ENGINEERING AND SCIENCE

MONTHLY

DECEMBER 1947

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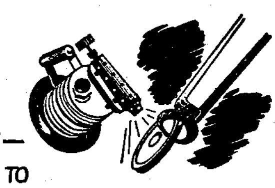
THE MARCH OF SCIENCE

MIRACLE HEAT— without fire or furnace!

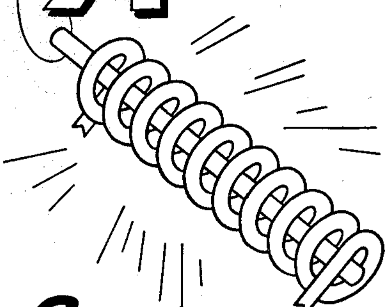


HEATING A PIECE OF METAL BY OPEN FLAME, BLOW-TORCH OR FURNACE IS RELATIVELY SLOW— APT TO LEAVE SCALE... IT'S HARD TO HEAT ONE SPECIFIC AREA WITHOUT HEATING THE WHOLE PIECE.

PRODUCTION MEN REALIZED HEAT-TREATING OPERATIONS SUCH AS FORGING, PRECISION BRAZING AND SURFACE HARDENING COULD BE STEPPED WAY UP IF A FASTER METHOD OF HEATING COULD BE FOUND... ONE WHICH WOULD CONCENTRATE THE HEAT AT PRE-SELECTED AREAS!

HEAT BY INDUCTION SEEMED LIKE THE ANSWER. SCIENCE HAD ALREADY DISCOVERED THAT METALS HEAT RAPIDLY WHEN INTRODUCED INTO A HIGH FREQUENCY, HIGH DENSITY MAGNETIC FIELD!

A NEW ELECTRONIC HEATER DESIGNED BY ALLIS-CHALMERS SCIENTISTS—

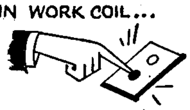


AMAZING PRODUCTION TOOL RECTIFIES ORDINARY 60-CYCLE CURRENT THEN STEPS IT UP TO 450,000 CYCLES. A MAGNETIC FIELD OF HIGH DENSITY IS SET UP IN WORK COIL AND WHEN METAL IS INTRODUCED INTO THIS FIELD, PASSAGE OF CURRENT CAUSES POWER LOSSES WHICH PRODUCE HEAT WITHIN THE METAL WITH INCREDIBLE SWIFTNESS.

BIG BENEFITS: COMPLETE, SELECTIVE CONTROL OF HEAT PENETRATION... EXACT UNIFORMITY... GREATLY INCREASED PRODUCTION!

SIMPLE AS

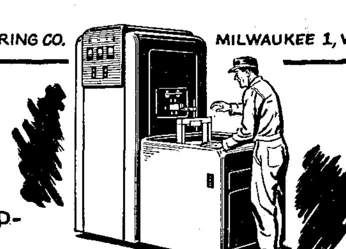
A PLACE METAL IN WORK COIL...



B PUSH BUTTON

C METAL IS HOT IN SPLIT SECONDS

ALLIS-CHALMERS MANUFACTURING CO. MILWAUKEE 1, WIS.



ELECTRONIC HEATER IS ONE MORE EXAMPLE OF HOW ALLIS-CHALMERS RESEARCH AND EXPERIENCE GO TO WORK FINDING BETTER, FASTER, MORE EFFICIENT WAYS OF HANDLING PRODUCTION PROBLEMS—ANOTHER GOOD REASON WHY A-C EQUIPMENT IS IN DEMAND IN EVERY MAJOR INDUSTRY...

ALLIS CHALMERS

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

BY-LINES

HOWARD G. VESPER

Howard G. Vesper grduated from C.I.T. in 1922 in chemical engineering and went to work for Standard Oil Company of California. He has been with this firm ever since. In 1931 Mr. Vesper was transferred from manager of the El Segundo Calif. branch of Standard's Research and Development Department to San Francisco as a staff assistant to the general manager of that Department. From 1933 to 1937 was spent in New York and the East as a general technical representative and in marketing various products. In 1938 Vesper returned to the West and became assistant manager and then manager of Standard's sales of lubricating products; and later manager of gasoline, diesel fuel and fuel oil sales. In December 1945 he was elected president of the California Research Corporation, Standard's subsidiary responsible for all research, development, patents and licensing work for Standard and its affiliated companies.

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FRANK B. JEWETT JR.

Frank B. Jewett Jr., vice-president and manager of the Vacuum Engineering Division of the National Research Corporation, graduated from the California Institute in 1938 with a B.S. in mechanical engineering. As an undergraduate he was exceptionally active in student affairs, serving as senior class president, A.S.B. vice-president, Beaver president, and on the board of control. Jewett also found time for participation in football, track, baseball, and rugby. After graduation he took the M.B.A. degree at Harvard, and stayed on for a third year as a research assistant at the Harvard School of Business. In 1941 he joined the National Research Corporation.

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COVER CAPTION

See page 2.

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Monthly

The Truth Shall Make You Free

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ENGINEERING AND SCIENCE MONTHLY

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COVER CAPTION

Informal discussion at the 1947 Freshman Camp at Camp Radford in the San Bernardino Mountains. A plentiful amount of time was alloted for incoming students to talk over their plans and problems with upperclassmen and faculty members between orientation periods morning, afternoon, and evening. Pictured here are Dr. D. S. Clark, associate professor of mechanical engineering, director of placements, and secretary of the Alumni Association, in the foreground, and Dean of Students Franklin Thomas, who has been professor of civil engineering since 1915. At least one faculty member and an undergraduate leader slept in each cabin, making them available to freshmen for questions and comment over 18 hours per day.

With the Editor--

GREMLINS haven't bothered ye editor very much but recently they slipped one over. He had planned to include in the October issue short accounts of two very pleasant experiences of the summer; but the office gremlins put the copy in the wrong file, and so the articles were not published. According to schedule, the October E & S was issued several days after the copy for the November E & S was complete; so the December issue is our first chance to tell you about the parties held by Vice-President and Mrs. Howard Lewis in July and by President and Mrs. Morton Jacobs in August.

In both cases the Board of Directors and their guests assembled in the afternoon to play badminton, tennis, croquet, and other games and later enjoyed excellent outdoor suppers. At Howard Lewis' party the guests' wives attended and no attempt was made to handle any business. At Mort's party, however, supper was followed by what was to be a short business interlude before games were resumed. To the disappointment of all, and particularly Mort, who had announced that every attempt must be made to make business meetings short, the business meeting lasted until nearly midnight when it was recessed to be resumed at a special meeting a few days later. In spite of the disappointment, however, this and Howard Lewis' party will remain in the memories of the guests as two of the most pleasant events of the summer.

* * * * * * *

In the October issue we told of a discussion between the managing editor and ye editor regarding the rarity of letters commending our efforts or telling of disagreement with our policy. The article which led to the M.E.'s proffered bet that we wouldn't get any reaction was published in the June issue. Ye editor now admits that up to now, time has proved that the M.E. was right — three months have passed and no comment has been received on the article. However, several alumni were spurred to action by ye editor's column. Excerpts from some of the letters are included herewith. That's a good start; keep it up.

Letters to the Editor

JUST a note to commend you for your excellent magazine. Why not carry the Humanities to the Alumni? You might offer book reviews and essays (non-technical) supplied by the Humanities Department. You could even carry articles on Atomic Energy and the United Nations.

—J. Kohl '40

Recent articles on these subjects will be found in E&S for Jan., Feb., April, May, June, October 1946; April and Nov. 1947. We shall continue to be on the lookout for such material. —Ed.

. . . THE LACK of reaction on the part of the Alumni can be interpreted in the way you describe, . . . or it can be interpreted in another way which places the blame squarely on the shoulders of the editorial staff; namely that if a magazine is not read it certainly will get no reaction. In my own case I would attribute my lack of reaction to the latter. . . .

Let's stop and analyze the October issue from my viewpoint. The first article is good from the standpoint of the engineers working in California or who expect to work there. I have not worked in California for over 10 years nor do I expect to work there in the future so I did not read the article. The second article is on a phase of the gas industry (detailed and dry). This is not my field of interest so I did not read it. . . . The next four pages have news items which, while drawing some interest, appear to be greatly padded, the same applies to the personals on the next three pages. It all sums up to

(Continued on page 17)

ENGINEERING AND SCIENCE
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Research in Industry

By HOWARD G. VESPER

SOME years ago the British magazine **Punch** published an extended analysis of research in business, concluding as follows:

"To sum up, the following are the main advantages and disadvantages of a research department:

"Advantages:

1. It does no harm.
2. Visitors and shareholders are impressed by the sight of so much science and the smell of so much hydrogen sulfide.
3. It provides congenial employment for a number of people who otherwise would invariably be reduced to teaching small boys that $2HCl + Zn = ZnCl_2 + H_2$.
4. One of these days someone may find out something that will make all the difference to your business; the thing is at least statistically possible.
5. Scientists are usually quite nice lads without vice.

"Disadvantages:

1. Cash.

"We cannot visualize any business man, comparing the advantages with this single slight impediment, being in any doubt as to what he should do. Money isn't everything, and you can always get somebody eminent to come down and open the new research building."

EVOLUTION OF MODERN INDUSTRIAL RESEARCH

In contrast to this humorous approach, modern industrial research has a long and interesting background of evolution. While there were a few earlier high spots, science really began about the 16th century gradually to take definite form and supplant the speculations of the alchemists and philosophers on the imaginary properties attributed to matter. This progress took great strides during the 19th century through the activity of scientists in Europe and the United States, substantially increasing man's fundamental knowledge. Notable landmarks included Count Rumford's establishment in 1800 of the first organized science laboratory, The Royal Institution of London, and Liebig's founding in 1825 of the first chemical laboratory for systematic study in that field.

There was a considerable lag between 19th century fundamental developments and their commercial application. This was mainly because industry had abundant resources and was serving a rapidly increasing population and market, with the result that there was small incentive to look for new or better things. The first industrial research laboratory in the United States is claimed to have been established by the Merrimac Manufacturing Company in Lowell, Massachusetts, in 1834. The second such laboratory of any significance was founded about 1860 at Wyandotte, Michigan, for investigating the difficulties of the Bessemer steel process.

Competition did not become sufficiently severe until roughly the last quarter of the 19th century to cause industrialists to turn with increasing frequency to science for assistance. However, when they did, the results were so outstanding that the gap between pure and applied science diminished quite rapidly and trained chemists, physicists, and other technicians found increasingly ready employment in industry. During this period independent investigators also made discoveries leading to the establishment of new industries, thus further demonstrating the practical value of science. Examples are many, including Bell, Edison, Goodyear, Hall, and Baekeland.

Until the 20th century industrial research remained largely a matter of the unorganized effort of individuals. Early in the 1900's a few companies organized separate research departments and began a systematic search for the solution to their immediate problems and for new knowledge. Thus, organized industrial research is less than 50 years old!

Public attention was focused by the first World War on the accomplishments of applied science. This resulted in a greatly stimulated growth of industrial research. Our supply from Germany of chemicals, dyes, medicines, and glass was cut off, thus inspiring American scientists to new and intense efforts, out of which grew a number of important new American industries.

This article is based on a talk presented at the annual Tau Beta Pi dinner at the California Institute, March 14, 1947.

Many companies started organized research activities in the early 20's, either directly or indirectly because of this war impetus, and set up laboratories which have become increasingly important since that time. For example, Standard Oil Company of California initiated an organized research and development program in 1920 as a research division within its Manufacturing Department. Initial efforts were directed toward improvement of refinery processes, particularly distillation, thermal cracking, acid treating, and acid recovery. Very successful results led to the formation of a separate Research and Development Department in 1926, which has since grown into the California Research Corporation with a total personnel today of over 800.

The impetus on research from World War II was similar to that of the earlier war, but much more important because of its greater magnitude. A few examples will be sufficient to illustrate; namely, atomic energy, synthetic rubber, high octane aviation fuel, radar, rockets, penicillin. This is emphasized by a statement made recently by Mr. Robert P. Patterson when he was Secretary of War: "There is a great new voice in the world today, the voice of science and technology. It is a voice heard since ancient times, but never until today has it spoken with such authority, have its words been so filled with promise, has it been listened to with such hope. And in no country in the world does the voice speak as eloquently as in our own."

The following table indicates graphically the amazing growth of industrial research in the United States during the past few years (based on National Research Council data):

Year	No. of Industrial Research Laboratories	Total Personnel	Personnel in Petroleum Research
1920	300	9,300	145
1940	2,200	70,000	6,000
1946	2,500	139,000	10,000

Best available data indicate that the present annual rate of industrial research expenditure is in excess of $700 million.

It is interesting to note that out of 139,000 people now engaged in industrial research work, approximately 41 per cent are technical graduates doing technical work, the remainder being administrative, clerical, maintenance, and similar supporting personnel. Of the scientific group, percentage wise, 39 are chemists, 38 engineers, 5 physicists, 4 metallurgists, with the remainder including a wide variety of special professions.

The distribution in research personnel within individual industrial research laboratories will vary considerably from these average figures. For example, in the California Research Corporation the percentage of scientic to total personnel is considerably higher, approximately 48 per cent. However, the ratio of engineers to total technical personnel checks the national average closely, being about 40 per cent.

CHARACTER AND MOTIVES OF INDUSTRIAL RESEARCH

The kind of research conducted by industry is primarily applied science using and extending the basic facts and principles uncovered through broad fundamental research. Thus, the fundamental findings of nuclear physicists and chemists in the atomic energy field are now being applied to atomic energy power development. The dividing line between fundamental and applied research is not distinct. Its complexion depends on the character of the problem and the nature of the agency conducting the investigations. The study of properties of a hydrocarbon by a manufacturer of electrical equipment might be fundamental research, but if conducted by a petroleum research laboratory, it might be considered largely applied research.

Broadly, industrial research is the endeavor to learn how to apply scientific facts to the service of mankind. In general, the objective of industrial research is the material objective of civilization itself—to prolong life, to improve health and comfort, to enhance happiness, and to enlarge productive ability and usefulness; in other words, to contribute to the common store of technical knowledge and thus improve our standards of living.

By helping to translate fundamental scientific facts into new or better products for a greater number of people, industrial research has become a vital part of our competitive economic system. Obviously, the profit motive is a basic consideration in selecting and carrying out industrial research projects. Nevertheless, the success of industrial research in improving living standards and making life easier and happier for more people is both a justification and an indication of greater things ahead.

Industrial research is essential to the survival of business. All businesses face changed post-war conditions in marketing, competition, customer demand, and other operations, and must be flexible to meet such changing requirements. This applies to large and small business alike. There are many examples of industries that have languished because they have had little or no research protection and support. Industrial research is also important in maintaining employment. Organized labor by 1940 had officially indicated its approval of the encouragement of applied science.

Mr. C. F. Kettering of General Motors has said, "An industrial research project should do one or more of the following:

1. Reduce cost of production
2. Reduce operating cost to the user
3. Increase the utility of the product
4. Increase its sales appeal
5. Produce new business
6. Determine technical information contributory to to some other project."

Industrial research operates in a variety of fields. Projects are often concerned with the finding, growing, creating, and use of raw materials. In the petroleum industry this refers to research in oil exploration, drilling, and producing. Another broad field is research work on "normal" processes and products. Within the petroleum industry this would include, for example, refining work on such indigenous products as gasolines, lubricating oils, and greases. An increasing field is research on synthetic processes and products. Examples in the petroleum field would be the increasing emphasis on synthetic fuels made from various non-petroleum sources such as coal and shale. Also included would be chemical syntheses from hydrocarbon raw materials. Another important phase of industrial research is the engineering related to the foregoing, including particularly the preliminary and final process designs for new plants.

An important field closely related to industrial research and frequently carried out by the same organization is that of technical service to operating groups on processes and products. This is in effect technical consultation by the research group for the purpose of increasing the efficiency of existing plants or bringing about better use of existing products.

Another closely related subject is that of patents and licensing. Generally the results of modern industrial research work are protected by patents, the degree of activity in this field being dependent on how aggressive the company concerned decides to be in exploiting its developments.

In the modern approach to industrial research, the coordination of motive, men, and money has replaced the scattered efforts of individuals and the poorly directed, planned and supported research of earlier days. The time has passed when a Daniel Boone with rifle and packhorse could add greatly to our store of geographical knowledge. To make significant industrial research addition today requires a wealth of scientific equipment and observers.

Careful organization planning is necessary to achieve maximum effectiveness of technical manpower. Too often in the past the time of highly trained technical men has been so restricted and hampered by other demands that technical efficiency was seriously reduced. Much of this was the result of the very rapid growth of industrial research organizations, furthered by the thought that technical activities do not lend themselves well to the same kind of organization planning as do other phases of modern business. Experience has indicated, however, that this is not true and that there is just as much — or more — need for the application of sound organizational principles in industrial research work as in other phases of business activities.

Research ideas may originate from any one or more of a number of sources, including individuals, groups, other departments, consumers. However, the modern industrial research laboratory handles the development of these ideas as projects assigned to teams or groups. There was wide adoption of this practice on war projects where its effectiveness was proved beyond doubt. These projects must be carefully planned, directed, and budgeted to accomplish specific objectives, yet with enough provision for flexibility to permit necessary changes as the work progresses.

RELATIONSHIP BETWEEN ACADEMIC AND INDUSTRIAL RESEARCH

From the foregoing discussion, there is an obvious close relationship between academic and industrial research. Any former lack of understanding and mutual confidence between industrialists and scientists has practically disappeared. Full cooperation between such groups is essential in the future if we are to continue our modern industrial progress. Industrial research is dependent to a very large degree on universities and colleges for fundamental research work. While industrial laboratories can and do carry out a moderate amount of such fundamental work, this type of activity is inherently a minor part of the job such laboratories are set up to do. In fact, a grave danger today lies in the possibility that industrial research and development may go forward so rapidly that they will outstrip the fundamental research on which future industrial projects must be based.

Not only is industrial research dependent on universities for fundamental work, but it also looks to these institutions for its technical personnel. This further increases the close bond between universities and industry. In this connection, many farseeing industrial firms are today maintaining fellowships at a variety of institutions of higher learning, partly to support their program of basic research and partly to assist students to become better trained for their ultimate work as either research or industrial scientists. Such support is increasingly important in view of the decreasing endowments available to many institutions. The following table illustrates the growth of this type of industrial aid for universities:

Year	No. of Companies	No. of Scholarships and Fellowships
1929	56	95
1941	210	721
1944	201	956

The number today is doubtless much larger.

The importance of academic and commercial institutions working hand in hand in the research field is well expressed in Dr. J. B. Conant's words, "In the last analysis the future of science in this country will be determined by our basic educational policy." However, the question of whether such institutions can do the necessary basic research job raises the possibility of Government support. Government interest in research has increased greatly as a result of World War II, and various federal agencies are now contracting or otherwise supporting extensive research projects. There is an obvious requirement for better coordination of such activities. What is needed is a national science foundation that will coordinate Government support for fundamental research through existing university and other laboratories — not compete on the basis of a separate Government research foundation. It is to be hoped sincerely that the present Congress will enact suitable legislation on this subject.

Another facet of the increasing cooperation between academic and industrial institutions is the growth of research in specific fields or on specific projects carried out in such institutions for an industrial concern. This is accomplished in part through institutions designed specifically for this purpose, such as the Mellon Institute, the Armour Research Foundation, and the new Stanford Research Institute. However, in addition, many universities will undertake specific projects on the basis of grants by the industry. Of 800 colleges and universities canvassed by the National Research Council in late 1945 and early 1946, 292 indicated that they were offering such research service to industry. Another important phase of academic-industry contact and correlation lies in the increasing number of faculty members who are retained as consultants by industrial firms.

PERSONNEL IN INDUSTRIAL RESEARCH

In his report to the President, of July 1945, Dr. Vannevar Bush stated, "The most important single factor in scientific and technical work is the quality of the personnel employed." We are in the midst of a serious war-induced deficit of science and technology students and graduates. The Bush report estimated this deficit in Bachelor degree graduates at 150,000, and in advanced degree men at about 17,000 by 1955. In spite of the remarkable registration being handled by universities today, it may be many years before the demand for qualified technical graduates can be fully satisfied.

Requirements for employees in a modern industrial research laboratory are high. They must, of course, have adequate educational training and background, and this may or may not include an advanced degree. There are as many opportunities for B.S. graduates as there are for those holding Master's and Doctor's degrees. Of comparable importance are such other factors as research attitude, positive approach to technical problems, a personality which will promote good relationships with fellow workers, ability to cooperate, physical fitness, training in oral and written self-expression,

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INDUSTRIAL HIGH VACUUM

By FRANK B. JEWETT JR.

THE development of any tool or technique is always of interest to technically trained men for its potential impact on their individual fields. Recent developments in high vacuum equipment and practice have indicated an ever-increasing sphere of commercial usage. Consequently, it is felt that a brief resume of the field may prove to be of considerable interest even to those not now involved in low-pressure work.

Industrial high vacuum may be defined as the use on a large scale of total pressures less than a few millimeters of mercury. Rarely do industrial applications require pressures less than 10^{-5} millimeters. In general, high vacuum represents to each industry the utilization of pressures lower by a large factor than that previously believed possible or practical.

Prior to 1940 industrial use of high vacuum was confined to a limited number of specialized applications despite the fact that very low pressures had been common in the laboratory for more than a generation. Up to that time, no commonly accepted standards or equipment and, probably more important, no large-scale demonstration that low pressure could effectively be used were available to the engineer seeking to use it in his process. The inevitable result was that where applications were made the design was usually done by men primarily interested in other phases of the work; consequently, the vacuum equipment represented in each case pioneering work in high-vacuum engineering and technique. As might be expected, the results were of varied quality; but it is fair to say that all suffered from the lack of contributions by organizations whose primary business was the production of the best in engineering design, equipment and technique. Despite these handicaps, however, high vacuum was early used in the production of electronic tubes and electrical capacitors, later in the distillation of marine and vegetable oils for vitamin content, and in the small-scale dehydration of blood plasma. Much of its later success hinges on these early applications.

Industrial high vacuum as a field may be dated from about 1940, when the military needs of the impending war first began to make themselves felt. Its rapid development during the war years was, in a large measure, the result of demands made by the magnesium, penicillin, atom bomb, and other military projects These programs not only fostered the development of rugged, dependable, large-scale equipment and demonstrated conclusively that low pressures, when properly applied, could be used economically on a commercial scale, but also brought into existence a large body of technical and business personnel familiar with the possibilities and limitations of high vacuum. Also extremely important was the growth during the war of several organizations specializing in the design, construction, and application of vacuum equipment. Whereas previously it was necessary to develop and construct all pumps and equipment for a particular job, now it is possible to secure catalogs of standard equipment and expert advice from any of several competent organizations. Now it is unnecessary for the process engineer to dilute his efforts by considerations of vacuum equipment design and construction.

VACUUM TECHNOLOGY

A brief description of some of the standard equipment or common practices of modern high-vacuum engineering may lend credence to the statement that engineering, fabrication techniques, and equipment are ready to handle any vacuum problem on whatever scale industry may pose. No longer need the development

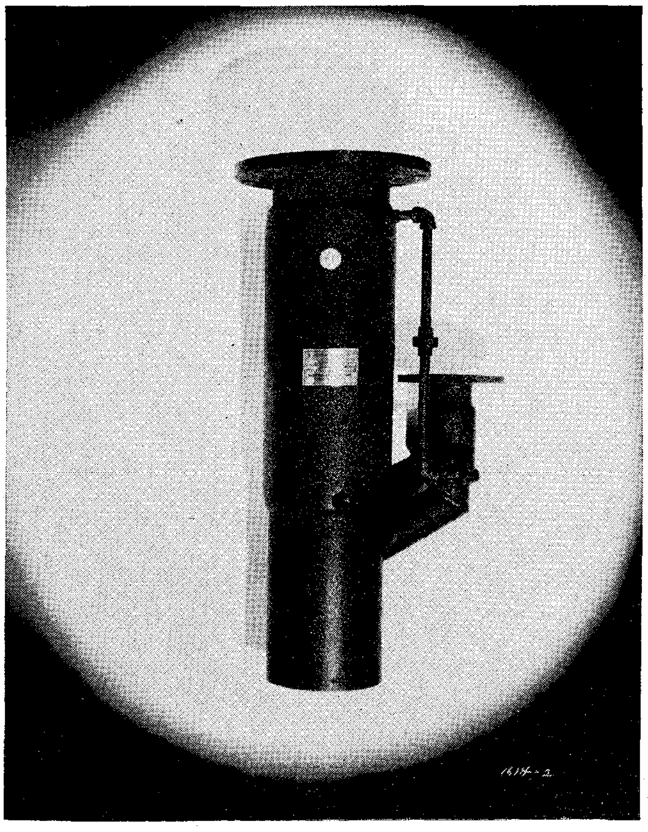
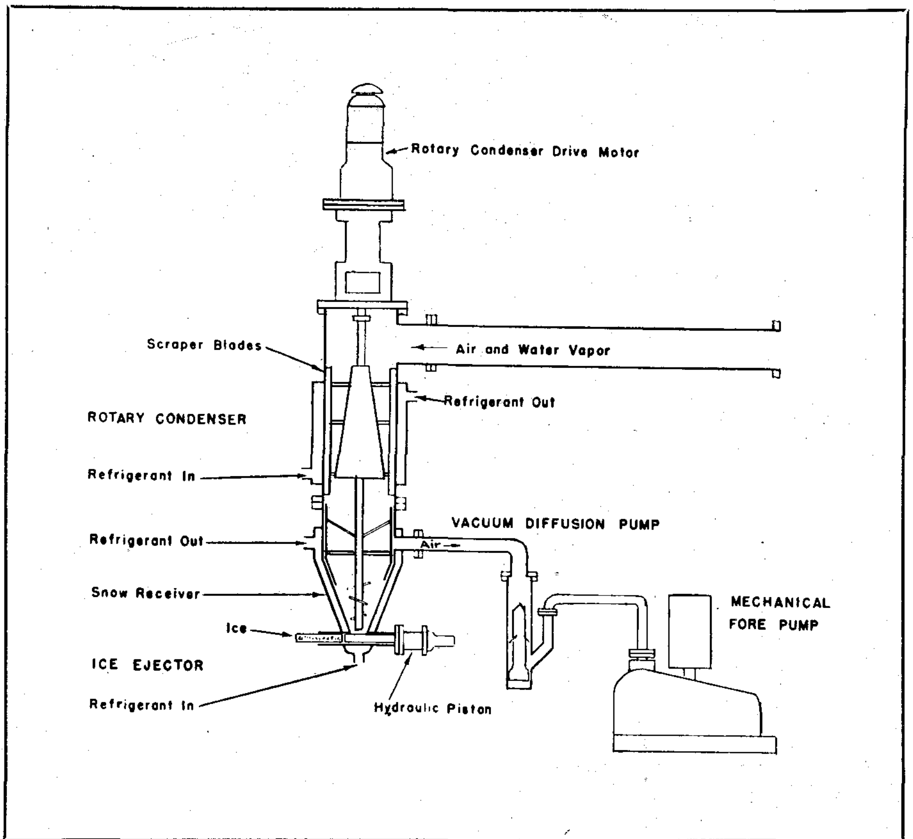


Fig. 1 Typical three-stage oil diffusion pump, 10-inch diameter inlet.

Fig. 2 Schematic diagram of Rotary Condenser unit for pumping water vapor at low pressures.



man discard a high-vacuum process merely because it involves low pressures on a large scale.

Diffusion pumps, similar to the 10-inch model illustrated in Fig. 1, up to 32 inches in diameter with speeds up to 30,000 cubic feet per minute at 0.1 micron* are standard items with several manufacturers. Electrically heated metal pumps have almost completely supplanted all other types. Diffusion pumps fall into two broad classifications, and each has its proper place: (1) The high-vacuum type usually consists of three umbrella stages in a cylindrical, water-cooled casing. It is designed to have its maximum speed at about 0.1 micron and blank off at 0.001 micron or less and to operate against a forepressure of 100 to 500 microns. This is the most common diffusion pump. (2) The booster type is designed to have its maximum speed between 10 and 500 microns and to blank off between 0.1 and 1.0 micron. It will operate against forepressures of 1000 microns or more.

It is interesting to note that diffusion pumps can be used either to produce low pressures or to reduce the number or size of mechanical pumps required to achieve a given speed at pressures in the micron range. No diffusion pump will exhaust to atmosphere directly, and so some sort of backing pump, either mechanical or steam ejector, must be provided.

With the exception of some conditions where very high forepressures are required, oil has replaced mercury as a pump fluid. Several types of oils make proper selection for particular applications possible. For instance dioctyl phthalate is useful where low back-streaming and high ultimate vacuum are required. It has good speed characteristics, but is quite heat-sensitive. Silicone types are also useful for low-pressure work and are heat-stable, but have relatively low pumping speeds. Chlorinated hydrocarbons, while not useful for very low pressures, have excellent speed characteristics at about 0.1 micron and are reasonably stable.

The pumping of condensible gases like water vapor offers interesting problems to the vacuum engineer. When one considers that to move 10 pounds of water per hour at 100 microns requires a pumping speed of 25,000 cubic feet per minute, it is obvious that diffusion pumps are unsatisfactory. Mechanically refrigerated cold traps have been developed into efficient water-vapor pumps for the lower micron range. The rotary condenser (Fig. 2) is an interesting example. In this case refrigerant at —70° F. to —85° F. is circulated through the jacket. Water vapor condenses in the form of ice on the inner surface of the condenser and is continuously removed from that surface by a rotating cutter blade. The resulting snow is customarily removed from an ice-receiver pot at the end of the run, but may be continuously ejected to the atmosphere. By virtue of its cold surface temperature, this type of unit can be used to produce ultimate water-vapor pressures down to 1 micron,* and it has the advantage of always presenting an ice-free surface for maximum condensing efficiency not possessed by the static trap. Within limits, the pumping capacity of any given rotary condenser is dependent upon the tonnage of refrigeration applied to it, and obviously the pressure varies with the condensing temperature. More recent developments indicate that liquid absorber units using a fluid like lithium chloride may replace the rotary condenser on large installations because of lower operating cost. For pressures of 1000 microns or higher, multi-stage steam ejectors are more

*One millimeter of mercury equals 1000 microns. One micron equals 0.0000194 pounds per square inch absolute.

*Equilibrium temperature of ice at 1 michon approximately —100° F.

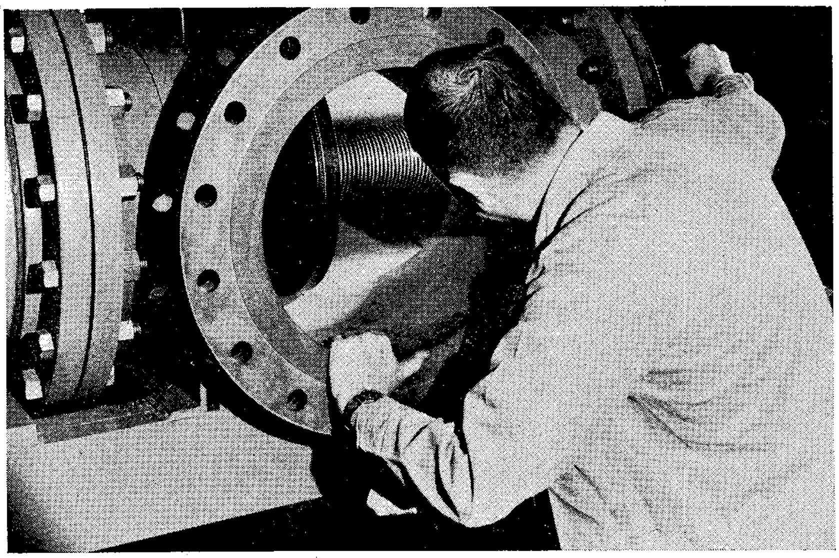


Fig. 3 Modern high-vacuum valve showing metallic bellows.

economical to use. Comparative operating costs for pumping water at 250 microns show 2.5 cents per pound for the rotary condenser, 1.5 cents per pound for liquid absorbers, and 25 cents per pound for steam ejectors.

Accurate vacuum measurement is difficult and is influenced by mixture and composition of gas, presence of condensible vapors, contamination, temperature, and location of gauge. Probably one of the greatest difficulties encountered by persons utilizing high vacuum is the discrepancy between gauge readings and the actual pressure in the system. This error can be many hundred per cent and often leads to dangerous misinterpretation of result. Many types of vacuum gauges are now on the market. Each has its field and its own peculiar limitations.

Vacuum measurement has often held an entirely different meaning for the engineer in industrial applications from what it has for the scientist in his laboratory. Where a repetitive process is involved, cycles are frequently worked out by trial and error using some form of gauge which gives consistent, but not necessarily accurate, results. Consequently, the comparison of operating conditions between two installations must always be preceded by a resolution of the methods of vacuum measurement. The proper use of new vacuum gauges will do much to eliminate these errors.

Representative of these developments is the Alphatron Gauge. It is actually an ionization gauge in which alpha particles emanating from a small radium source, rather than electrons from a hot filament, act as the ionizing agent. Not susceptible to filament failure, the gauge may be operated at atmospheric pressure and covers the range between 1 micron and 10 millimeters in three linear scales. For all practical purposes, it has an instantaneous response. Where water vapor is present, the instrument is of special value because of the small variations in calibration between water vapor and air.

A complete new chapter in valve requirements has been written by the demands of high vacuum where impedance at low pressures and inleakage are so important. All good vacuum valves must have exceptionally wide openings to reduce impedance. Generally they should be as short as possible. Sealing of the operating mechanism is accomplished either by a metal bellows (Fig. 3) or by some variation of a rubber gasket-vacuum grease seal.

Anyone familiar with vacuum equipment undoubtedly has visions of hours, days, or weeks spent immersed in castor oil, acetone, and various waxes and greases, while one searches for hard-to-find leaks. Of necessity, those whose business is the production of vacuum equipment have solved this problem partly by improved design and production methods and partly by vastly superior testing methods. The old technique of spark-testing glass tubing still lingers on, pressure-testing with soap bubbles has its place, and acetone or ether-spray-testing has changed only in that it is more frequently done with a radium-type ionization gauge. But by far the best method, the most accurate and quickest way of locating even minute leaks, involves the use of a mass spectrometer. A tracer gas such as helium diffuses through a leak and into a pre-set mass spectrometer tube. The ion current registers not only the leak but, with special care, the magnitude of the leak as well. Suffice it to say that in this manner leaks which would allow a volume of one cubic foot to show a pressure change of 0.1 micron per hour can be located within a small fraction of an inch.

From the brief summary presented above it is possible to visualize the tremendous progress made in the art of producing very low pressures. The refinements in vacuum equipment, the tools for producing vacuum, would, however, be meaningless by themselves. The end result of these developments must lie in commercially profitable operations if they are to be of interest and importance. Although new applications are constantly coming to the fore, some indication of the direction of motion of the whole field may be gained from areas already well explored.

LOW-PRESSURE DEHYDRATION

Among the larger vistas in which vacuum is used, dehydration deserves a major rating. Low-pressure dehydration is usually required for the drying of heat-sensitive materials. Such materials may be dried either to save shipping weight and make distribution more economical or to prevent decomposition and spoilage in the liquid form. The actual mechanism of low-pressure drying will apply to any particular product for one or more of the following reasons: (a) to reduce or eliminate thermal decomposition of the product during the drying operation because of low equilibrium temperature, (b) to obtain a low final-moisture content, (c) to produce a lyophilic (easily rehydrated) structure in the dry product, or (d) to improve the appearance of the dry product.

Perhaps the most interesting dehydration operation from the engineering point of view is that of the orange juice plant at the Vacuum Foods Corporation at Plymouth, Florida. Briefly the plant (Fig. 4) operates as follows. Oranges are squeezed in a juicing plant at an average rate of 500 boxes per hour. The juice is then passed to either of two banks of falling-film concentrators, where approximately 86 per cent of the water (75 per cent of total mass) is removed by steam ejectors at a pressure of 12 millimeters. In this stage more than 2000 gallons of product per hour are handled. Subsequently a portion of the output is canned and marketed as a frozen orange juice concentrate, while the remainder is dried to a powder in the vertical dryers at a pressure of about 100 microns. The water is pumped by large rotary condensers. This stage is interesting in that the product is introduced as a liquid and removed as a powder without breaking the vacuum. Tests have shown that the mean retention of ascorbic acid in both concentrate and powder is more than 96 per cent of the fresh juice content. The size of this plant, probably one of the largest commercial vacuum installations in the world, may be judged by comparing the size of the man and the equipment.

EVAPORATION OF METALS AND SALTS

One of the best-known applications of high vacuum developed rapidly during the war. Starting with the deposition of one-quarter-wave-length films of magnesium fluoride and other substances on glass to reduce surface light reflection, this field has now expanded to include the deposition of metallic films on a wide variety of materials. A typical wartime optics coating installtion depicted in Fig. 5, and a modern, high-speed evaporating tank in Fig. 6. Machines have been developed for applying metal films to continuous rolls of plastics, paper, and other materials. These machines open up the whole electrical capacitor field where small, self-healing units can be constructed from zinc-coated paper.

By far the most interesting development, however, is the automatic metallizing unit (Fig. 7). This unit was designed to produce front-surface aluminum reflectors for the optical systems of television sets, but it is equally important for its revelation of what can be done with modern high-vacuum equipment. Clean pieces to be metallized approach the machine in jigs on a conveyor line from the left. They are automatically staged into the machine and moved from chamber to chamber until they reach the coating cell which remains constantly at a pressure of about 0.1 micron. Here aluminum, continuously evaporating from a controlled source, is deposited on the surface. The material is then staged out of the machine and back to the line. Complete controls and safety devices make the entire operation automatic, and labor is reduced to a minimum. Although this particular machine was designed for television applications, the general philosophy of the design will have a much wider application.

VACUUM METALLURGY

Vacuum metallurgy represents a field yet in its infancy but with unlimited possibilities. Four basic phenomena make high vacuum metallurgical processes possible. (1) High vacuum provides the only true inert atmosphere, and by its use metals may be protected during processing or heat treating. (2) At low pressures the boiling or subliming temperature of metals is reduced sometimes by as much as 1000° C. This phenomenon allows the purification of some metals by selective evaportion, the evaporation of metals for mirror work, and similar processes. (3) Operation in a vacuum tends to lower the reaction temperature by favoring any reaction

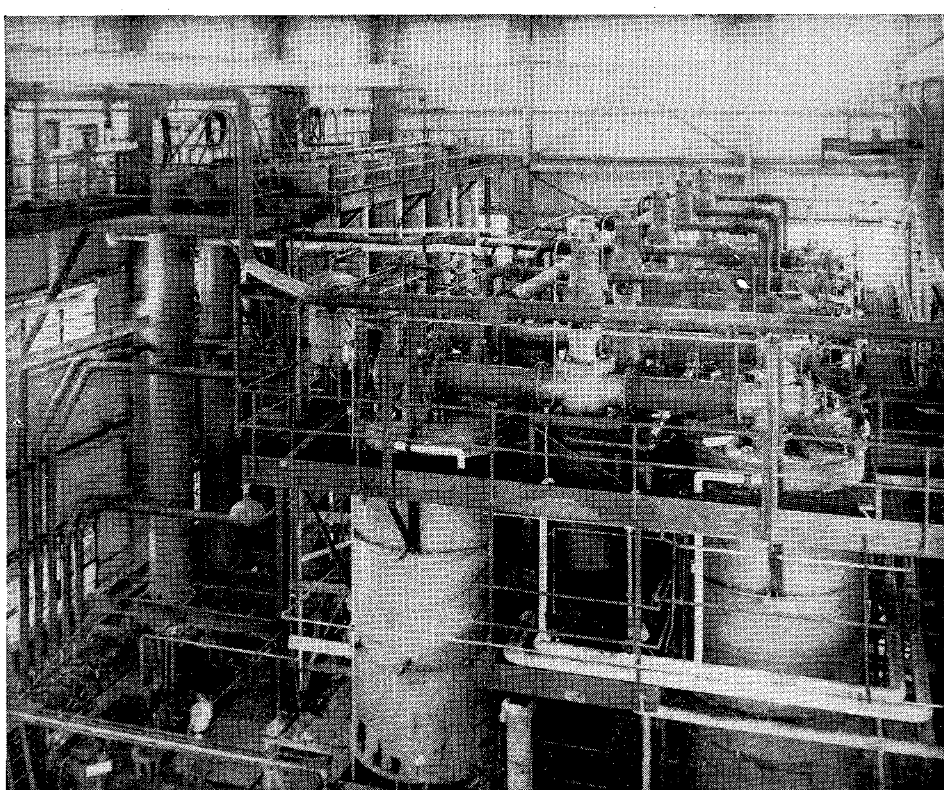


Fig. 4 Vacuum Foods Corporation drying plant for orange juice. Falling-film concentrators at left; two rows of powder dryers in foreground with rotary condensers between.

in which gas or volatile metal is produced from non-volatile constituents. (4) In many cases dissolved gases can be removed by melting the base metal in vacuum.

During the war these properties were put to use in the now-abandoned thermal-reduction process for producing magnesium. Although the economics of the process would not justify its use except for emergency operations it represents a typical application. Calcined dolomite and ferrosilicon are crushed, mixed, bricquetted, and charged into a vacuum retort. There, at a temperature of 1175°C. and at a pressure of 100 microns, magnesium vapor is condensed away from the other constituents in a very pure form.

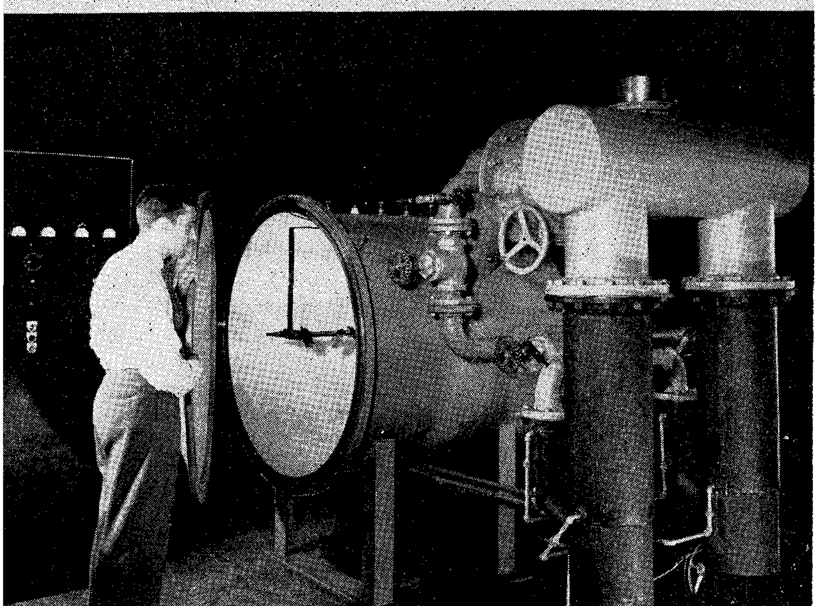
In this reaction vacuum prevents the oxidation of magnesium, allows the metal to distil as rapidly as it is formed, and by lowering the boiling point of magnesium permits the reaction to proceed 500°C below the temperature required for reduction at atmospheric pressure. Similar processes are used for obtaining other metals in pure form.

The properties of gas-free metals are extremely interesting. In general they seem to show increased ductility, conductivity (both thermal and electrical), density, and permeability, and decreased hysteresis loss, blow holes, and gas evolution.

An interesting illustration of the use of vacuum furnaces lies in the hydrogen-atmosphere, heat-treating field. Despite the added cost of vacuum equipment, the process is quickly made more economical by virtue of the fact that only about 2 per cent of the customary amount of hydrogen is consumed. For use in this field, equipment has been developed capable of handling tons, not pounds, at temperatures up to 2000°C.

VACUUM DISTILLATION

Vacuum distillation has long been a field of great interest to the chemist and chemical engineer because low air pressures minimize oxidation, lower boiling points



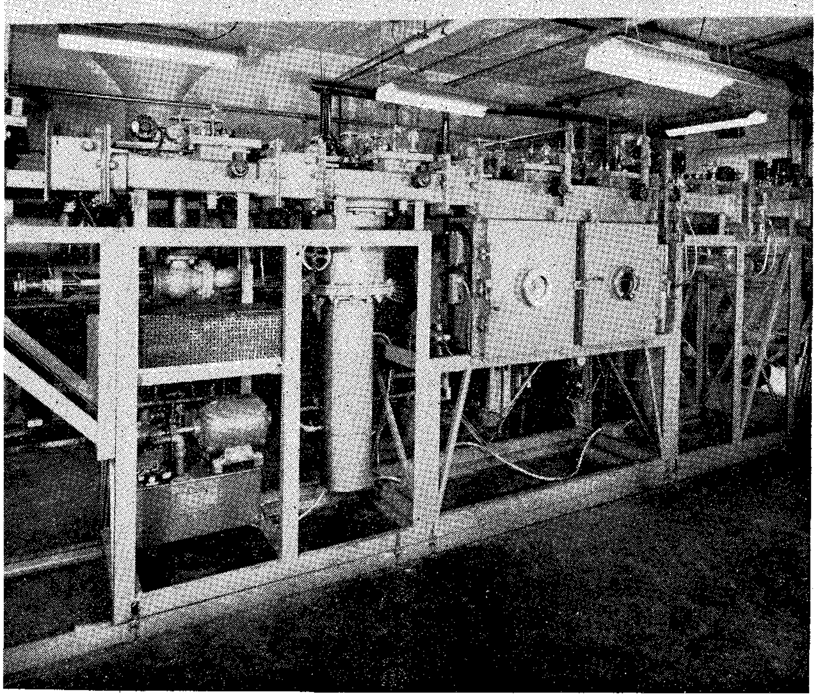
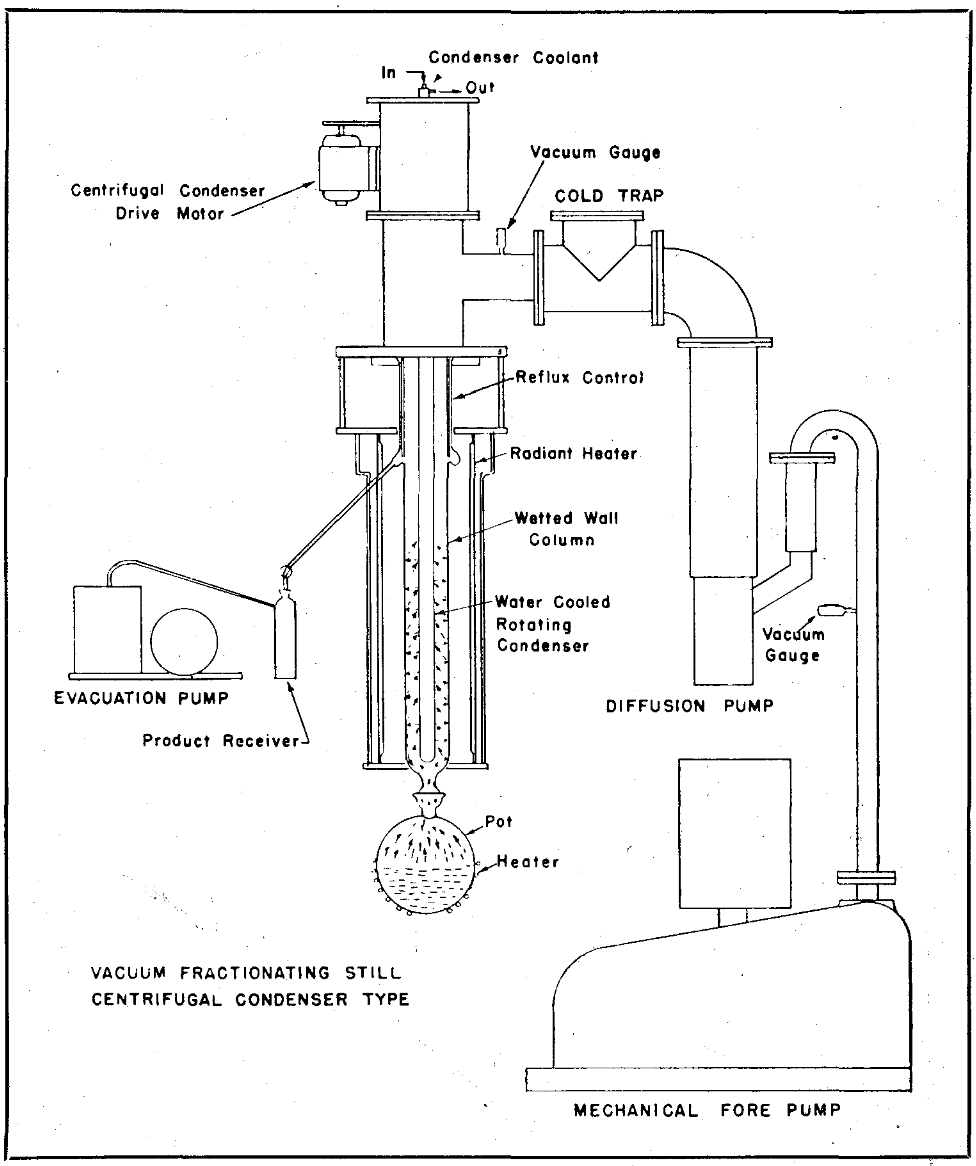


Fig. 5 UPPER Installation of bell jar units for deposition of low-reflection films on optics.

Fig. 6 CENTER Large high-speed tank unit for evaporation of both metals and salts.

Fig. 7 LOWER Machine for continuous production of front-surface mirrors. Glass enters from conveyor on left; mirrors returned to conveyor on right.

Fig. 8 Schematic diagram of Rotary Condenser Still having high fractionating power.



with consequent reduction or elimination of thermal decomposition, and remove the effect of residual gas on distillation rate.

Butyl stearate may be used as a typical example of boiling-point depression with reduced pressure. At 1.0 millimeter the boiling point is 155°C., while at 10 microns the boiling point is reduced 55 degrees to 100°C. The effect of residual gas pressure on distillation rate is typified by data reported by K. C. D. Hickman for dioctyl phthalate. With partial pressure of the distilland held constant at 1 micron, the distillation rate was five times as great with a residual air pressure of 0.2 micron as it was with a residual air pressure of 50 microns.

To the organic chemist no development could be more important than the rotary fractionating still developed by Dr. J. R. Bowman of the Mellon Institute (Fig. 8). This unit operates on a unique principle and has demonstrated fractionating powers as high as 100 theoretical plates. Heat applied to the bottom pot evaporates the material initially. The vapor then condenses on the outer surface of the rotating condenser and is subsequently thrown by centrifugal force to the outer wall. The thin film on the outer wall is re-evaporated, and the cycle is repeated. By adjusting the heat ratios between wall and pot, the number of re-evaporations and the amount of fractionation versus through-put can be controlled. Obviously the still requires a very large amount of heat input when the material is re-evaporated several times. Although its actual commercial potentialities are not yet known, this type of still will at least provide the research chemist with a valuable new analystical tool. Standard laboratory models are now under construction.

In conclusion, high vacuum may be regarded as a realm that has demonstrated its importance in many industrial fields. Past work forms a firm basis of departure for new. Its future expansion is subject to conjecture, but continued development of equipment and more wide-spread understanding of its possibilities and limitations cannot but make for wider application.

C. I. T. NEWS

PALOMAR MIRROR IS SAFELY MOVED

AFTER a two-day trip, the 200-inch Telescope Mirror arrived safely at Palomar Mountain from CalTech. The transfer was started when a truck and semi-trailer rolled out of the grinding shop at 3:30 in the morning of November 18, escorted by the California State Highway Patrol, Institute officials, and 50 cars full of press and radio representatives. Going inland, the cavalcade stopped at Escondido for the night, shifted gears into low the next morning for the grind up Mt. Palomar. The unloading was successful, and the mirror was deposited to be aluminized and attached to the telescope mounting.

The concave face of the huge disc — 3.75 inches in depth at the center — must now be coated with aluminum to create the necessary reflecting surface. A huge vacuum tank has been constructed at the Observatory to do this job.

Mounting the mirror, already installed in the cell in which it will ultimately be placed in the telescope tube, and testing of the entire telescope will follow. This will require several months, and the telescope cannot possibly be completed and ready from a programmed search of the heavens until late in the spring or early summer of 1948.

ZONING VARIANCE MAKES WAY FOR NEW LABORATORY

THE long-anticipated Earhart Laboratory appears now well on the way toward realization following a Pasadena City Zoning Commission ruling granting the Institute a zoning variance for its property at San Pasqual Street and Michigan Avenue. This new air-conditioned plant physiology laboratory, which will be the only one of its kind in the world, is to be constructed on the same property where the present small greenhouse and laboratory is located. Funds are being made available by the Earhart Foundation, and cost of the addition will be in excess of $200,000.

THE Institute would certainly be remiss in its duties if it failed to call to the attention of all alumni the excellent assistance it received from R. M. "Bob" Lehman '31, in obtaining a zoning variance from the City so that the Earhart Laboratory could be built. Lehman did an outstanding public relations job for the Institute when he, and other persons whom he paid out of his own pocket, circulated a petition in the general area of the laboratory location seeking signatures of property owners stating they approved granting of such a variance. These petitions formed the basis upon which the entire Institute presentation was made to the Zoning Committee. It was an outstanding contribution by an alumnus and gains added importance by the fact that it was his idea from the beginning.

L. A. DuBridge
President

Completely air-conditioned and temperature controlled, the Laboratory will enable not only Institute biologists, but also visiting scientists to work out in detail plant physiological discoveries made in the present small laboratory. Dr. Frits W. Went, professor of plant physiology, who will direct the Laboratory, will through accurate control of individual factors, be able to manufacture his own climate through absolute control of temperature, humidity, light, wind or gas content of the air.

An understanding of the responses of plants to climate will make possible the determination of ideal conditions for growth and production of any kind of plant. It will enable scientists to eliminate the guess-work in developing and discovering the types of plants that will do best in any given area. With records which are available as to the temperature, humidity, amount of daylight and darkness of a specific location, Dr. Went and his associates will be able to duplicate those conditions in the Laboratory.

Other problems to be attacked include study of such fundamentals as "What makes a plant grow?" "What makes a plant flower and set fruit?" "What are the effects of wind and rain on the mineral and water uptake of plants?" It was in the small existing laboratory that much of the work on plant hormones, which influence fruit flowering and fruit set, was developed — and that is only a start in the right direction.

RESEARCH ORGANIZATION HONORS DUBRIDGE

A 1947 Award of the Research Corporation of New York for outstanding scientific achievement was presented to Dr. Lee A. DuBridge, at a dinner in his honor November 3 in Los Angeles. Dr. DuBridge was chosen to receive this award, which carried with it a plaque and a $2500 honorarium, "for his outstanding scientific achievements in directing the Radiation Laboratory of the Office of Scientific Research and Development in the field of microwave radar research, development and application to national defense," Dr. Joseph W. Barker, Research Corporation president, stated.

Chosen in 1940 to head the Radiation Laboratory at the Massachusetts Institute of Technology, Dr. DuBridge served as its director until January, 1946. Out of research and development work done there during the war came the "know how" in microwave radar that enabled the United States to lead the world in its military applications. Four months after leaving the Radiation Laboratory and returning to his prewar position at the University of Rochester, Dr. DuBridge was called to the presidency of the California Institute. Twenty-eight volumes reporting work done at the Radiation Laboratory under Dr. DuBridge's direction are now being published, and are being heralded as the "bible" for all those working in that field.

The Research Corporation is an organization which distributes all its net earnings through grants for the advancement of science. Organized in 1912 through the foresight of Dr. Frederick Gardner Cottrell, who assigned to the Corporation valuable patent rights in the field of electrical precipitation, it makes grants-in-aid to support research in the physical sciences, mathematics and engineering to many colleges and universities. Other public spirited inventors have assigned valuable patent rights to the Corporation which increase its net earnings. In one of these, Vitamin B_1 synthesis, Dr. Edwin R. Buchman, now of the staff of California Institute of Technology, was a co-discoverer and donor with Dr. R. R. Williams and Mr. R. E. Water-man. A large part of the net earnings of this patent supports research in the combat of dietary deficiency diseases.

Three professors of the California Institute, Dr. D. M. Yost and Dr. E. R. Buchman, chemistry, and Dr. G. D. McCann, electrical engineering, are currently doing work under grants from Research Foundation.

MILLIKAN TO SPEAK AT FRIDAY EVENING LECTURE

FRIDAY Evening Demonstration Lectures were resumed in November. This series, which has been made available to the public for the past 20 years, with the exception of interruption during the war, is again held in Room 201, Norman Bridge Laboratory of Physics at 7:30 p.m. This season's lecturers will deal with recent developments in the fields of physics, chemistry, astronomy, mathematics, biology, geology, paleontology, meteorology, aeronautics, hydraulics and electrical, mechanical and civil engineering.

Dr. Robert A. Millikan, professor emeritus of physics, will speak on "The Jubilee of the Electron," December 5.

"Blood and Heridity" will be discussed by Dr. R. D. Owen, associate professor of biology, on December 12.

FOREIGN STUDENTS HAVE OWN ORGANIZATION

STUDENTS from 40 foreign lands are among the 1320 men who have completed registration at the Institute for the 1947-48 school year. The number of foreign lands represented on the campus is considerably in excess of last year when only 24 countries had students at the Institute.

The Inter-Nations Association, comprising CalTech students from all 40 foreign lands and this country, held a get-acquainted party Saturday night, November 8, at the Athenaeum. President of the Association is Patrick Michael Quinlan of Ireland, and Mrs. Jerome Seitz, now of Pasadena, but formerly of Brazil, is social chairman. Miss Esther Gilbert is membership chairman. Professor Horace N. Gilbert, chairman of the faculty committee on foreign students, addressed the gathering as did also Dudley C. Monk, head of the United Nations organization in Pasadena and a member of the association. This was the first of a number of programs planned for the year.

Countries in addition to the United States which were represented at the party by students included Cuba, India, Malaya, Iraq, Brazil, Turkey, Egypt, Palestine, Puerto Rico, France, China, Canada, Austria, Norway, Belgium, Switzerland, Colombia, Lebanon, Hungary, Holland, England, Mexico, Italy, Australia, Sweden, Honduras, Wales, Argentina, Iran, Germany, Burma, Peru, Ireland El Salvador, Siam, South Africa, Uruguay, Czechoslovakia, and Yugoslavia.

INSTITUTE CHEMISTS DEVELOP NEW ANTIMALARIAL DRUG

EXTRACTION OF two antimalarial chemicals, one of them 100 times as powerful as quinine, was announced recently by Dr. J. B. Koepfli, J. F. Mead and John A. Brockman Jr., of the Institute Chemistry Department, in a report to the **Journal of the American Chemical Society.** The chemicals were obtained from the leaves and roots of a plant long known to the Chinese as having antimalarial properties. In China, its roots are called **ch'ang shan.** The botanical name for the plant is **Dichroa febrifuga.**

Febrifugine and isofebrifugine are names the chemists give to the the new antimalarials. The names, as well as the last name of the plant, come from two Latin words meaning fever-reducing. Febrifuge is an old medical term for any fever-reducing remedy.

Tested against malaria in ducks, **febrifugine** was about 100 times as active as quinine. **Isofebrifugine** has only slight activity against duck malaria. Koepfli, Mead and Brockman are now exploring the possibility that leaves of the plant may contain still another antimalarial chemical.

J.P.L.'S DUWEZ APPOINTED M.E. PROFESSOR

DR. POL DUWEZ of the Jet Propulsion Laboratory was appointed associate professor of mechanical engineering at the Institute, effective September 1. Professor Duwez came to CalTech in 1941 from Belgium as a special Belgian-American Education Foundation student on research work. During the war he was concerned with research work conducted at the Institute for both the OSRD and the Navy and since then has been connected with the Jet Propulsion Laboratory doing research and development work with both ceramics and metals in the field of jet propulsion.

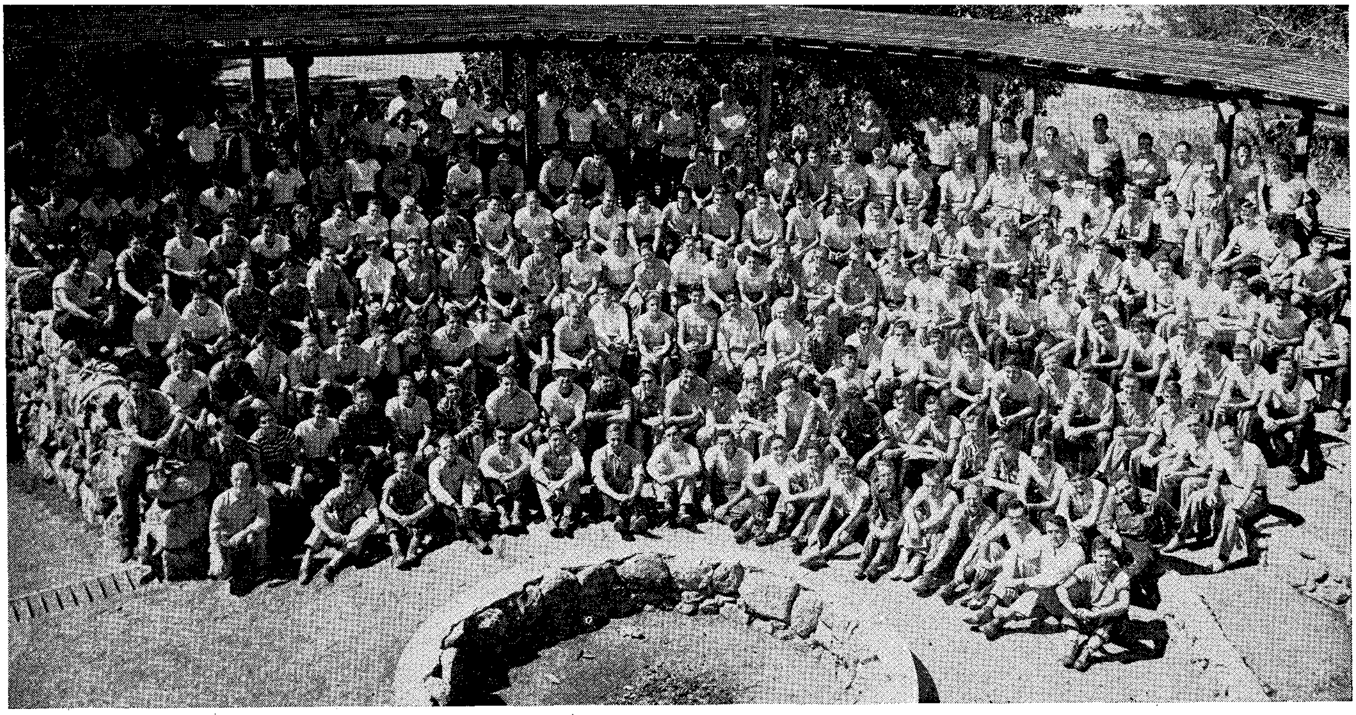
SERVICE LEAGUE NOW OPERATING

CALIFORNIA Tech students, their wives and their babies are getting unprecedented attention these days as a result of the newly-formed Service League, which completed its formal organization late in October. Patterned somewhat after the Stanford University Mother's Club, organization of the League commenced last spring with parents of students, friends of the Institute, and faculty members meeting with school officials to present the proposed student welfare program. With enthusiastic approval of President DuBridge and other school officials, a specific program was laid out and organization work started.

Three major projects of the League are already well along to realization. First is the establishment of a new CalTech Health Center on the campus. A war surplus temporary building which had previously been a sick bay was obtained by the Institute and is now approaching completion on the campus. It will have six beds, 24-hour nursing service, and a full-time physician. Meals will be prepared in the kitchen of the student houses. The League is not only decorating but also helping otherwise to furnish this building.

With convalescent care of students arranged, the League next turned to a program of welfare aid for students' wives and children. Out of this came a decision to do two things — establish a well-baby clinic and also a baby furniture and equipment pool. Both are now in their early stages of operation. The well-baby clinic is held one afternoon each week by Dr. Belle D. Poole, supervisor for the Southern California District of the State Maternal and Child Hygiene Department. Cooperating with her in conducting the clinic is the City of Pasadena Health Department.

Bassinets, bathinettes, play pens, baby scales and other types of infant equipment are already being contributed by members and others to establish a pool of such equipment for loan to married students with families. Mrs. Archibald Young, Pasadena, is chairman of the committee in charge of this project.



Report from Camp Radford

By LEONARD F. HERZOG*

THAT now ivy-encrusted CalTech tradition, the Frosh Camp, this year was a spectacular success, and members of the class of '21 who conceived the first one-day Freshman "retreat" can look with pride on the robust youngster their idea has grown to be.

Through the years, the Frosh Camp has expanded from its original form to a full three-day briefing and get-acquainted session; two years ago the Institute, recognizing the value of this YMCA-sponsored activity, assumed management of the camp. This year's result was a well-integrated, purposeful, enjoyable meeting, notable for the evident quantity of behind-the-scenes preparation which had preceded it.

To this observer, the most notable aspect of this year's meeting at Camp Radford, California, was a new emphasis. In addition to informing the Freshmen on such subjects as Institute history, departments, activities, student life, and "how to study," every speaker stressed one point: The foremost duty of the student, to himself and to humanity, during his stay at Tech was the development of character, the integration of personality, and the acquisition of those qualities which would enable him best to communicate, cooperate, and mix socially with his fellow men.

Periods during morning, afternoon, and evening were devoted to talks and orientation. Plenty of time for sports and recreation during which the new men, representing some 40 nations as well as most states, could best get acquainted — was provided throughout the schedule, and night meetings were over early enough to allow further social mingling, mostly in the form of "bull-sessions" and card games, to take place.

Meals were excellent, thanks to the capable work of Mrs. Ellen Bunton, manager of the Student Houses, and her staff, which journeyed en masse to the San Bernardino Mountain resort for the meet.

Featured in the closing hours of the camp was the traditional Frosh-Faculty baseball game, played on the banked (balls hit to the outfield bounced off the mountainside and back to the infield) Radford diamond. The powerful bats of DuBridge, Hershey, Clark, Strong, et al built up an early Faculty lead, which the oldsters managed to hold onto long enough to eke out a 9-8 victory over the surprised youngsters.

Choicest bit of repartee of the camp was engaged in during the seminar on "how to study"; the participants were Dean Strong and Prof. Owen of the Biology Department, who had just completed a discussion of thought-processes.

Prof Owen (probably abeted by new-Dean Eaton's reference to himself as Assistant Dean): "Someone has said that an Assistant Dean is like a mouse trying to become a rat."

Dean Strong: "I'd like to know where that leaves me — I'm an Associate Dean."

Prof. Owen: "I should say that sounds like an impossible hybrid."

Heading the list of speakers were President Lee A. DuBridge, and Howard Lewis, Vice-president of the Alumni Association, whose remarks were aptly titled "Report from an End Product." Other speakers included Bruce Worcester, ASCIT president; Registrar L. W. Jones, formerly associate dean for upper classmen; Dr. Chester Stock, new chairman of the Division of Geological Sciences; Placement Director Donald S. Clark; Mr. H. Z. Musselman, director of physical education; J. Mason Anderson, varsity football coach; Ed Preisler, Freshman football coach; "Doc" Hanes, cross country mentor; Dean Franklin Thomas; Prof. Frederick Lindvall; Prof. John Schutz, and various student leaders.

*Junior geologist Herzog is editor of the CALIFORNIA TECH, attended camp not only in advisory and reportorial capacities, but also to scout prospective staff members.

Research in Industry

(Continued from page 7)

and some understanding of the economic and social problems of modern business.

For the right men there exists today a great field of opportunity in industrial research. It is in itself a rapidly growing "business" in which high reward may be found both professionally and financially. In fact, a noticeable trend today is to provide for ample salary advancement in straight non-administrative technical work for suitably qualified men. There are, of course, many other avenues of advancement as well, including administrative work within the industrial research group, or transfer to other types of business activity such as manufacturing and marketing.

FUTURE OF INDUSTRIAL RESEARCH

Industrial research is now a large industry in itself and is at the threshold of its greatest expansion. Immediate major problems include the training of more research personnel, the provision of adequate physical facilities, the promoting of public understanding of research and its importance, and the developing of a permanent mechanism for applying effectively the results of industrial research to national security. As potential participants in industrial research, men trained in science and engineering can look forward to the future with confidence. "Science has its cathedrals built by the efforts of a few architects and of many workers."* Industry will look to science and engineering graduates as architects of its future cathedrals of applied scientific knowledge.

*From the preface of Lewis & Randall's "Thermodynamics."

Letters to the Editor

(Continued from page 3)

if I had been busy I would not have read the magazine.

So much for destructive criticism, now for the constructive part. . . . Why not articles on what is new at the Institute? Set some of the graduate students to write them up; it would be good practice for them. An article like this if advertised on the front cover would cause most of us to at least open the magazine. . . . How about the Placement Service? It certainly deserves a place in the magazine giving an account of the new openings available and also in more normal times the men available.

E. D. Alcock '33
Dallas, Texas

What do others think? Thanks for your ideas, we are working on them. Some of our difficulties are mentioned in "With the Editor," November 1947. —Ed.

THE article on Registration of Engineers in California by Martin H. Webster in the October issue has been read with great interest. It has been of particular interest to me because of my long residence in California and the fact that I am now an active participant in the campaign for registration of engineers in Texas.

We have found one of our greatest problems to be that of interesting the young engineering graduate in the value of future professional status during those years when he is gaining the experience necessay to qualify for professional rating. Since the Texas law itself makes no provision for this we attempt to handle it through the Texas Society of Professional Engineers, affiliated with the National Society of Professional Engineers, membership in which is limited to registered professional engineers.

As a member of the fees and salaries committee of the Texas Society of Professional Engineers and a director of its Fort Worth Chapter, I should be very interested in receiving or furnishing any additional data along these lines which may be available or desired and which might in any way promote the acceptance of engineering as a recognized profession.

F. C .Clayton '25
Fort Worth, Texas

E&S will be glad to serve as a clearing house for questions or information. —Ed.

ALUMNI NEWS

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

C.I.O. ORGANIZER SPEAKS TO ALUMNI

"LABOR'S View of the Industrial Future and the Taft-Hartley Act" was the speaker's subject at the first dinner meeting for the 1947-48 year in October. Mr. John A. Despol, international field representative with the United Steel Workers of America, said that he was speaking both as a union organizer and as a private citizen on the premise that he believed thoroughly in civil liberties and the right to speak out against any impending dictatorship, whether it be political, church, capital or labor.

The platform of the C.I.O. includes among its planks: a guaranteed annual wage; more social security; international control of atomic energy; and the spending of more money on education.

A constant threat to our future, said Mr. Despol, is the infiltration of Communism into our society. The C.I.O., under the leadership of Phillip Murray, who is a staunch Catholic, is waging a bitter fight against Communism. Labor's attitude on the Taft-Hartley Act is that it is a legislative monstrosity incapable of enforcement and a measure over which even the authors are in disagreement concerning the meaning.

Approximately 30 minutes of questions and answers concluded Mr. Despol's part of the meeting.

LIEUT. GOVERNOR WILL SPEAK AT DECEMBER ALUMNI MEETING

LIEUTENANT Governor Goodwin J. Knight will speak at the December 4 dinner meeting of the Association. "America Comes of Age" is his topic, to consist of a critical analysis of current national problems.

Preceding Lieut. Gov. Knight on the program is Frederick C. Lindvall '28, youthful professor of electrical and mechanical engineering, chairman of the Division of Civil and Mechanical Engineering and Aeronautics, and a member of the Executive Committee. Dr. Lindvall will briefly discuss "Current Engineering Interests at the Institute."

Lieut. Gov. Knight, whose talk, it is expected, will be transcribed and broadcast later in the evening of December 4, is a Stanford graduate. He received the bachelor's degree in 1919 following 19 months of Naval service.

Upon his graduation, he received the Telluride Scholarship grating him a year of study at Cornell. Knight then returned to Los Angeles, where he practiced law until 1934.

In 1933 he purchased a Mojave Desert gold mine. Developing the property, he operated it successfully until 1936, when he sold one-half interest. Knight's employee relationships of that period are still considered a model of good mine operation. His mine was not troubled by strikes and work stoppages prevalent in that area.

Appointed Judge of the Superior Court in Los Angeles County in 1935, he faced 5 contenders for this office in the elections of 1936. Knight defeated them all in the primaries, and was opposed in 1942.

Knight was elected Lieutenant Governor in the fall of 1946, and assumed office last January.

With the Board

WE have mentioned how the affairs of the Association have grown in number and complexity. One means of assuring that there always will be experienced members of the Board is that of replacing only part of the membership each year. This has served well but even so it has been difficult for new Board members to take hold quickly. To remedy this situation, Don Clark suggested along toward the end of the 1945-46 year that a pamphlet describing how the Board works and what it does would be very helpful. The writer was then a member of the Board without portfolio and so he took on the preparation of a Manual of Operations.

The draft prepared at that time was turned over to Harold Huston at the beginning of the 1946-47 year and he labored hard and long collecting comments and advice of past and present members of the Board. In June 1947 when Harold's term on the Board expired he turned over to Jim Bradburn, his successor, a pile of Manual papers about an inch thick, saying the job of collecting was done and from then on, the editing, rewriting, and compiling could receive full attention. Jim Bradburn has secured the aid of Earl Burt whose job it now is to distil from this mass of notes the essence of wisdom and experience which went into their preparation and to present this essence clearly and briefly. Having seen how Earl gets things done the writer has great confidence that there will soon be a Manual of Operations for the Board of Directors and officers of the Association, and that it will be a good one.

* * * * * * *

You've heard of the difficulty experienced occasionally when a person has tried to give away dollar bills or to sell five-dollar bills for a dollar. As you know, the Association By-laws provide for the remission to chapters of a fraction of the membership dues paid to the parent association. This provision is to encourage the formation and activity of alumni chapters wherever there are enough Tech men to warrant. The only requirement to receive remission of the sum due is that a chapter notify headquarters of its membership each year; a check is then sent to that chapter. Yet in some cases, the director in charge of chapters frequently asks chapters more than once if they want the money. As this is written one or two chapters still can obtain financial aid for their activities by writing to Doug Sellers, care of the Alumni Association. And we might add, Doug will be glad to see that the money is forwarded promptly.

H. K. F.

DAVID PRESSMAN '37 NOW DOING RESEARCH IN NEW YORK

DR. DAVID PRESSMAN '37, American Cancer Society senior fellow, who has been doing research work at the Institute on immuno-chemical radio activity tracers on tumors and tumor tissue, is continuing his work in New York City at the Sloan Kettering Institute Memorial Hospital. After receiving his doctorate here in 1940, Dr. Pressman remained at the Institute as a research fellow from 1940 to 1942 when he became a senior fellow in the Chemistry Department. During the past year he has been a research fellow of the Cancer Society, carrying on work under a Cancer Society Grant.

PERSONALS

1924

FRED A. HOUGH has recently been promoted to vice-president of the Southern Counties Gas Company. He will also continue in his present capacity as executive engineer and a director of the Company

L. BENTLEY COPELAND died October 16, 1947 after a short illness. Mr. Copeland was in partnership with Alfred W. Knight '22, patent attorney for Western Precipitation Co., Los Angeles.

1925

HENRY R. FREEMAN recently spent a vacation in San Francisco. While in the Bay area, Mr. Freeman attended the annual San Francisco Chapter Barbecue, which was held at Bob Bowman's walnut grove home in Concord. Between 50 and 60 San Francisco Alumni, wives and friends attended. They met on the afternoon of September 20, played games, visited, ate heartily, and swam in Bob's swimming pool until late evening.

1931

GLENN CHAMBERLAN is now with Bechtel Corp., in Louisiana, Missouri, as senior engineer, and is in charge of the Electronic and Dynamic Department. Bechtel Corp. is operated by the Bureau of Mines.

1932

EDWARD C. KEACHIE is now on the U.C.L.A. faculty as lecturer in Industrial Management.

1933

LOUIS H. GOSS, former city engineer of Monterey Park, became city engineer at Redondo Beach, November 1. Goss was assistant engineer for South Pasadena and engineer-manager of Brawley before serving as city engineer of Monterey Park. During the war he served in the Army Engineer office in Los Angeles.

1934

N. van WINGEN, associated with the Richfield Oil Corporation, Los Angeles, since 1938, has resigned to join the faculty of the University of Oklahoma as a professor of petroleum engineering.

1935

L. J. STUPPY was graduated from Harvard Medical School and spent five years in the Army Medical Corps. Stuppy is now practicing in Los Angeles, specializing in heart diseases and internal medicine. Larry and his wife, the former Miss Mary Lissner, have four children.

1937

DANIEL T. GERLOUGH is studying at the University of California for an M.S. in Electrical Engineering. Dan expects to write a thesis on some phase of electronic computing devices.

HUGH F. WARNER is now with Westinghouse Electric Corp. as manufacturing engineer in the newly acquired 57-acre plant in Sunnyvale, Calif. Schedules call for production of heavy electrical equipment and employment of 4000 workers by the end of 1948.

1938

STEPHEN JENNINGS received a Ph.D. in physics from Ohio State University in August.

1940

J. KOHL is now teaching a U.C. Extension Division course at Berkeley in Process Instrumentation.

DR. JOSEPH F. MANILDI has recently received two appointments: to the staff of University of California Extension; and to an assistant professorship of engineering on the Los Angeles Campus of the University. Previously he served for some years as director of research and chief engineer for the G. M. Giannini & Co., Inc., directing a research program connected with jet propulsion engines.

1941

NEWELL T. PARTCH now has two children, a six-months-old daughter, and a son Eric, two and one-half years old.

1942

W. T. HOLSER, lecturer in geology at Columbia University, spent the summer months near Philipsburg, Montana, doing geological field work under a special research grant from Columbia University. The investigation is concerned with contact metamorphic effects around the Philipsburg batholith and related intrusive, and the magnetite iron deposits associated with these contact effects. Holser was assisted by J. W. ALLINGHAM '48.

FRANK I. GIVEN announces the birth of a daughter in mid-September. Given is now a project engineer at Bendix, in North Hollywood, testing components for guided missiles.

1945

RICHARD A. B. KNUDSEN is attending U.C.'s Hastings College of Law. Before entering Hastings, Dick worked at U. S. Propellers as assistant engineer testing experimental propellers.

1947

ADOLFO J. ATENCIO, Argentine naval officer, is studying plant layout and overhaul base operation in Pacific Airmotive Corporation's new Burbank aircraft overhaul facility. These studies are to be used as the basis for setting a similar type of operation in Argentina. Lt. Atencio is a graduate of the University of Buenos Aires in Civil Engineering. Following his work at Pacific Airmotive, he will be stationed at Bahia Blanca, Argentine Naval Base.

CARL RASMUSSEN is now employed at North American Aircraft, in Inglewood, Calif.

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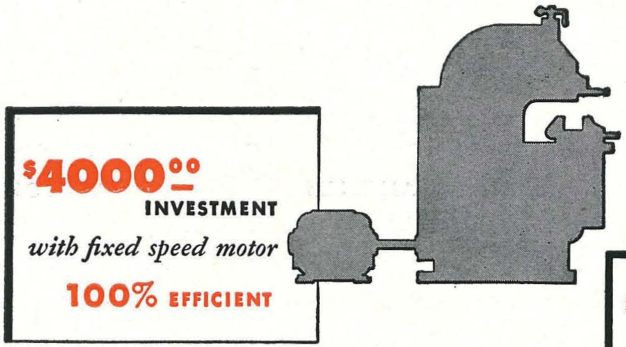

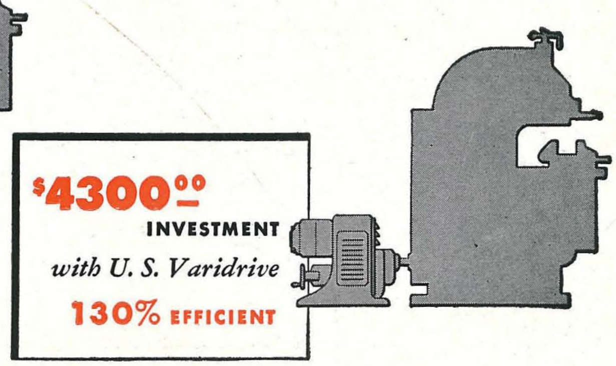

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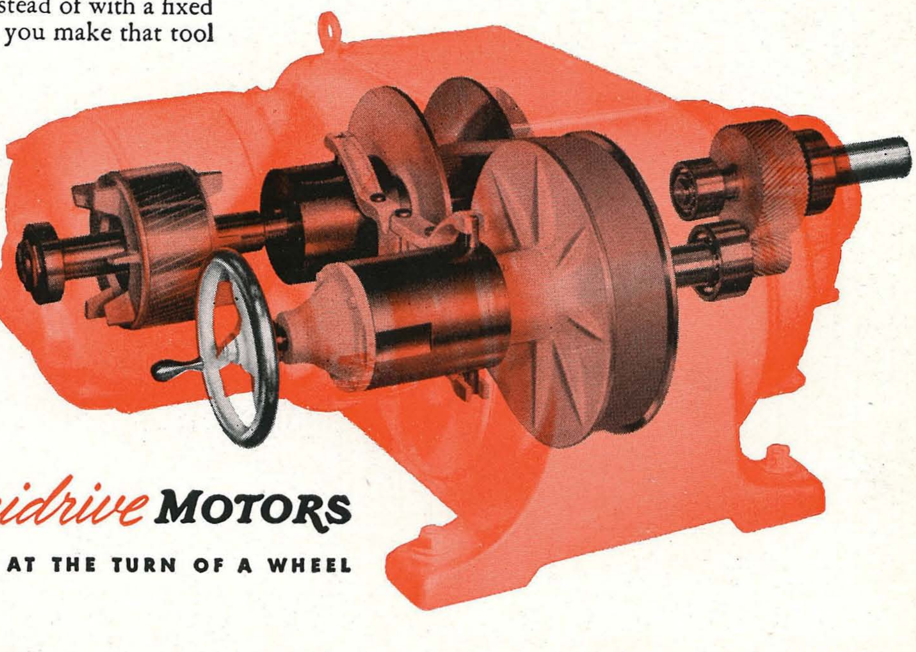

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