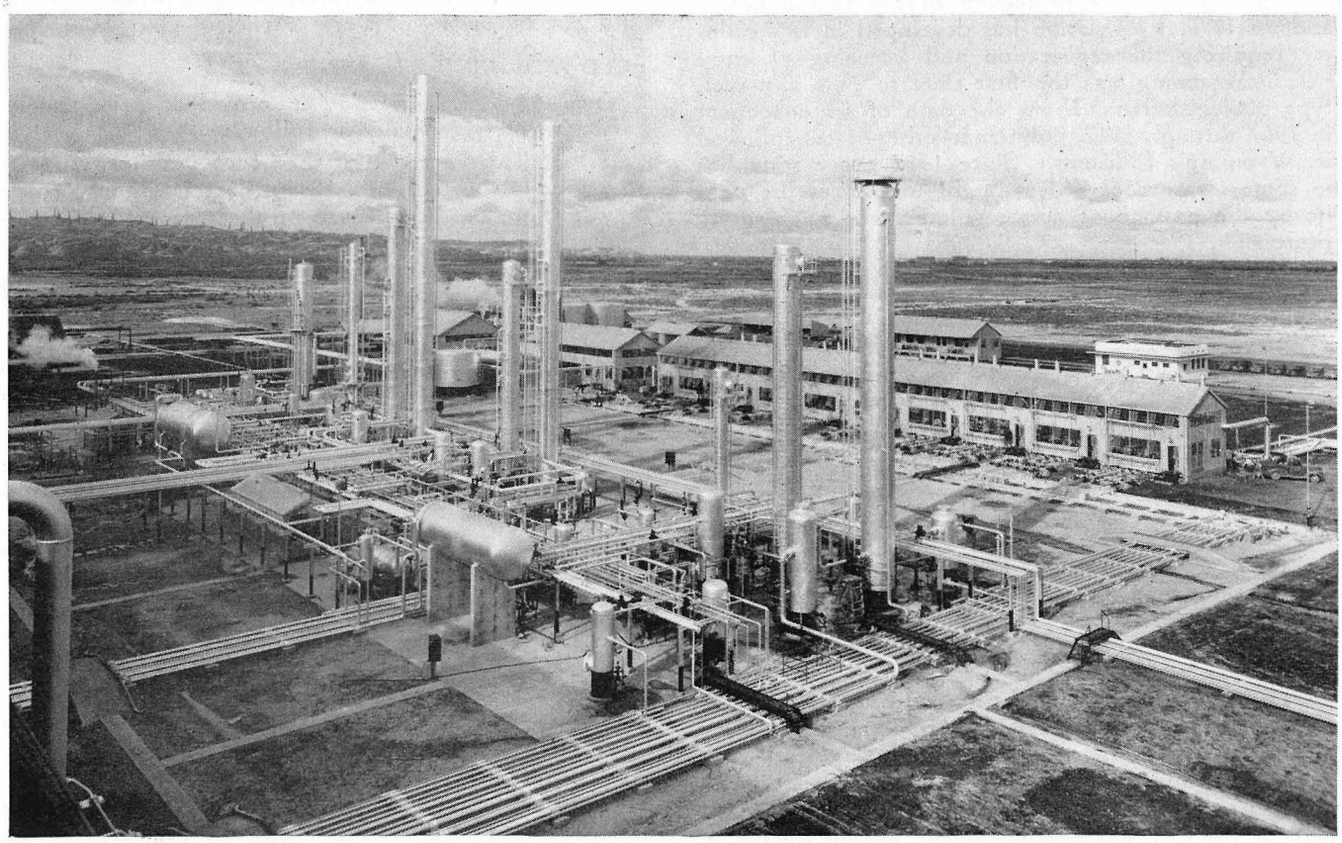


Figure 1. Modern recycling plant showing compressor building housing units which compress injection gas to 3700 lb/in.^{2}

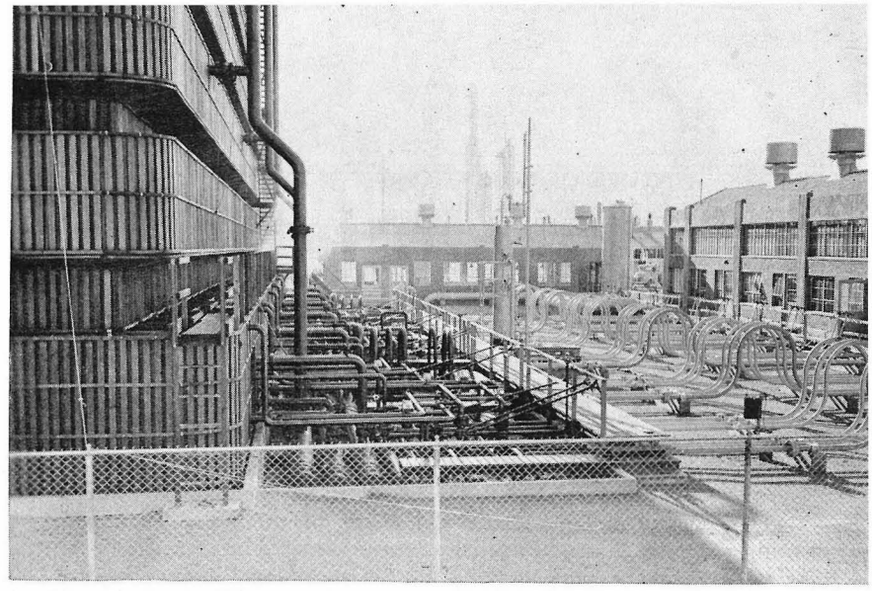


Figure 2. Typical compressor piping system employing vertical expansion bends in both suction and discharge laterals.

at low pressures. However, many systems have been observed where the effect of vibration is remarkably pronounced, even though the discharge pressure is quite low. It has also been common to find that the suction system of a compressor plant operating at low pressures will manifest extremely dangerous conditions of vibration. These effects have been studied to a considerable extent in the past, and many efforts have been made to design piping systems which will withstand the stresses imposed upon them by forces originating in the pulsating gas flow.

Arnold* has presented a study of these effects which gives a basis for determining whether they may be of a destructive nature. Even though vibration phenomena, which result from pulsative flow in certain instances, may not be of a destructive nature, many operators consider them to be a psychological hazard which could well be eliminated for the purpose of producing better working conditions for employees.

A second undesirable situation which may be engendered by pulsation phenomena is the necessity for oversizing pipelines to take care of increased pressure drops which may result from pulsative flow. It is also necessary to select heavier pipe when such flow exists, in order to insure safety in its operation. Both of these effects require the use of a large amount of steel which would be unnecessary if the gas flow were not pulsating.

A third result of extreme conditions of pulsative flow is concerned with the efficiency of the compressor itself. When pulsations are present in the piping downstream of a compressor cylinder, it is possible to have a standing wave of such nature that the cylinder is discharging under conditions whereby the internal pressure of the cylinder rises considerably above the average system pressure for a considerable portion of the discharge part of the cycle. This causes the consumption of power which is not effective in transferring compresesd gas to the lines, and hence the efficiency of the cylinder is adversely affected.

Another difficulty which may be traced to pulsative flow in gas lines is the well-known effect which becomes evident in orifice meters when the flow through the orifice plate is not uniform. In such cases the recorder pen will be caused to indicate a broad band of vibrating lines, rather than a single trace. When this condition exists accurate metering is not possible without considerable attention being given to the manner of analyzing the chart. There have been many discussions of this problem and much disagreement exists, even at the present time, as to the proper correction to be made to meters operating under these conditions.

Many measurements have been made in compressor plants operating in the field. These have resulted in a collection of data which reveal the nature of pulsations to be expected from various types of compressors, as well as the effects which are produced by different types of piping and other equipment which may be associated with the compressor. Data have also been secured from relatively small commercial compressors operating under laboratory conditions which allow a further study of pulsation phenomena. It is now possible practically to eliminate pulsations in piping systems by applying pulsation dampeners which have been developed for this specific purpose. Since this equipment usually reduces the peak-to-peak pulse pressure to a point where less than 10 per cent of the original pulse remains, it is possible to show the effects produced upon a piping system when the pulsation phenomena are substantially removed.

Although it is not the purpose of this paper to discuss the details of the design of pulsation dampeners which may be used for the service indicated above, it may be of some interest to outline briefly the manner in which these devices operate. A dampener of this type is a device constructed of piping usually somewhat larger than the line in which the dampener is inserted. Generally speaking, the dampener proper is included between two flanges in the form of a spool which is located in the lateral, which can be either the discharge or suction piping to the compressor cylinder. This unit includes a filtering device consisting of suitably proportioned inertance and capacitance passages which serve to smooth the pulsations by a process analogous to phase shifting. Such an apparatus requires no moving parts and hence may have a construction based entirely upon welded units. Because the operation is contingent upon a phase shifting process, it is possible to minimize any pressure loss which results from the insertion of this equipment in a pipe line. At the same time, a high degree of reduction of pulse amplitude can be achieved; for example, amplitude reductions of greater than 90 per cent are quite possible, with pressure drops of less than ½ of 1 per cent of the static pressure of the gas being transported in the line.

*Arnold, M. L. Vibration in Compressor Plant Piping. California Oil World, First issue, December, 1944.

NATURE OF PULSATIONS

When attempts are made to analyze the conditions which exist in pulsating systems of the type found in installations under discussion here, it is seen immediately that the problem is extremely complex. Compressor systems, which usually consist of several units, ordinarily discharge gas into pipelines in such a manner that pulsations of very complex wave forms are developed. The complexity of these waves indicates that a great many frequencies are present and hence the pulsating gas has a pressure variation which is the resultant of all these frequencies. These waves are primarily the result of the pulse produced by the stroke of the compressor cylinder, which is in turn modified by the action of the intake or discharge valve. It is found that the "fundamental" pulse repetition rate is determined by the speed of the compressor. However, in most cases, the wave form is shaped by the action of the valve, and is partially modified by the characteristics of the piping system downstream of the valve. Some compressors operate at such speeds that the fundamental discharge frequency may be less than 3 cycles/sec. The more modern high-speed double-acting cylinders found in present-day compressors may exhibit fundamental frequencies in the vicinity of 10 cycles/sec.

Because of the wide variety of frequencies higher than this fundamental which may be present in the complex wave, it is always likely that some portion of a plant downstream from the compressors will have such dimensions that it may be in resonance with at least one of the frequencies present in the pressure wave. In such a case this particular portion of the plant will be excited readily by the pulsating flow and will be maintained in a state of vibration which may involve considerable amounts of energy. It is to be noted that any particular pipeline or piece of equipment may have two possible media in which vibratory motion may be set up. The gas within the system may carry a pulsating wave whose wave length is determined by the speed of sound in the gas. Similarly the metal shell of the line or vessel may carry a vibratory wave of the same frequency but having a wave length considerably shorter because of the greater speed of sound in metal. The ratio of the speed of sound in steel to that of hydrocarbon gases at relatively high pressures is approximately 10 to 1. Hence, it may be seen that for the average type of construction used in compressor plants, there is a relatively great possibility that structural features will be such that a large number of portions of the plant will be excited by different frequencies in the pulsating wave. Therefore, the plant as a whole may exhibit a large number of vibrations of different frequencies throughout its various portions. When such conditions exist, a plant may be considered as a very complex mechanical oscillator which is being excited by the pulsating energy being emitted by the compressors.

A very important phenomenon associated with pulsating flow arises from the appearance of beat frequencies in the system. These beats result from the combining of waves from two or more compressors with the production of relatively long wave length beats. These are usually evident in headers and those portions of the plant beyond the point where the discharge streams of several compressors are combined. These beats are probably primarily responsible for the very pronounced vibrations of large amplitude which occur in lines of considerable length. They may also be the source of excitation for vessels of large dimensions.

FIELD DATA

Fig. 4a shows the pressure-time charts secured at a point immediately downstream of the cylinder in the discharge piping of a common type of compressor, the Cooper-Bessemer Type 19. Fig 4b is the same type of chart for transfer header which receives gas from six compressors. All of these records were made while the plant was operating under normal conditions with a suction pressure of approximately 275 lb/in.^{2} gauge and a transfer header pressure of 480 lb/in.^{2} gauge at a compressor speed of 172 rev/min. It is to be noted that both the suction and discharge systems immediately adjacent to the cylinder show pressure-time curves which are very smooth, and almost approach a sine wave in form. This is found to be more or less typical of low-speed compressors operating at pressures less than 700 lb. However, in both the suction and transfer headers the wave form becomes much more complex and shows evidence of higher frequencies having been superimposed

Figure 3. Pulsation dampener installation on 1500 and 3700 lb/in.^{2} discharge laterals feeding into header system.

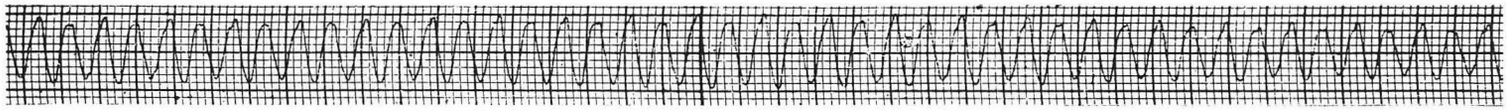


Figure 4a. Pressure-time curve for discharge piping immediately downstream of cylinder.

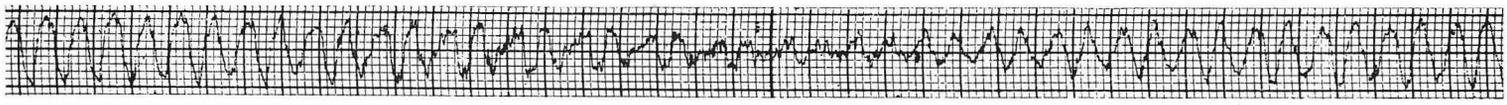


Figure 4b. Curve for discharge header connecting six compressors.

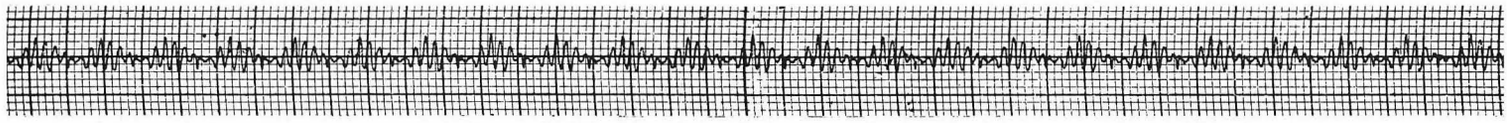


Figure 5a. Pressure-time curve for same point as Fig. 4a after installation of pulsation dampeners.

Figure 5b. Curve secured from discharge header at same point as Fig. 4b after installation of dampeners.

upon the original wave from a single compressor. Fig. 4b shows marked evidence of the presence of a beat frequency which occurs with a period of about 7 seconds. The charts shown here should be used for purposes of wave form comparisons only. Since they are not taken with the same amplification factor in the recording apparatus, they are not comparable with respect to amplitude. This compressor plant did not show evidence of serious vibration phenomena. However, because of the marked pressure changes taking place in the piping, it was desirable to eliminate the pulsations as much as possible for other reasons, such as saving horsepower in the compressors themselves. Therefore, pulsation dampeners were designed and installed in each compressor discharge lateral.

Fig 5a shows the pressure-time curve secured at the same point as the curve of Fig. 4a. Fig. 5b corresponds to Fig. 4a in that the curve was taken in the transfer header after the installation of dampeners on all six compressors in the plant. A comparison of Figs. 4b and 5b reveals that the peak-to-peak pressure in the header was reduced from 17 lb/in.^{2} to 1.0 lb/in.^{2} when the pulsations were removed from the system. It was not possible to make measurements in this plant at a point immediately downstream of the dampeners in the discharge laterals; hence, no comparison may be made of the reduction of pressure pulsation at this point. However, an investigation of Figs. 4a and 5a indicates a peak-to-peak pressure reduction from 97 to 28 lb/in.^{2} at a point between the cylinder and the dampener. From other information which is available and from indications found in this plant it is to be expected that the peak-to-peak pulse pressure found downstream of the dampener would have a value of less than 10 lb/in.^{2}

It is of interest to note that pulsations in the discharge piping immediately downstream of the compressor were reduced, even though this point is above the entrance to the dampener. As has been mentioned above, pressure pulsations at this point may be reflected in the pressure developed within the cylinder itself, and hence may contribute to inefficiency in compression. On the cylinder involved in Figs. 4 and 5, indicator card data showed a reduction of horsepower loss from 10.3 to 2.5 per cent at the head end and from 12.4 to 5.8 per cent at the crank end.

Although vibration problems were not of great significance in this plant, it was found that the acceleration on the suction pipeline immediately adjacent to the cylinder was reduced from 115 in./sec^2 to 12 in./sec^2 when the pulsations were reduced as indicated above.

Another type of compressor which may be considered typical of those found on gas transmission lines is the Cooper-Bessemer Type GMV. The following data were secured from a 1000 hp unit of this type operating with three double-acting single stage cylinders. The speed of the unit was 300 rev/min with a suction header pressure of 322 lb/in.^{2} gauge and a discharge header pressure of 773 lb/in.^{2} gauge. Fig. 6a is a pressure-time curve taken in the discharge piping immediately downstream of a single compressor. In this case three cylinders discharge into each lateral. The maximum peak-to-peak pressure was measured at 77 lb/in.^{2} Fig. 6b is a similar chart recorded in the discharge header which receives gas from 15 identical units. At this point, the peak-to-peak pulsation pressure was 17 lb/in.^{2} The long period wave shown on this chart is not a characteristic of the pulsating flow but is caused by voltage variation in the measuring instrument. This plant was subject to severe vibration which induced stresses in the piping system sufficient to cause damage to anchors and clamps used on the piping system. Vibration measurements showed values of acceleration between 250 and 400 in./sec^2 at critical points where damage had occurred.

It has previously been mentioned that the combination of pulsations in a piping system may result in beats which are of considerable magnitude and which may contribute markedly to damage which is traceable to pulsating flow. One of the most outstanding cases

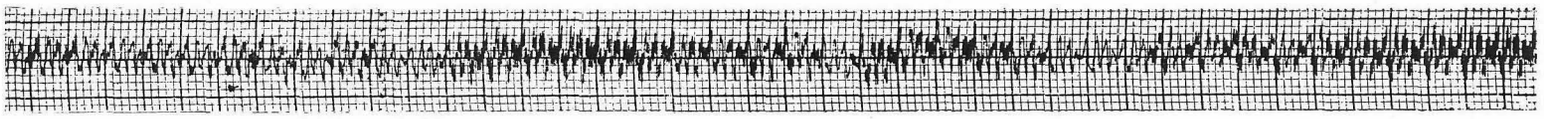


Figure 6a. Pressure-time curve taken in discharge lateral of a single compressor.

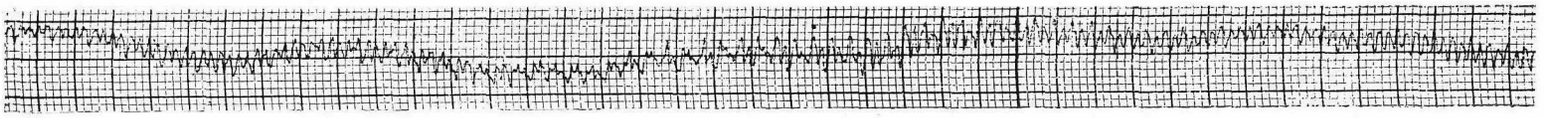


Figure 6b. Curve for discharge header receiving gas from 15 compressors.

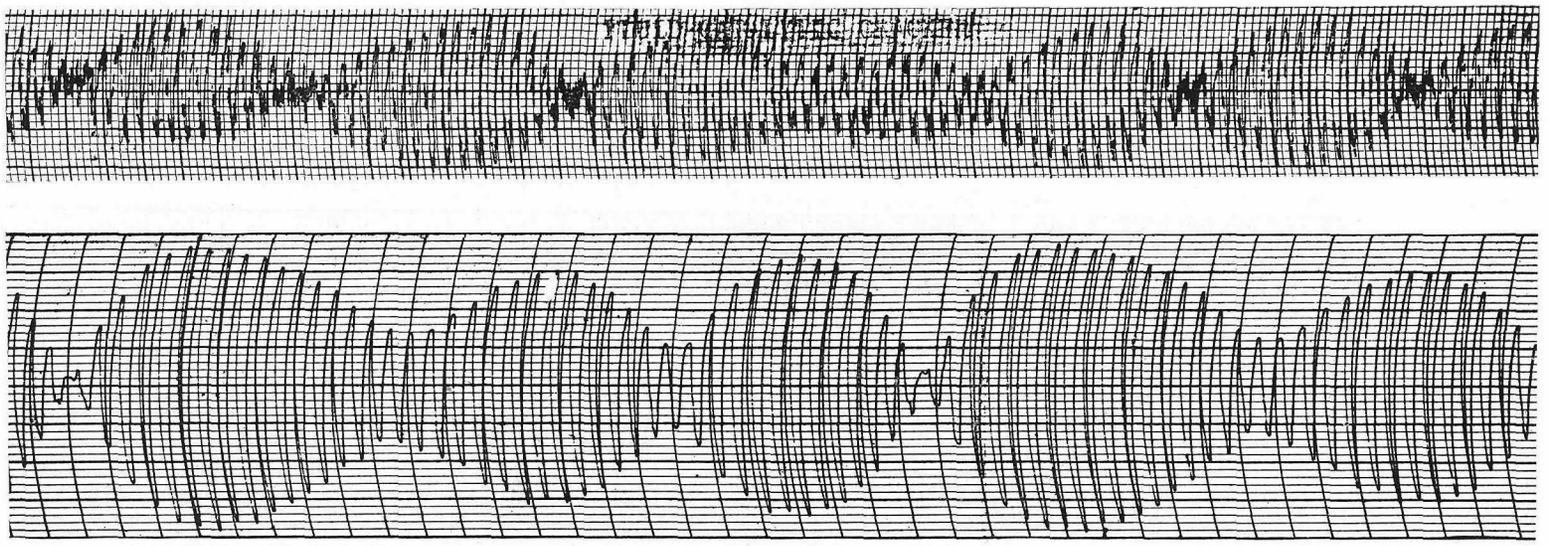


Figure 7. Pressure-time curves showing extreme conditions of beats encountered in suction systems of typical compressor installations.

of beats which has been measured to date is shown in Fig. 7. The top chart was recorded at the suction of a Clark RA-8 two-stage double-acting compressor. The measurement was made in the suction "bottle" of the second stage. The suction pressure of this unit was 42 lb/in.^{2} gauge and the maximum peak-to-peak pulse pressure was 8.5 lb/in.^{2} At this time the operating speed was 325 rev/min. It is to be noted that these beats have a period of approximately 1.25 seconds. The vibratory motion of the piping system at this point was severe enough to cause fracture of welded joints. Acceleration measurements made at this point gave values of 450 in./sec^2. Since the equipment included in this area is quite massive, it is believed that the presence of relatively long period beats was primarily responsible for the high stresses which were evident.

One of the most interesting investigations made concerned itself with measurements on a piping system in a plant where pulsation dampeners were in-

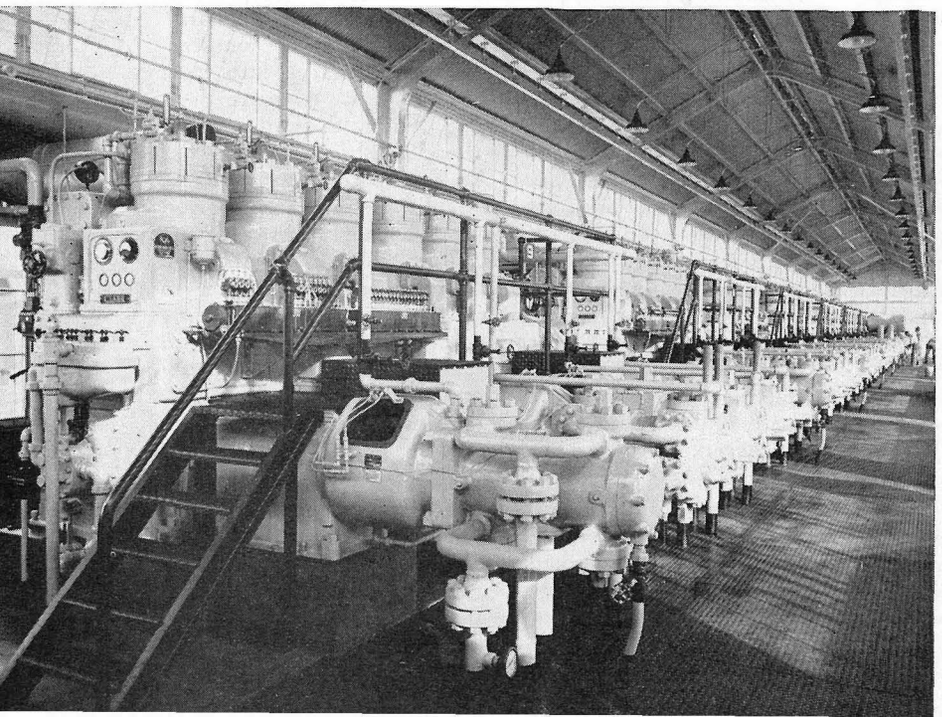
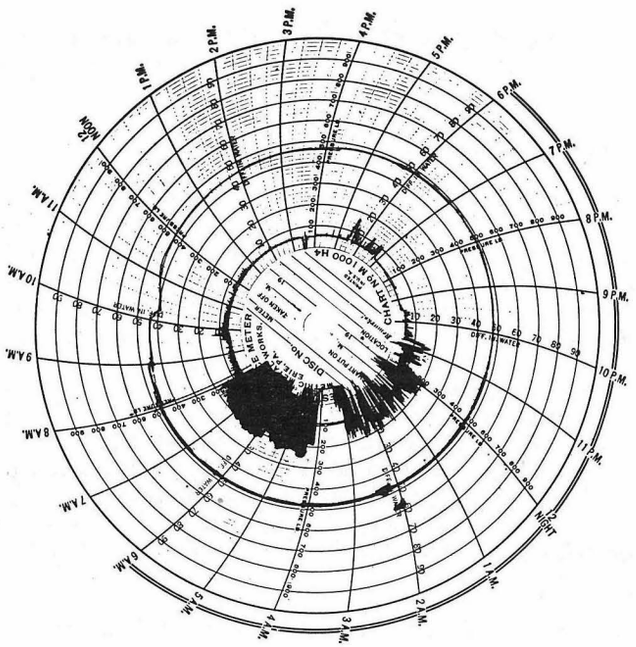
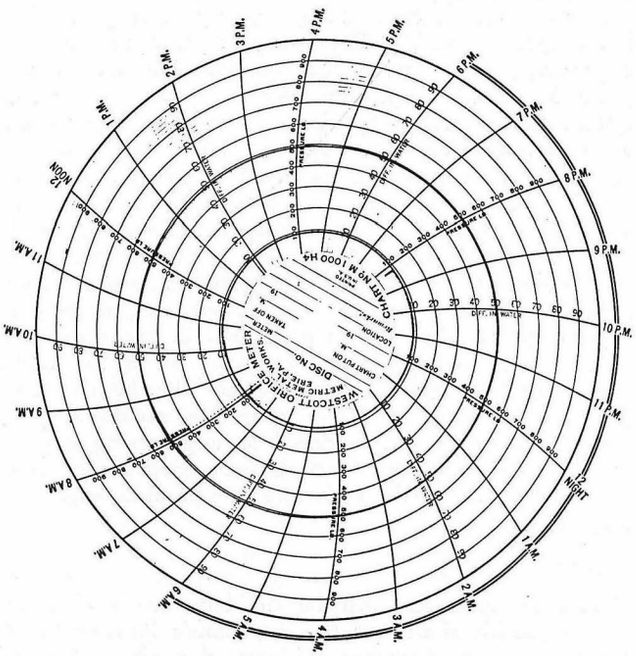


Figure 8. Recent installation of nine high-speed angle type compressors.

Figure 9. (Upper) Orifice meter chart from instrument located on the discharge side of gas compressor.
Figure 10. (Lower) Chart taken from same meter as that shown in Fig. 9 with dampener in system.





cluded in the original design. These dampeners were installed at the time the plant was constructed, and hence no data could be secured under conditions where dampeners were not in the system. This plant was equipped with nine 600 hp Clark Type RA-6 units (See Figs. 1 and 8). Two of the services being handled by these units were equipped with dampeners. The high-pressure service delivered gas into the header at 3620 lb/in.² gauge. The speed of the compressor for which data are presented here was 302 rev/min. The peak-to-peak pulse pressure was 127 lb/in.² at a point immediately downstream of the pulsation dampener a pulse pressure of 29 lb/in.² was measured. Measurements made in the discharge header gave a pulse pressure calculated to be 15 lb/in.² Although the discharge pressure of this system is quite high and the pulse pressures immediately below the cylinder are greater than those indicated above, it was found that the vibration measurements reveal very low values of acceleration throughout the entire piping system. Acceleration readings of a magnitude of 6 to 70 in./sec² were found in the system below the dampeners.

It has previously been indicated that pressure pulsations may have a very adverse effect upon orifice meter recorders. An outstanding example of the effect produced is shown in Fig. 9, which is a reproduction of a meter chart taken from an instrument on the discharge side of a commercial compressor system. When one of the compressors was started, the wide band of vibrating lines was recorded by the meter. After the installation of a pulsation dampener in this system, the recorder pen was no longer subjected to this pulsating condition and charts such as that shown in Fig. 10 were produced.

All of the pressure-time charts shown above are run with a horizontal speed of 25 mm/sec. The vertical or pressure deflections are not comparable within the series of charts presented here, since the amplification used was different in the several cases shown. However, since actual peak-to-peak pulse pressures are mentioned for each case, it is possible to arrive at a comparison of the data shown in the charts. The recordings shown here were made with a group of special instruments which have been developed particularly for the purpose of measuring pressure pulsation phenomena in piping and other equipment. This equipment has been especially designed to be responsive with good fidelity down to frequencies as low as 1 cycle/sec. Recordings are made with practically uniform response up to 120 cycles/sec.

The examples used in the above discussion were selected from many which have been encountered in making measurements in the field. They were purposely selected to illustrate the four effects of pulsation phenomena indicated in the beginning of this paper. The data have been drawn from measurements made on certain types of compressors. This does not imply that only these types produce pulsation phenomena in their associated piping systems. It has been found that all compressors produce some type of compressor may be found to give results of both systems. From the smallest units used in the laboratory, **e.g.,** ½ hp refrigeration compressors, up to the 1000 hp units discussed above, it has been found that pulsations are a common characteristic of all systems. In some systems the pulse pressure is so small as to be insignificant, while in others it is of extreme severity, and hence is of importance as a destructive factor in the system. The same type of compressor may be found to give results of both extremes, depending upon the piping system and other equipment associated with the unit.

Registration of Engineers in California

(Continued from page 5)

branches of chemical, electrical, mechanical, and petroleum engineering.

REGISTRATION OF PROFESSIONAL ENGINEERS

The touchstone of registration under the Act is the ability to use the title "Professional Engineer." A "Professional Engineer" is defined as a person engaged in the professional practice of rendering service requiring education, training, and experience in engineering sciences, and the application of special knowledge of the mathematical, physical, and engineering sciences. All civil engineers registered under the old Act may use the title "Professional Engineer" automatically. Engineers in the chemical, electrical, mechanical, and petroleum engineering branches may use the title "Professional Engineer" and, according to registration with the board, the titles "Structural Engineer," "Chemical Engineer," "Electrical Engineer," "Mechanical Engineer," "Petroleum Engineer," or "Engineer in Training" only upon registration.

In order to receive a certificate of registration as a Professional Engineer in any of the foregoing branches, the applicant must furnish satisfactory evidence of good moral character, pay the application fee of $15, furnish evidence of six years or more of experience, and pass a written examination. Until June 30, 1948, a person who complies with these qualifications will be issued a certificate of registration without taking an examination.* Graduation from a reputable school of engineering approved by the board is considered the equivalent of four years of required experience. Satisfactory completion of each year at such an approved school of engineering without graduation is considered equivalent to one-half year of such experience. The board may at its discretion give credit as experience, not in excess of one year, for special post-graduate work in a reputable school of engineering approved by the board. Engineering teaching, if of a character satisfactory to the board, shall be considered as engineering experience. Engineering experience in the armed forces shall be given equal credit with any comparable engineering experience.

EXAMINATIONS

The examinations will be divided into two parts, one of which shall test the applicant's knowledge of fundamental engineering subjects, the other the applicant's ability to apply his knowledge and experience. An applicant may request that he take the prescribed examination in two stages. The first stage may be taken at any time after the applicant has completed four years of the required engineering experience, as defined above, upon submission of an application for certification as an engineer-in-training and the payment of a $5 fee. The second stage may be taken after completion of the six years of engineering experience, as defined above, upon the payment of the $15 application fee. Those persons who shall have graduated on or before June 30, 1948, from an approved engineering curriculum of four years or more shall be entitled upon payment of a $5 application fee to a certificate of registration as an engineer - in - training without having to take a further examination. Thereafter, upon completion of the required six years of engineering experience, as above defined, he will be required to take the second stage of the examination.

The foregoing represents a thumbnail summary of the principal provisions of Assembly Bill No. 1930. For further details reference made be made to Chapter 7 of Division 3 of the Business and Professions Code of the State of California, as amended.

GENERAL OBSERVATIONS

By reason of the peculiar legislative history of Assembly Bill No. 1930 (the requirement laid down by the civil engineers that the new bill be an amendment to the old Act), certain irregularities and inconsistencies exist between the civil engineering group on the one hand and the other branches of engineering covered by the Act on the other. For example, the old Act (still in effect upon this point) makes it illegal to use the title "Civil Engineer" unless registered, under penalty of a $500 fine and three months in jail. On the other hand, the punitive provisions of the amendment, insofar as it deals with other than civil engineers, merely states that use of an improper title is unlawful and stipulates no punishment for the offense. The lobbying history of the bill likewise produced some odd results. Thus, while mining engineers were covered by the original bill and by all but the last amendment thereto, the last amendment deleted reference to mining engineering and to substituted therefor the term "Petroleum Engineer." It would thus appear from this legislative history that mining engineers are not covered by the Act. Another illustration of applied lobbying technique is the specific exclusion from the purview of the act of employees in the communication industry and of employees of contractors while engaged in work on communication equipment.

On the whole, however, the legislation which has been discussed above represents a creditable advance towards the regulation of a profession definitely "affected with the public interest." Engineers now take their place along with accountants, attorneys, contractors, architects, and land surveyors as members of a regulated profession. Engineers throughout California hail this step as a progressive move toward the establishment of needed minimum professional standards and toward the protection of the public from the activities of unqualified persons.

It has been suggested that there is room for further development. The present law could be made mandatory; and, were agreement forthcoming, all registered engineers could be known by the title of "Professional Engineer" without emphasis upon the particular specialty. Such changes would make for uniformity among all engineers and in the long run provide the type of prestige which, for example, the Certified Public Accountant enjoys over the uncertified accountant. These improvements are for the future, however, and California may well be proud of at least its present accomplishment.*

*Registration may be made at the branch office of the State Board of Registration, 907 State Building, Los Angeles, whose telephone is MAdison 1271. The main office is at 529 Business and Professions Building, Sacramento. No forms are available for registration, but they are expected not later than the first of next year. Due publicity will be given out by the Board of Registration to accredited professional societies well in advance of this date.

*Due credit is given to Mr. W. L. Chadwick, manager of the Engineering Department, Southern California Edison Company, for assistance in the preparation of this article. Mr. Chadwick, as president of the Los Angeles Engineers' Council, was heavily responsible for the enactment of the present law.

Letters to the Editor

I HAVE BEEN very impressed with the high caliber of the Engineering & Science Monthly, particularly as exemplified by two recent articles which caught my eye, one by Mr. Puckett on supersonics and the last by Mr. Anderson of General Motors who wrote a very revealing article on industrial relations. I merely want to tell you that I think you are doing a bang-up job in producing an outstanding magazine which has already proven of distinct value to members of my staff for the information contained on a wide variety of subjects.

Very truly yours,

Robert M. Stanley '35

Chief Engineer
BELL AIRCRAFT CORPORATION

I WAS VERY unhappy with your budget percentage expenses for 1946-47. It seems to me that the amount spent on Alumni Magazine could be certainly cut, and the amounts for administration put to some use in furthering the employment facilities or helping the student body.

I may be speaking alone, but except for my time in the service, when anything from the past was a great pleasure to read, I could do with less of the "slick" in the Alumni Magazine, and have more news. I think that we should not try to "sell" the magazine by its looks, but rather give a little of what our classmates are doing.

Yours truly,
John Small '41

The subject of proper allocation of funds to ENGINEERING AND SCIENCE has consumed many hours of debate in meetings of the Board of Directors. How many alumni prefer that a small news-letter be substituted for ENGINEERING AND SCIENCE MONTHLY?

How many news-items of classmates has member Small submitted? —Ed.

C. I. T. NEWS

PAULING TO TEACH AT CAMBRIDGE

PROFESSOR Linus Pauling, Division of Chemistry and Chemical Engineering chairman, who returned in August from England where he received honorary doctor of science degrees from Cambridge University and the University of London, will return next December as Eastman Professor at Oxford University.

The Eastman professorship is awarded periodically to outstanding American scholars and scientists and has previously been held by such men as Supreme Court Justice Felix Frankfurter and the late Simon Flexner, then director of the Rockefeller Institute for Medical Research.

Dr. Pauling will lecture in the field of chemistry at Oxford from January to June, covering the second and third terms at that school and will return to CalTech upon completion of his work in England. In addition to receiving the two honorary degrees on his recent visit to England, he was inducted as an honorary member of the Chemical Society of London and gave an address at the International Congress of Pure and Applied Chemistry, of which he was president of the section on physical chemistry. He was also made an honorary member of the Royal Institution of Great Britain and of the London Athenaeum.

BIOLOGY GETS $10,000 GRANT

AN ANNUAL grant of $10,000, renewable each year for a period of five years, has been made to the Division of Biology by the Herman Frasch Foundation. This money will be used for basic research work in the development and application of methods of enzyme and protein chemistry in the study of plant growth and development.

The grant will enable the Institute to carry on further research in a field in which it has done notable work for the past 16 years. It was such research in this field, under the leadership of Professors F. W. Went, A. J. Haagen-Smit and James Bonner, that was basic to the recent remarkable advances in practical applications of specific chemicals to the control of plant growth and behavior. The present extensive use of hormones in the control of rooting cuttings, regulating flowering, inducing fruit setting and in differential killing of undesirable species of plants (weed killers) is one result of basic research work by CalTech plat physiologists in the past.

The Frasch Foundation grant will enable the Division of Biology to search for new hormones which function in plants and the possibility of their application from the outside as means of further control of plant growth. It is proposed to undertake the separation, isolation and study of particular enzyme systems of higher plants, especially those which appear to have the greatest interest in relation to plant growth.

STERLING IS TEACHING AT WAR COLLEGE

DR. J. E. WALLACE STERLING, of the California Institute, has joined the resident faculty of the National War College at Washington, D. C., for the autumn semester.

Dr. Sterling is one of four or five civilian members of the resident faculty whom the government has selected from nationally known instructors in international affairs.

Prior to going to Washington, Dr. Sterling spent two weeks at Dartmouth College attending a seminar on problems of U. S. foreign policy which was organized by The Brookings Institution.

The National War College, which was established last year, will give some 110 carefully chosen students an intensive course on international politics, economics and security. Ten or 12 of these students are from foreign service and the others highly qualified and experienced Army and Navy personnel.

Except for the year 1939-40, when he did research in Canada as a Rockefeller Fellow, Dr. Sterling has been at CalTech since 1937. He came to the Institute from Stanford University where he was a member of the research staff of the Hoover War Library.

BENO GUTENBERG INSPECTS JAPANESE GEOPHYSICAL ORGANIZATION

DR. BENO GUTENBERG, professor of geophysics at the Institute, returned to Washington, D. C., via Guam folowing a four day inspection and observation tour of Japanese seismological organizations.

While in Tokyo, Dr. Gutenberg conferred with Supreme Command for the Allied Powers and 43rd Weather Wing officials, and inspected the Central Meteorological Observatory and the Earthquake Research Institute.

He declared that the Japanese research organizations inspected were comparable to any in the world today, and, that while no basic discoveries were made during the war, the developments of their continuing research program are being made available to world seismologists through the medium of the 43rd Weather Wing.

Dr. Gutenberg has been professor of geophysics since 1938, and has done extensive research for the armed forces as a member of the National Research Council. Among his many scientific accomplishments is the first exact determination of the radius of the earth's surface.

NEW FACULTY SALARY PLAN INAUGURATED

A NEW FACULTY salary plan based on twelve instead of nine months appointments and providing for substantial salary increases was put into effect July 1 by the California Institute of Technology Board of Trustees. The new plan will provide a month's vacation annually, and for granting of leaves of absence with or without pay, depending on the type of work to be done by faculty members during such periods of leave.

Although some faculty members were already on a twelve month basis, this has not been general practice at the Institute. It is felt that changing to this plan will be beneficial to both the faculty and CalTech, and the increased annual salaries will aid in keeping Tech's excellent faculty and in obtaining top men in science, engineering, and the humanities in the future.

The new year-round appointment plan will enable faculty members to do research, study, preparation of course material, teaching, student supervision and administration work during the summer months both on and off the campus. Although the Institute does not plan to re-establish summer sessions, there may be times when refresher courses or graduate seminars will be desirable during the summer months.

Vacations will be encouraged whether faculty members remain at CalTech during the summer or go elsewhere on leave.

BIOLOGY'S STURTEVANT RECEIVES PRINCETON DEGREE

DR. ALFRED H. STURTEVANT, professor of genetics at CalTech, received an honorary degree of Doctor of Science from Princeton University this June.

An eminent theorist, biologist, and field naturalist, his researches on genes and chromosomes have laid the foundation upon which much of modern science of genetics is built today, and it was for this outstanding work that Princeton honored him.

He was one of eight scientists, including Walter S. Adams, astronomer and director emeritus of the Mount Wilson Observatory, to receive this honorary degree from Princeton.

NEW GRANT FOR ELECTRICAL CALCULATOR

A $5,000 FREDERICK Gardner Cottrell grant from the Research Corporation of New York for "Research on Fundamental Methods of Computing by Electrical Circuits," was recently received by the Institute. These funds will be used for basic research on large scale calculators such as CalTech's new Electric Analog computer now nearing completion. Much of this work will be devoted to developing new techniques as related to such computers.

Weighing approximately 33,000 pounds, the completed machine will occupy some 1,000 square feet of the new analysis laboratory which is being built at a cost of approximately $100,000. The laboratory is under the direction of Dr. Gilbert D. McCann, professor of electrical engineering, who is supervising construction of the Calculator.

PLANT PHYSIOLOGIST WENT HEADS SOCIETY

ELECTED PRESIDENT of the American Society of Plant Physiologists for 1948 is Dr. Frits W. Went, worker with plant hormones, at the Institute. Professor Went is credited with being the first to advance that phase of plant physiology so that it could be dealt with experimentally. His discoveries in the use of plant hormones for rooting cuttings and in inducing fruit to set have led to wide commercial application by growers. He is currently doing extensive work with plants under controlled conditions in CalTech's unique air-conditioned plant physiology laboratory and green house.

GRAY OF INDUSTRIAL RELATIONS HEADS SURVEY

UNDER THE guidance of an advisory committee representing leading industrial organizations and California commerce and business groups in this area, the Industrial Relations Section launched a comprehensive survey of personnel practices in Southern California in August.

The survey is designed to obtain comprehensive information as to work schedules, premium incentive and holiday pay, shift differentials as well as union representation. The questionnaire was sent to 1200 Southern California industries, covering piece-rate and other incentive work on one hand and salaried workers on the other hand.

Copies of the final tabulations will be made available to all companies participating as soon as such tabulations have been completed. Copies of the final report will not be made generally available to others until four months after participating companies have received their reports.

NOYES PROFESSORSHIP GIVEN TO CORNELL CHEMIST

THE APPOINTMENT of Dr. John Kirkwood, professor of chemistry at Cornell University, to the Arthur Amos Noyes Professorship of Chemistry at the California Institute of Technology has been announced by President Lee A. DuBridge.

Dr. Kirkwood is the first to be appointed to this professorship which was recently created by the Board of Trustees in honor of Dr. Noyes, first chairman of the CalTech division of chemistry.

An outstanding theoretical chemist, Dr. Kirkwood obtained his Bachelor of Science degree from Chicago University in 1926 and his doctorate from Massachusetts Institute of Technology in 1929. He also spent two years as a student at CalTech. A National Research Fellow in 1929-30 and research associate in Physical Chemistry in 1930-31, he later studied at Leipzig and Munich in 1931-32 as an International Research Fellow. From 1932 to 1935 he was a research associate at M.I.T. and in 1934 was appointed assistant professor of Chemistry as Cornell. In 1937 he became associate professor of Chemistry at Chicago University and in 1938 returned to Cornell as a full professor.

He received the International Academy Chemical Society Award in 1936, was associate editor of the Journal of Chemical Physics in 1941 and is chairman of the Division of Physical and Inorganic Chemistry of the Chemical Society.

He will come to Pasadena this fall to assume the Noyes Professorship.

HUMANITIES ADDS TWO

NEW MEMBERS of the California Institute of Technology Humanities Division faculty this year are history professors Dr. Henry McCreery and Dr. Rodman Paul. Dr. McCreery, who joined the faculty as assistant professor of history, comes here from Stanford where he obtained his doctorate degree and was a Rockefeller Fellow. He is a graduate of Princeton University and was on the staff of Robert College in Turkey. He also studied in Munich and Paris.

Dr. Paul, who is here as associate professor of history, has been an instructor in history at Yale for the past year. A graduate of Harvard, where he also obtained his doctorate, he was an instructor and tutor at that school from 1938 to 1940. In 1940-41 he had a Sheldon Traveling Fellowship from Harvard. He was also assistant dean of Harvard College in 1937-38 and 1942-43. From 1943 to 1946 he served with the U. S. Navy.

Dr. Paul's special field is American history, particularly California history and he has just published a book "California Gold" dealing with that subject.

"STATURE OF A MAN" McKINNEY CONTEST SUBJECT

CHARLES SUSSKIND and Alfred E. Waters, both juniors at Tech, won first and second prize respectively, in the McKinney Prize Contest in English, an annual event at CalTech established last year by Dr. Samuel P. McKinney of Los Angeles to cultivate proficiency in English.

First prize consisted of $75 and a copy of Webster's Biographical Dictionary; second prize $50 and a copy of **Bartlett's Familiar Quotations.** Prizes were awarded on the composition and reading of an original essay under the general title of "The Stature of a Man" based on the reading of 4 novels, Lewis' **Arrowsmith,** Santayana's **The Last Puritan,** Wells' **Research Magnificent** and Maugham's **Of Human Bondage.**

The contest was held under the supervision of Professor C. K. Judy, Chairman of the Division of Humanities.

PROFESSOR OF MATH PHYSICS NAMED

DR. H. P. ROBERTSON, nationally known mathematical physicist who since 1928 has been on the faculty of Princeton University, became a member of the Institute faculty as professor of mathematical physics July 1. In his capacity of professor of mathematical physics, Dr. Robertson will also have an opportunity to continue his interest in astrophysics and theoretical astronomy in which he has done a great deal of original research. He will add new strength to the CalTech astrophysics department which in addition to supervising the construction and installation of the huge 200-inch Palomar Mountain telescope will, in conjunction with the Carnegie Institution in Washington, operate both it and the Mt. Wilson Observatory. The Palomar telescope is expected to be in operation early in 1948.

Dr. Robertson is no newcomer to the Institute. He obtained his doctorate here in 1925 and was an assistant professor at the Institute prior to going to Princeton in 1928. As a National Research Fellow he studied at Gottingen, Munich, and Princeton. He obtained his bachelor of science and master degrees at the University of Washington.

A member of the Office of Scientific Research and Development and the National Defense Research Committee, he also served in Europe during the war in Scientific Intelligence with the U. S. Army.

ALUMNI NEWS

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The San Francisco Chapter meets weekly for lunch at the Fraternity Club, 345 Bush Street, on Mondays.

TOM SIMPSON '25 NEW SOCONY-VACUUM RESEARCH DIRECTOR

THOMAS P. SIMPSON, 1925 chemical engineering graduate, was named director of research for the Research and Development Department of the Paulsboro, N. J., works of the Socony-Vacuum Oil Company in June. This Department is the central research unit for Socony-Vacuum. The staff comprises 850 scientists and technicians, and is one of the largest industrial research units in the country. Research is carried on in many fields, varying from nuclear physics and organic chemistry to the production of heavy duty lubricants and motor fuels.

A few of the notable recent developments originating in the Paulsboro laboratories include the Thermofor Catalytic Cracking Process, which played a vital part in the manufacture of high octane gasoline for the armed services during the war; the Bead Cracking Catalyst, improved alkylation methods for producing super fuel ingredients; and processes for converting natural gas into chemical raw materials and liquid fuels.

Simpson has been with Socony-Vacuum since 1935. Recently he has served as assistant director in charge of development, and earlier as chief development engineer. Starting with the General Petroleum Corporation of California, now a Socony-Vacuum subsidiary, he worked in the Process Laboratory, becoming assistant manager in 1933. Two years later he was transferred east to Paulsboro.

DAVID WONG '32 WINS REDLANDS ALUMNI AWARD

DAVID Y. WONG '32, M.S. in C.E. '33, was awarded an annual Alumni Achievement Award in April by the University of Redlands where he received the B.A. degree in 1931. While taking work at the Institute, Mr. Wong worked with the Los Angeles County as a highway inspector. After completing his college work, he became building inspector for the city of Canton, China. With the outbreak of war he became active in construction of bridges on the Burma Road. After the Road's capture by the Japanese, his work turned to the second communication road, the Ledo Road. Mr. Wong worked for many months on railroad survey and construction. His final contribution was in airfield construction with his report serving as a model for all Chinese engineers.

METEOROLOGY GRAD HEADS 15TH AIR FORCE

BRIG. GEN. Leon W. Johnson '36, recently given command of the 15th Air Force, is one of the few Army Generals to have received the Congressional Medal of Honor. A 1926 graduate of the United States Military Academy, Gen. Johnson transferred to the Air Forces after three years in the Infantry. During the pre-war period he received an M.S. degree in meteorology at the Institute.

For his extraordinary heroism in the low-level bombing attack on the Ploesti oil fields in Rumania from bases in Africa in 1943, Gen. Johnson added the Medal of Honor to his list of decorations which included the Silver Star for gallantry and the Air Medal for exceptional wartime flying service.

Soon after Pearl Harbor, Gen. Johnson helped to organize the Eighth Air Force, and upon its arrival in England, he served as commanding officer of a bombardment group, later as operations officer for the entire Eighth Air Force, and finally as commanding general of a heavy bombardment wing.

CHARLES KIRCHER '31 HEADS ROSE POLY DEPARTMENT

DR. CHARLES Edward Kircher Jr. '31 has been appointed professor of chemical engineering at Rose Polytechnic Institute. Chemistry and Chemical Engineering are being separated at Rose, and Dr. Kircher will head a new Department of Chemical Engineering.

Recognized as an authority on the production of plutonium, an essential element in atomic energy research, Dr. Kircher directed a group of research workers at the University of Chicago on the problem of plutonium production during the war.

The 1948 ALUMNI DIRECTORY is being organized, and the Association hopes to have it printed by the first of the year.

Will all delinquent alumni mail their questionnaires in to the Alumni Office immediately.

ENGINEERING AND SCIENCE WINS ALUMNI MAGAZINE AWARD

In the Magazine Awards Competition of the American Alumni Council, of which the CalTech Association is a member, *Engineering and Science*, in competition with technical and professional schools throughout the country, won the award here reproduced "—for general excellence of series of articles, running throughout the publication year, interpreting various phases of modern technical education and reporting significant research activities of the school together with appropriate illustrations".

For Outstanding Editorial Achievement
In publication of an alumni magazine

AWARD OF MERIT

In the 1947 Magazine Awards Competition sponsored by the American Alumni Council for alumni publications in the United States and Canada

William S. Gibson
Director for Magazines

Joseph L. Bell
President, American Alumni Council

Following receipt of the B.S. degree, Kircher took graduate work, being awarded the M.S. in chemical engineering in 1933. From 1933 to 1936 he was employed by the Du Pont Company in El Monte, Calif., and Niagara Falls, N. Y. From 1936 to 1938 he was stationed at Iowa State College, Ames, on research for the company in cooperation with the college. A pilot plant for the extraction of soybean oil was designed, erected and operated. In 1939-40 he was granted leave of absence by Du Pont to complete work for his Ph.D. in chemical engineering at Iowa. From 1940 to 1943 Dr. Kircher was with Du Pont at Niagara Falls.

1936 CLASS SECRETARY RETURNS FROM YEAR'S TRAVEL

HOLLY B. DICKINSON '36, wrote at the beginning of the summer after a year's travel:

Got a leave of absence from Lockheed last June and in September my wife and I left for 18,000 air-miles of traveling in Central and South America. Saw Mexico, Guatemala, Brazil, Uruguay, Argentina, Chile, Peru, Equador, and airports in between. Also Ted Coleman, class of '26, in Sao Paulo, Brazil. He's importing airplanes—Fairchilds, mostly, for Brazilians to supervise their fazendas from. He expected to return here about now, or by the end of this year. During the war he was V.P. of Northrop, you remember.

To condense four months of travel into a sentence, don't miss Guatemala, especially if you're a Kodachrome fan. If you must go to South America, go way south to the Argentine, Chilean Lake Country in the Andes. It's worth it. But first consult Dickinson's travel service and avoid some of the things I bumped my head into, from Rio taxi drivers to Guayaquil rioters.

On June 1, I am starting off in another direction. I begin as an apprentice in the office of Richard J. Neutra, Los Angeles architect.

PERSONALS

1922

HAROLD R. HARRIS, ex Air Forces general, has recently raised a loan of 12 million dollars to buy planes for American Overseas Airlines, of which he is vice-president and general manager.

1927

CHARLES A. BRADLEY, on vacation from the Corning Glass Works in New York, visited the Institute this summer. Back for the first time since graduation, he expressed surprise at the absence of an orange grove on the east end of the campus near the Athenaeum.

1931

ROBERT V. CAREY has taken a position with the Eng-Skell Company of Los Angeles doing design and sales of food-handling machinery and store equipment.

CHARLES K. LEWIS, M.S. '32 is with the Morrison-Knudsen Co., serving as office engineer in the construction of a 14 mile section of the large Friant-Kern Canal. Previously, he had been with the Glenn Martin Co. plant at Omaha, in an executive capacity.

1933

MERRILL BERKLEY is now operating the Berkley Engineering and Equipment Company, of which he is the sole owner. His firm, which employs two sales engineers, has expanded to two offices, one general and the other for sales, located downtown in Los Angeles and on Riverside Drive.

FRANCIS ROBERT HUNTER has been assistant professor of physiology at the University of Oklahoma since he was discharged from the Army Air Corps as as captain early in 1946. Francis and his wife, the former Margaret A. Kershaw, whom he married in 1937, have two sons, Robert A., eight, and William Bruce, five.

WYATT H. LEWIS participated as one of the clinical speakers at the First Annual Convention of the American Society for Quality Control, held at Hotel Sherman, Chicago, Ill., June 5 and 6. The title of his paper was "Re-establishing Operator Responsibility for Quality."

Mr. Lewis is Quality Control Engineer at the Ontario, Calif., work of the General Electric Company. He has three children, two boys and a girl.

HAROLD E. PEARSON transferred to Stanford in 1932, receiving his A.B. there in 1933 and his M.D. in 1938. From 1937 to 1939 he was instructor in bacteriology; in 1939 he was a fellow at the I.H.D. Rockefeller Foundation, Influenza Laboratory in Berkeley, followed by two years as S. S. Fellow at the Harvard School of Public Health, where he received the M.P.H. degree in 1941. Following this he was assistant professor of epidemiology at the University of Michigan School of Public Health. Harold is now medical microbiologist and assistant professor of bacteriology at U.S.C. Medical School. Married in 1938 to Miss Catherine R. Guerard, he now has four children: David Bruce, seven, Leslie Anne, five, John Stuart, four, and Gregory Anders, one.

1934

ROBERT D. BOCHE, Ph.D. '38, is now assistant professor of zoology at the Institute of Radiobology and Biophysics in Chicago. Prior to accepting this position he was head of the Radiology Division, Manhattan Department, University of Rochester. Bob married Miss Marjorie Stern of Baltimore in 1938. They have three children, Barbara, four, Kenneth, two, and Philip, five months.

WILLIS R. DONAHUE is foreman at the Burrel, Calif. Gasoline Plant of General Petroleum. Prior to this assignment, Willis was with General Petroleum in Taft, California. While at Taft he was engaged in the conservation of natural gas for the Company's use as fuel on its producing properties. Willis was then transferred to Fresno County to be the Company's representative to contractors in installing 30 miles of gas gathering pipe lines to collect wet gas from wells in the Helm and Riverdale oil fields. This gas is processed in the Burrel Gasoline Plant by absorbing and extracting liquified petroleum gases and natural gasoline for sale. The plant is designed to handle 50 million cubic feet per day. Equipment consists of three boilers, providing steam for 300 bhp pumping equipment, 2800 bhp compressors, and 900 bhp auxiliary gas engine-driven equipment plus necessary absorption, distillation, and fractionation columns. The personnel consists of Donahue as foreman and 23 craftsmen, mechanics, operators, metermen, labmen, and others. With the first year's operation behind him, Willis is looking forward to enough free time to get in some golf. He and his wife, the former Miss Betty Foster of Pasadena, have two children, Valerie Laura, seven, and Steven Michael, going-on-three.

1935

MAJOR OLIVER C. DUNBAR is back in the army and is stationed at the Sandia Base in Albuquerque, N. M., as Post Radio Communication Officer.

NELSON P. NIES attended a special one-week course in X-ray Diffraction and Spectrometry conducted by North American Philips Company, Inc. in its New York auditorium. Nies is working for the Pacific Coast Borax Co.

1936

CLARENCE F. GOODHEART of White Oaks, Md., has been appointed associate professor of electrical engineering at Union College, Schenectady, N.Y. Mr. Goodheart comes to Union after five years as section chief at the Naval Ordnance Laboratory at White Oaks, Md., where he was in charge of numerous naval torpedo, and magnetic device projects. He is also a lecturer at the University of Maryland and formerly taught at Ohio State University from 1936 to 1938, and at Texas A & M from 1938 to 1942.

PAUL J. SCHNEIDER received his M.D. at Johns Hopkins in 1941, after which he spent three years in the Baltimore City Hospitals, mostly in surgery. Later, as an Army Medical Corps captain, he served as general surgeon in three European Theater hospitals. Paul is living in Berkeley, but has not as yet established a practice since his discharge in December. Married to the former Neal Respers, he has a daughter, Cynthia Ann, three.

BOB MARSH is employed as manager of the Carbide Tool Division of the Union Twist Drill Company, Athol, Massachusetts, and is in charge of engineering, sales, and production of carbide tools. He was formerly chief engineer and sales manager of the Cal-Cutter Division, Super Tool Company, Detroit, Michigan, and before that, chief engineer for the Machinery Manufacturing Company, Los Angeles. Bob has purchased a 162 acre farm at Barre, Massachusetts, where he is raising thoroughbred horses as a hobby.

C. C. TAN, Ph.D., is a professor of genetics at the National University of Chekiang, Hangchow, China. He was in the United States from June 1945 to August 1946 on a special Rockefeller Foundation Fellowship. Most of his time was spent at the Zoology Department of Columbia University in work on a problem of the genetic origin of the sexual isolation of **Drosophila.** During the year he traveled a great deal in the States, visiting various genetic laboratories and giving seminar talks. He visited the CalTech campus for a few days in the early part of April 1946, the first time Dr. Tan had been back in ten years. Toward the end of his stay away from home, he traveled to England, France, and Switzerland at an invitation of the British Council. He returned to China in September and has since settled down with his wife, fourteen year old daughter, Magie, and sons Sinyu and Sinhung, aged thirteen and nine, at Hangchow, the original location of the University to which he has been attached since 1937. Dr. Tan has recently finished reorganization of his laboratory, and has started working on some population problems of **Harmonia** and **Drosophila.**

THEODORE VERMEULEN has left Shell Development Company and is now serving as associate professor of chemical engineering at the University of California.

1937

DEAN NICHOLS, M.D., has been delayed two years by illness in work as a fellow in dermatology and syphilology at the Mayo Foundation for the Master's degree. He took out his California license to practice medicine last June, and expects to return here after finishing his fellowship. Dean was married to Miss Martha Adams in 1941.

CARL JOHNSON is in partnership with JOHN K. MINASION '38, maintaining a School of Applied Engineering to assist men who are preparing for state licenses in civil or structural engineering. They did structural work on the new 750 foot KFI radio tower near Buena Park, Calif.

JOHN SELBERG reports the birth of a son last September. Selberg is still with the International Derrick and Equipment Company as an executive in the development of new types of steel equipment. He also had a hand in the KFI tower, for which Tech's PROFESSOR FREDERICK CONVERSE made soil tests.

JOHN G. TYLER, ex '37, is a machine tool planner for Douglas Aircraft Co. in Santa Monica. Before the war he was expedition photographer for U.S.C.'s Hancock Foundation, taking biological pictures. His main interests are in photography, and he is now working on some special equipment for scientific photography, especially the biological-medical field. This will permit close-up motion pictures to be taken just as

easily as a scenic picture with conventional equipment. Jack is also working on three-dimensional motion pictures.

1938

CARROLL F. CHATHAM is the first person in the world to successfully develop a method for producing synthetic emerald crystals commercially. These are now on the market as "Chatham Emeralds."

DANIEL C. PEASE, M.S. '38, went on to Princeton for his Ph.D., which he received in 1940. He is now assistant professor of anatomy at the U.S.C. Medical School. During the war Dan did work for which he received the O.S.R.D. Medal of Merit. He is also running the electron microscope belonging to the Department of Experimental Medicine at U.S.C. Married to Miss Phyllis Frankel in 1939, Dr. Pease has two daughters, Katharine Susan, five, and Elizabeth Karen, three.

EMANUEL WINDSOR is taking graduate work at the Institute. After graduation he worked at the Sansum Clinic at Santa Barbara as biochemical research assistant until 1941. The next two years he was senior scientific aide at the U. S. Engineer Laboratories in Los Angeles. From 1943 to 1944, Windsor was an analytical chemist at the Gooch Laboratories in Los Angeles. In June 1944 he entered the Army Medical Department and worked as laboratory technician, surgical technician, and first sergeant of a medical detachment in the European Theater with General Patton's Third Army. At present he is working in biochemistry under Dr. Borsook.

1939

RICHARD H. BISHOP has resigned from Ames Aero Laboratories, and is now working on the non-linear mechanics research project at Stanford in connection with study for a doctorate in physics.

STEPHEN C. CLARK is now assistant to the director of student personnel at the New Haven Y.M.C.A. Junior College in Connecticut.

J. H. GOODELL has left the General Electric Company, where he had worked since his graduation. His new position is with the Essex Wire Corporation of California, subdivision of Essex Wire of Indiana, manufacturer of magnet wire, as chief engineer.

J. SCOTT GASSAWAY has completed his second successful year as a professional mechanical engineer designing specialized mechanical equipment for manufacturing industries. His clients have included manufacturers of rubber goods, printing equipment, furniture, internal combustion engines and toys. In conjunction with R.C.A. he has recently developed electronic application equipment for drying of glue for the prefabricated housing industry. During the war he was executive assistant to the vice-president of manufacturing for North American Aviation, Inc. Scott's extra-curricular activities include three sons, aged six months to five years.

CURTIS M. LEE, due to severe eyestrain, has given up his engineering work and is now "raising lemons, eggs and kids" on his father's chicken and citrus ranch at Ramona, Calif. He feels that the change has been fruitful, and he has been able to use his educational background from CalTech. At present he is building his own house with the help of his young son and daughter.

1940

RAYMOND O. CLINTON is now with Sterling-Winthrop Research Institute in New York.

CAPTAIN WILLIAM E. GENTNER JR. reports that he is back at duty with the Chief of Naval Air Advanced Training as director of training at NAS, Jacksonville.

ISYDORE HLYNKA, Ph.D., expects to change soon from his position of agricultural scientist (dairy chemistry), Chemical Division, Science Service, Arricultural Dept., Ottawa, Canada, to research chemist (cereal chemistry), for the Grain Research Laboratory Board of Grain Commissioners, Winnipeg, Manitoba, Canada. Dr. Hlynka was recently elected fellow of the Chemical Institute of Canada. He and his wife have one son, Leslie Denis, five.

LAURENCE C. JONES, special student in 1939 and 1940, is a chemist and analyst with the U. S. Food and Drug Administration in Los Angeles. Veteran of World War I, Larry is at present secretary of the Southern California Section of the American Chemical Society. Having color photography as a hobby, Jones has been instrumental in the formation of photo-chemical division of the Southern California Section of the A.C.S. Present enrolment is about 20. He has collaborated on electrometric titrations and on a fluorine survey for the Society of Official Agricultural Chemists.

C. B. LYON, graduate student in 1939-40, is assistant general manager, Plantation Division, of the Hawaiian Pineapple Co., Honolulu. He was formerly a physiologist with the U. S. Plant, Soil, and Nutrition Laboratory in Ithaca, New York. He and his wife, the former Jacqueline Fuller of Ames, Iowa, have a two-year-old daughter, Barbara Jean.

A. BOYD MEWBORN went to the University of Arizona as assistant professor of mathematics after receiving his Ph.D. in 1940. In January 1943 he went on active duty in Naval aviation training work as a lieutenant, USNR. He received his wings as a navigator and served as navigation officer and as ground training officer at various stations. Dr. Mewborn returned to inactive duty in October 1946, and reported that month as associate professor of math and mechanics (civilian) at the Naval Postgraduate School, Annapolis, Maryland.

DWIGHT D. MILLER, Ph.D., is instructor in Zoology at the University of Nebraska. Dwight was married to Miss Dorothy Slaughter in the spring of 1946 after his release from the Army Air Corps as a captain. He is teaching elementary biology, zoology, advanced genetics, and doing a small amount of research on **Drosophila** species.

R. S. NEISWANDER is now employed as a staff engineer by Link Aviation. He has applied for a Rhodes Scholarship.

DUMONT S. STAATZ has been practicing as a physician and surgeon with his father and an orthopedic surgeon in Tacoma, Washington, since his discharge from the Army Medical Corps as a captain. Dr. Staatz, married to Miss Martan Baker in 1943, has three children, Frederick Sutherland, three; William Dumont, two; and Gret-

chen, seven months. He is vice-chairman of the Pierce County Cancer drive, sponsored by the local Junior Chamber of Commerce. Their goal is set at $25,000.

ELLERY C. STOWELL, JR., received his M.A. in biochemistry from the University of California in 1943. He plans to get his Ph.D. in biochemistry at U.C. this summer and subsequently to take a position in academic life. A former teaching assistant, Ellery was married to Miss Helen Anderson in 1941.

FRANK D. STREIGHTOFF is associated with Eli Lilly and Co. in their Research Department. He served with the Army Sanitation Corps as nutrition officer of the Military District of Washington, and was in charge of the O.S.-R.D. research program on vitamin retention of foods in large scale cooking. Frank set up and ran the Pentagon Nutrition Laboratory. Married in 1942, he and his wife, the former Ann Mitchell, have three children: Ann Fennel, Elizabeth Doan, and Charles Franklyn, age three, two, and one.

YUJI A. TAJIMA is with Julius Human and Co., Rocky Mountain Arsenal, Denver, Colorado, as research chemist. He was formerly director, Physical Laboratories, Velsicol Corporation. Yuji plans to continue his graduate work at the University of Chicago in physics and mathematics.

1941

FRANK G. CASSERLY is entering a three-year course in electronics at the Post-Graduate School, U. S. Naval Academy, Annapolis, Md.

JOHN GORDON PALMER, an ensign during the war, was recently married to Miss Virginia Agnew Baer of San Marino.

1942

DR. ANDREW A. BENSON took part in the research of the first by product of the atomic bomb to be applied peacefully. This work, which was a study of photosynthesis, is described in an article released by the Atomic Energy Commission.

CHARLES M. BROWN is now employed at the Bone Engineering Company in Glendale.

EDWIN A. DOANE, M.D., is now research assistant to Dr. Emil Bogen at Olive View, California. He formerly served as major, Army Medical Corps, in the Veterans' Administration in New York. Dr. Doane plans to take graduate work in Chemistry at the Institute, which will be the third time and the third field in which he has studied here. Originally of the class of '26 in Physics, Ed performed biological research in 1942 at C.I.T.

J. B. FRANZINI is father of Joseph B. Jr., born late in May.

CARTER HUNT announces the birth of a son, Gregory Norman, born in April.

EDWARD B. LEWIS, JR., Ph.D., has served as an instructor in the C.I.T. Division of Biology since his discharge as an Air Corps captain. Dr. Lewis was married in September 1946 to Miss Pamela Harrah.

WAYNE MACROSTIE has recently accepted a position as associate civil engineer with the State Division of water Resources. He is in charge of an investigation of the ground water supply in the Pajaro Valley near Watsonville.

GERSHOM R. MAKEPEACE has worked up during the past five years from chemist to laboratory department manager at the Menasco Manufacturing Co. The research and engineering activities at the Laboratory occupy 28 persons. Studies conducted are principally in connection with materials and processes used in the manufacture of gas turbojet aircraft engines. Gershom specializes in metal finshing research and some optical methods for metal analysis. He, his wife, Bethmarie whom he married in his sophomore year at Tech, and their four-year-old son, David Lee, live in Pasadena and engage in horticulture with especial attention to orchids. Other hobbies are music and yachting.

DR. WILLIAM R. V. MARRIOTT, B.S. in chemistry '40, M.S. in biology '42, is interning at the Los Angeles County General Hospital. Bill graduated from U.S.C. Medical School in 1946 under an Army program. He is still in the Army and will return to active duty this summer as a first lieutenant. When Bill is finally discharged, he plans further work in pathology and biochemistry for the National Board in Pathology.

EDWARD NOVITSKI, who until recently was a Guggenheim Fellow at the University of Rochester, is now associate, Manhattan Department, at the University's Department of Biology.

JOHN SPIZIZEN, Ph.D., is an associate in virus research of the Medical Research Division of Sharp and Dohme, Glenolden, Pennsylvania. During the war, he was a captain in the Army Medical School, Sanitary Corps, Washington, D. C. John was married in 1942 to the former Evelyn Boelter.

ROY C. VAN ORDEN has a new son; Ronald Craig, born in June. Roy is currently employed by the City of Los Angeles as an associate structural engineer.

1943

CHARLES H. ELLIS, Ph.D., is a research associate in the laboratories of Dr. Gordon A. Alles '22, in Pasadena. He has been married to the former Elizabeth Wilson for nine years, and has three children: Charles H., Jr., six; Terrell William, five; and Robert Arthur, eighteen months.

SIDNEY GOTTLIEB, Ph.D., research chemist with the Food and Drug Administration in Washington, D. C., is at present doing research on properties of mydriatic alkaloids from plant sources and on synthetic sex hormones. He has bought a small farm outside the city, and spends his spare time in "five o'clock farming." Besides the farm and his family consisting of his wife, Margaret, and daughters Penny and Rachel, age two and almost one, Sid is interested in studying Hindustani and other Oriental languages.

ROBERT PAUL LE VINE is engaged to Miss Elayne Nossiter of Manhattan. Bob received his master's degree from Columbia. During the war he served as a lieutenant in the AAF.

KLAUS J. MAMPELL is giving courses in Evolution and Heredity and Genetics as an associate withe Zoological Laboratory of the University of Pennsylvania. Married in May 1946 to Miss Tera Haex, Dr. Mampell is continuing research with the mutator gene and virus in **Drosophila.**

LLOYD W. MERRYFIELD, M.S. '43, is at Harvard Medical School.

STEPHEN BERNARD ROBINSON JR. was killed by the accidental discharge of a rifle in his San Marino home.

1944

KEITH S. DITMAN, M.S. '44, is also receiving his M.D. from U.S.C. in June, and will intern at the Los Angeles County Hospital. Keith was married in 1944 to Miss Mary Thomas.

JOHN P. (PAT) MEEHAN, ex '44, is another U.S.C. June graduate.

HORACE M. HIGGINS is employed at Aerojet Engineering Corporation in Azusa as a research engineer, working on a confidential Navy project.

GEOFFREY L. KEIGHLEY, Ph.D., is senior research fellow at the Institute.

ALFRED G. KNUDSON, JR., will graduate in June from Columbia College of Physicians and Surgeons in New York. He will begin his internship at Huntington Memorial Hospital July 1. A member of Alpha Omega Alpha, national honorary medical fraternity, Al is interested in pediatrics and medical research. He plans to be married after graduation.

KEITH MILLER, who attended Tech in 1944, has been appointed as one of 12 instructors for the New Haven Y.M.-C.A. Junior College. Keith will teach mathematics.

WILLIAM F. ROBERTS is employed at Hughes Sales Company as a salesman of dairy and food machinery.

JAMES R. ST. JOHN, ex '44, will graduate from U.S.C. Medical School in June and subsequently intern at the Santa Fe Hospital in Los Angeles. Jim was married last summer to Miss Dorothy L. Rolls of Santa Paula.

WILLIAM J. TUDDENHAM of Salt Lake City, was married to Miss Phyllis Stapley in June. Bill spent a year at Tech as a graduate student before entering the Navy. After their honeymoon, the Tuddenhams will make their home in West Philadelphia, Pa.

1945

ROGER R. BATE, former student from Colorado, graduated from the United States Military Academy in June. Commissioned in the Corps of Engineers, Bate will go to Oxford on a Rhodes Scholarship. He was appointed to the Academy from the AAF.

R. L. SCHRAG is employed in the engineering research division of Douglas Aircraft Company, Inc. He received a M.S. in electrical engineering last June from the Institute.

1946

JAMES F. DRAKE announced the birth of a son, James F. Jr., in June.

JOHN W. GRYDER, who took graduate work in chemistry this past year, has joined the Chemistry Department at Brookhaven National Laboratory.

GEORGE DONALD MEIXNER JR. was married in August to Miss Nancy Jane Robinson of Los Angeles. Don is a member of the University of California faculty.

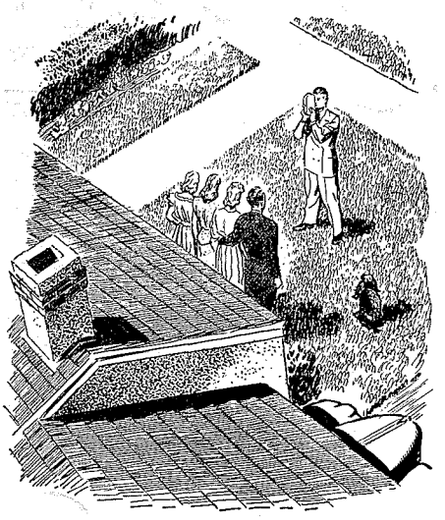
1947

LANGDON CLYDE HEDRICK, who started in the class of '42, was married to Miss Jean Corbitt of Seattle, Washington, June 23. The 1946-47 ASCIT president served as a radar officer with the Ninth Air Force during the war.

POSTMASTER Return postage guaranteed

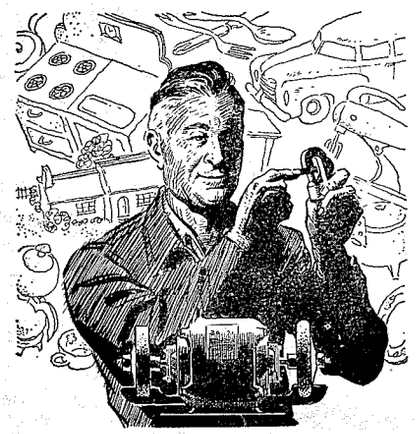
The story of John Czarniecki

1. In 1902, at the age of 15, John Czarniecki immigrated to the United States from Poland. In 1911 he came west to Seattle and went to work as a teamster for Union Oil Company. Today, 36 years later, he is still working for Union Oil as a maintenance mechanic for the Seattle truck fleet.

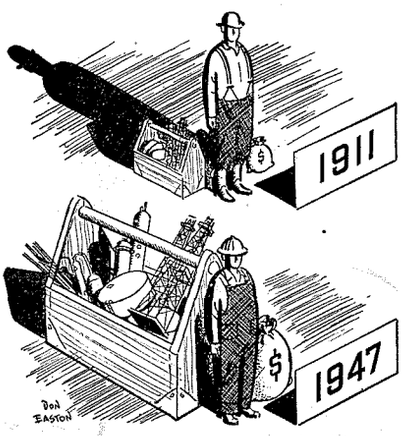


2. During that 36 years Mr. and Mrs. Czarniecki have raised a son and three daughters—two of whom are still living. The son, a graduate mechanical engineer from the University of Washington, is supervisor of production at a motor factory in Seattle. The two daughters are married. The Czarnieckis own a new 5-room home in Seattle and drive a 1940 Nash.

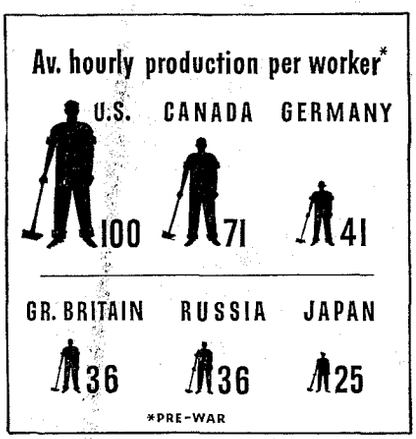
3. John Czarniecki gave us permission to tell his story in order to drive home one fact. He didn't become president of Union Oil Company. (In fact, the job he holds today is comparable to the one he held in 1911.) Neither did he go into business for himself. He simply went to work.



4. But our American economic system offered him greater opportunity for *productive* work than he could have found anywhere else in the world. Work by itself means nothing. Only work that *produces* something—which a man can exchange for the things he needs—is of any value. Consequently, the more a man can *produce* with an hour's work, the higher his standard of living.



5. During the 36 years that John Czarniecki worked for Union Oil, his capacity to *produce* increased steadily. For during that time, the Company increased the tools-per-employee threefold. Consequently, production-per-employee went up. And, as a result, John Czarniecki has more than tripled his take-home pay. He makes 7 times as much per hour today as he did in 1911 and he works less than half as many hours—40 instead of 84.



6. In other words, we all can't be presidents and we all can't go into business for ourselves. But the American economic system is still just as *important to all* of us. For each man's standard of living depends directly on what he can produce. And our American system has so encouraged the introduction of new tools and new techniques that, year after year, the average American has been able to produce more and more and thereby continue to improve his standard of living.

UNION OIL COMPANY

OF CALIFORNIA

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This series, sponsored by the people of Union Oil Company, is dedicated to a discussion of how and why American business functions. We hope you'll feel free to send in any suggestions or criticisms you have to offer. Write: The President, Union Oil Company, Union Oil Building, Los Angeles 14, California.

AMERICA'S *FIFTH* FREEDOM IS FREE ENTERPRISE