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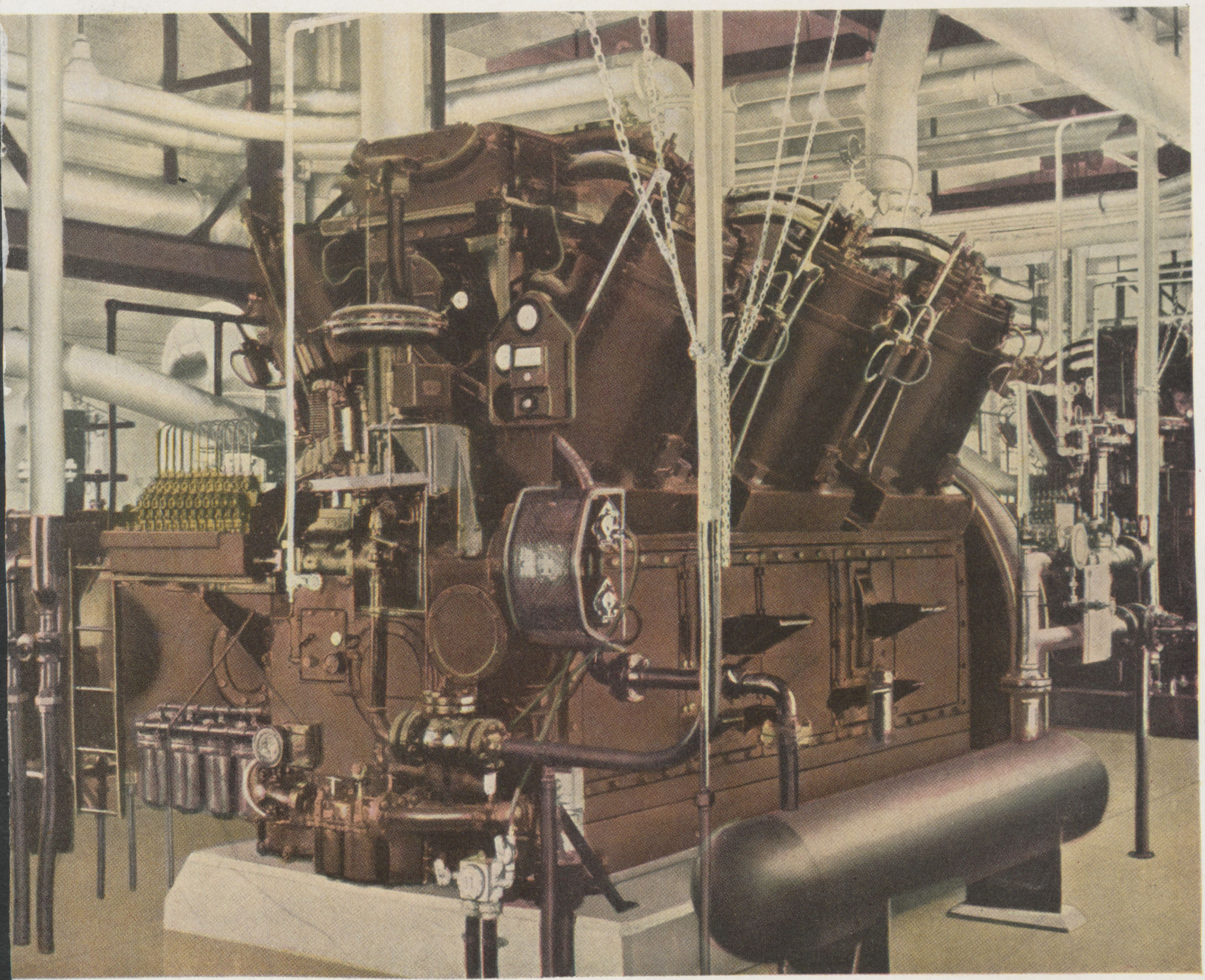

MARCH, 1946

MEMBER ENGINEERING COLLEGE MAGAZINES ASSOCIATED

THE ROSE TECHNIC

VOLUME LVI, NO. 8 MARCH, 1946

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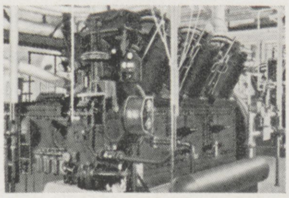

A Cooper-Bessemer Diesel Engine
—Courtesy Diesel Power Magazine

FRONTISPIECE

160,000-Kilowatt Steam Turbine Generator
—Courtesy General Electric

CENTER SPREAD

36-inch airway beacons coming off the production line
—Courtesy Westinghouse

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Engineering Is a Profession

Within recent years there has been much discussion concerning the classification of engineering as a profession. All such discussion, of course, centers about the definition of the word itself. By setting rigid limits to the types of occupations which may be classified as professional, it is possible to exclude engineering; but it may be easily shown that an engineer satisfies a more liberal definition which includes the social obligations of a professional man.

It is impossible to describe a professional occupation adequately with a few words or even with a sentence; it must be defined in terms of the characteristics of the occupation, of the type of people engaged in the occupation, and of the training necessary. Society is the final judge of whether an occupation is or is not a profession.

What, then, are the characteristics which mark one occupation as a profession and a second as just another job? First, it must be a type of activity in which there is a great deal of responsibility, and in which the problems are of an intellectual nature. Second, a profession is motivated by service and self-expression, as distinguished from profit.. Third, the individuals in the occupation must have acquired a body of knowledge and skill. Finally, a profession must have a code of ethics through which it promises certain things in the dealings of its members with society.

Does engineering satisfy these four requirements?

Engineering certainly involves a great deal of responsibility. The engineer designs a bridge; he is responsible for the safety of perhaps millions of people that will cross that bridge. An engineer designs a plant to produce a new product; he is responsible for the safety of perhaps millions of dollars that his company will invest in the plant. The problems of engineering are of an intellectual nature. Engineering is based on mathematics, which is the most exact of all sciences.

The second requirement is one of motives. Of course, money is always a motive, but the professional man will think of service before money. A doctor will try to save a dying man whether he can pay or not. The question of motives is one that varies with each individual. Some lawyers will take cases when they know their client is guilty; some engineers practice only for economic reasons; but I believe most engineers are proud of their work and are more interested in solving the problems connected with it than they are in getting more money for their efforts.

The third requirement—that of possessing both knowledge and skill—is definitely met by almost all engineers. To acquire the large fund of information needed for engineering work, it is usually necessary to obtain a college degree. While it is true that an equal amount of knowledge may sometimes be obtained through experience, it is also true that this method is much more difficult. A college degree also implies some realization of the social significance of engineering.

The fourth requirement is that of a code of ethics—which all branches of engineering certainly possess. The controversial question under this point is the method of enforcing this code. In the law profession, the code of ethics is enforced through the bar association, which has the power to keep a man from practicing law if he should break the code of ethics. In engineering, however, the responsibility of keeping the code is left to the individual. This may not be as satisfactory a method of enforcing the code, but the code is in existence and is kept by most engineers.

Does society recognize engineering as a profession? In general, it must be admitted that such recognition is not extended at present. One very important reason for this is that engineers do not deal directly with the public, as do doctors, lawyers, and ministers. When the doctor administers penicillin or a new sulfa drug to a patient, the patient gives the doctor full credit for the drug and does not realize the engineering necessary to develop the drug from a laboratory curiosity to an industrially manufactured product.

What can engineers do to be recognized by society as members of a profession? The best way of accomplishing this is to educate the general public—including engineers themselves—to the place and the significance of engineering in our modern world. Through publicity, the public must be kept aware of what engineers are doing. Engineers report most of their achievements in the technical press, but only the most outstanding achievements ever filter through to the public.

Engineering is a profession, but it is the duty of engineers to see that society recognizes this fact.

HERBERT BAILEY

BRIEFS

by Ray Osburn

Midget radio receivers and other delicate pieces of electrical equipment are now employing "wires" of metallic inks printed on small plates. In the new process, silver-containing inks are stenciled on thin ceramic plates to produce a wiring circuit of thin lines of silver instead of the conventional copper wires. Resistors are supplied in a similar manner by stenciling the plate with carbon inks. The rest of the instrument is then built around the printed wiring circuit by soldering condensors, midget tubes, and other necessary parts to the circuit.

The new process was developed during the war to meet special needs for extremely compact, light-weight, and yet accurate electrical equipment. Printed wiring diagrams were used in such important instruments as the proximity fuse, an intricate radar mechanism which had to be small enough to fit in the end of a bomb or shell. Such diagrams will also find many peace-time applications in radio and electronics. They are expected to bring great savings for some applications by replacing hand-wiring with accurate mass-production methods.

* * *

The development of civil aeronautics will be substantially aided by the manufacture of planes with folding wings. With the introduction of such planes, the capacity of present hangars will be doubled, with a corresponding reduction in storage cost. By increasing the capacity of small airports, the manufacture of this type plane is expected to make the building of new airports more attractive from an investment standpoint.

* * *

A new gas turbine power plant built for the Navy by Allis-Chalmers is now operating successfully at 1,350 degrees Fahrenheit and may be capable of operation as high as 1500 degrees. A 3500-horse-power unit, it is believed to be the first large multi-stage gas turbine for continuous power generation at high efficiency ever operated at such high temperatures. The unit utilizes two turbines operating in parallel, the first to supply the power for the compressor and the second to furnish the delivered power. The device requires 40,000 cubic feet of fresh air per minute.

* * *

In an attempt to lessen the cost of long-range television, much experimental work is now being done in the use of airplanes and blimps as relay stations. Since television utilizes extremely short waves which may not be transmitted beyond the horizon, conventional long-distance television broadcasts require the use of expensive coaxial cables or the construction of relay stations about 35 miles apart. By using planes or blimps at 30,000 feet as relay stations, an area 422 miles in diameter may be blanketed. While the value of the airborne stations is a matter of future determination, it is hoped that they will be cheap and efficient.

* * *

A newly-perfected 1000-watt electric lamp gives three times the light of a conventional 1000-watt bulb. Tubular in shape, it utilizes a mercury vapor arc and provides a yellow-green light. The arc is enclosed in a quartz tube which, in turn, is enclosed in a hard glass tube 14 inches long and 4 inches wide. The high efficiency is attained by the compression of mercury vapor in the arc.

Although a 1000-watt lamp of similar efficiency has been previously developed, it required a stream of air or water for cooling purposes. The new lamp is cooled by the surrounding air alone, although operating temperatures are between 1,100 and 1,300 degrees Fahrenheit. The new lamp is expected to have applications in arc-welding booths, high-ceiling factories, and sports arenas.

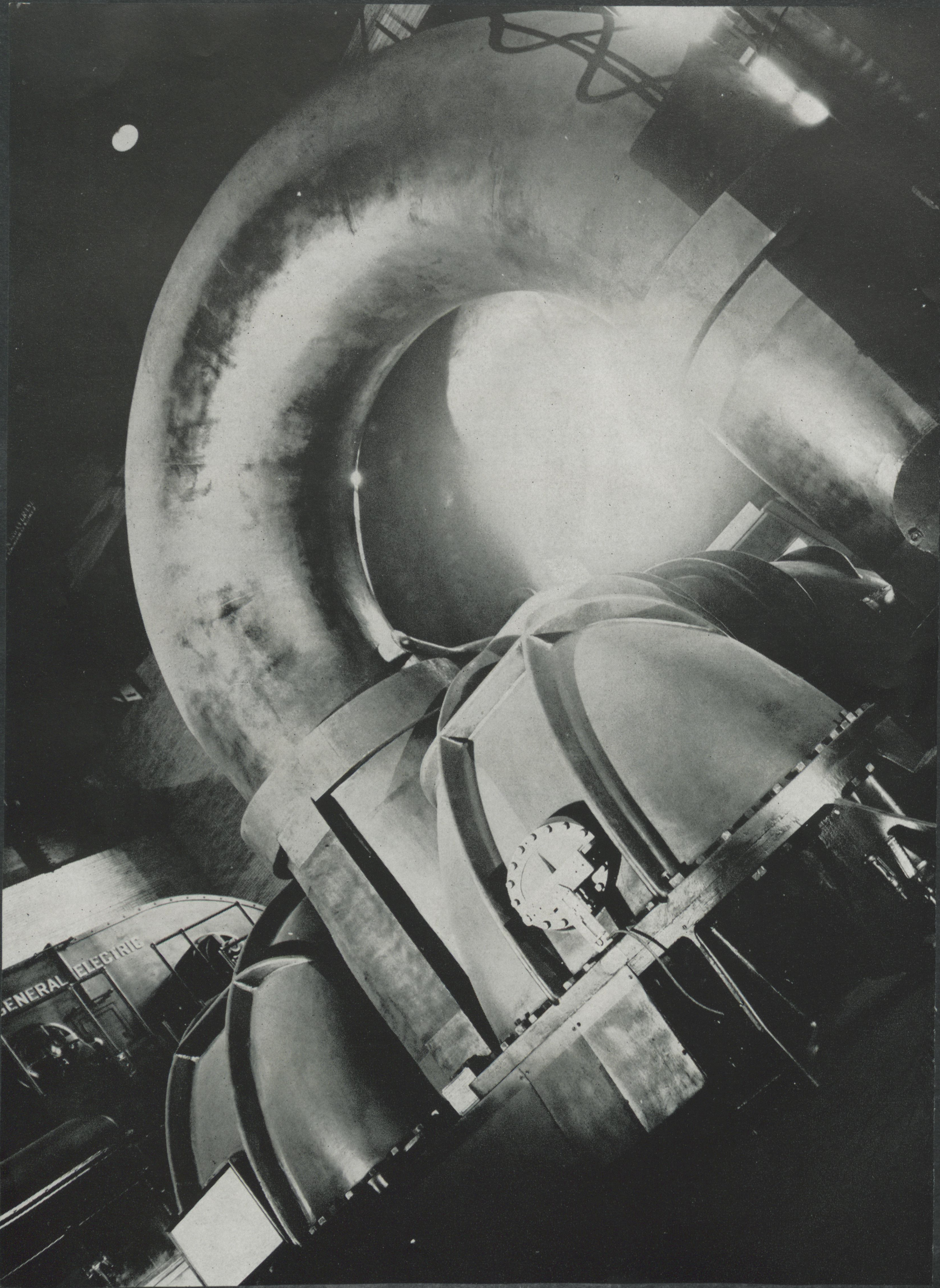
* * *

A new, very rich source of anti-scurvy vitamin C has been discovered in the West Indian Cherry. These cherries yield 34 times as much vitamin C as oranges, and are one of the richest edible fruit sources of this vitamin known. One cherry a day would supply 4 times the needed amount of this vitamin. Fleshy and bright red, these cherries, called acerola in Spanish, grow on small trees in tropical and subtropical America. Six of them weight one ounce, and they have an agreeable acid taste. Although commonly called cherries, they are only distantly related to the cherry family.

* * *

New methods developed during the war for controlling the amount of light reflected from glass by employing chemical films are expected to prove practical for post-war uses. The new reflection-control methods consist of dipping, spraying, or swabbing chemicals on the surface of the glass. The new methods may also be used to increase the amount of reflection from glass and to produce high-reflecting coatings of varied colors.

The new process replaces older methods by being simpler and applicable to larger areas of glass. The uses of the process will range from reflecting windows and one-way glass for ovens and refrigerators to reflection-resistant lenses for binoculars and cameras. Plastics, paper, oil paintings, and photographic prints may also be treated by a modification of the process.


GENERAL ELECTRIC

Synthetic Rubber - Past and Future

by Warren Haverkamp, sr., ch.e.

Photographs Courtesy U.S. Rubber Company

WHEN Japan struck at Pearl Harbor on December 7, 1941, and followed with the capture and looting of the rubber lands of the Far East, America lost 90 percent of its rubber supply. Fortunately for America, a group of men—mostly research chemists and chemical engineers—had been working for a number of years on a group of products generally known as "synthetic rubbers." These, however, were produced only upon a relatively small scale (less than 20,000 tons annually just prior to 1942). The abundance of comparatively low priced natural rubber from the Orient had made the production of synthetic rubber unprofitable.

Few men during the 1920s and 1930s were far-sighted enough to realize that the natural rubber supply from the Dutch- and British-controlled East Indies might some day be cut off, although some experimental work was being done in Central and South America and in Liberia. This work was slowed down, however, by the South American leaf blight, which was extremely harmful to the plants.

It was only after the war in Europe had started and the fear of war with Japan had become more pressing that America became aware that something must be done to insure itself of an abundant supply of this essential commodity.

On June 28, 1940, the Reconstruction Finance Corporation created the Rubber Reserve Company for the purpose of acquiring and maintaining an ample supply of natural rubber. This government agency had the stock pile of rubber at its peak in April, 1942 with 634,000 long tons. The year before, 1941, the consumption in the United States was 766,000 long tons.

In addition to the stockpiling of natural rubber plans were made for the establishment of a domestic synthetic rubber industry. In May, 1941 a program was authorized for the construction of Government synthetic plants capable of producing 40,000 long tons of synthetic rubber annually. A few months after the United States entered the war this program was increased to 805,000 tons, a 20-fold expansion. Additions were made until at the end of the war the capacity stood at 833,000 tons.

These figures are based on engineer's original estimates. Experience showed, however, that the actual production could be expanded to a third more than the estimated production. This would make the synthetic rubber industry capable of producing about 1,100,000 tons of rubber annually. This expansion in quantity, however, results in a deterioration of quality. This capacity may exceed the country's peacetime need, as the peak of prewar consumption came in 1941 with 800,000 long tons.

Types of Synthetic Rubber Produced

The Government produced three types of synthetic rubber under its program. They are as follows—GR-S (butadiene-styrene), GR-I (butyl), and GR-M (neoprene)—for which plant capacities are respectively 705,000, 68,000 and 60,000 tons.

GR-S (*butadiene-styrene*). This rubber represents 76 perecent of the total production, being the general-purpose rubber and most nearly like natural rubber. The principal materials used in the manufacture of GR-S are two compounds, butadiene and styrene, about three parts butadiene to one part styrene by weight being used. Butadiene is a gas produced from either petroleum hydrocarbons or alcohol, while styrene is a liquid produced from ethylene and benzene. The process of combining butadiene and styrene in the production of GR-S is known as copolymerization, performed in copolymer plants. This rubber was used mainly for tires.

GR-I (*butyl type*). This rubber is very impermeable to air. For this reason it is more suitable than other rubber substances for the manufacture of inner tubes, gas bags, barrage

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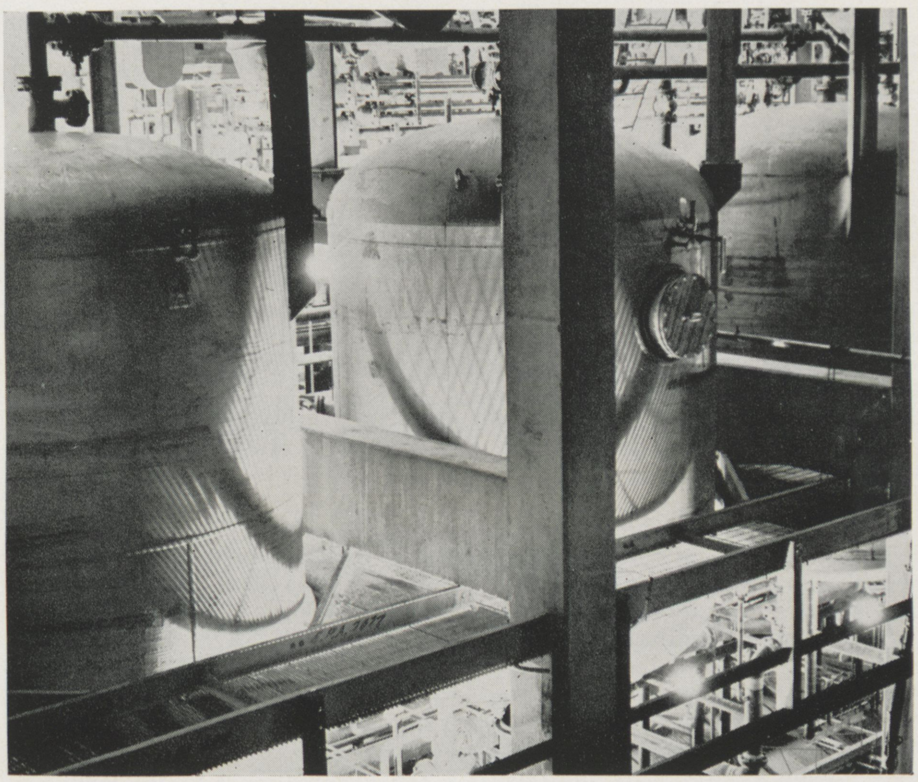
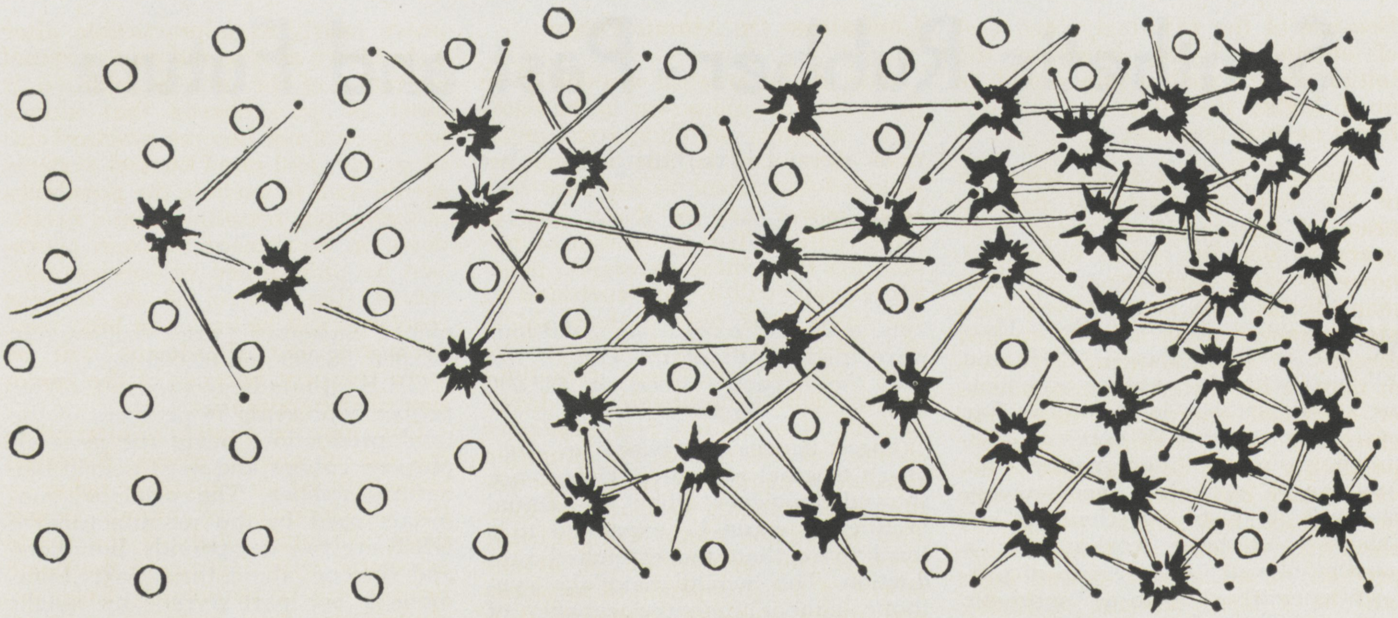


Butadiene-styrene polymerization reactor units. 72 of these units produce 90,000 long tons of synthetic rubber yearly.



Utilization of Atomic Energy

by Robert G. Bannister, sr., ch.e.

IT is a widely known scientific fact that all the power and energy resources used by man in present-day civilization are derived, in the last analysis, from the sun. In burning wood, coal, oil, or gas, we utilize solar energy captured by the photochemical reactions of plant growth; in harnessing wind and water power, we utilize solar heat absorbed by the atmosphere and hydrosphere. With the advent of atomic power, however, we have begun to utilize energy of quite different character. Atomic power, while originally derived from the sun in the sense that all earthly matter originally came from the sun, is unique in that it is produced by direct nuclear reactions within the atom, just as energy is produced in the sun. Thus, man for the first time is learning to use the unlimited power resources inherent in his own planet.

Due to the fact that the first tangible results of atomic research were produced during the war, public opinion has naturally been focused on its tremendous military implications. However, there has also been considerable public interest expressed in the vast peacetime aspects of atomic energy. If effective international control over military uses of atomic energy is ever established, as it must be, atomic energy will offer many possibilities for raising the general standard of living. Until then, government secrecy restrictions may prevent effective research on peacetime uses.

The utilization of atomic power in direct competition with other sources of energy will be much more difficult than its use for military purposes, where the enormous power concentration available more than offsets even the most extreme cost barriers. Contrary to the belief of many, however, there are no fundamental problems blocking the controlled utilization of atomic energy for peacetime use. The manufacture of plutonium for the atomic bomb was carried on as early as 1942 in regulated chain-reacting piles. Large amounts of energy were also produced by these units, but because of the urgent military character of the project this energy was considered as an unwanted by-product rather than as an asset. In the opinion of many scientists, it is very likely that future research will make possible the utilization of this energy on a competitive basis, at least for certain special uses.

Applications of Atomic Energy

The production of power from the heat energy given off by a chain-reacting pile will be analogous to the utilization of heat from present power sources. The process will probably involve a constant circulation of air, steam, or liquid metal through the chain-reacting unit to a heat-exchanger and back again, in a closed system. The heat picked up by the fluid in the pile would be transferred through the heat-exchanger, at which point it could be utilized in any desired manner by methods already standard for other energy sources. Except for the use of the atomic energy unit as a source of power, there would be no changes necessary in standard plant design.

The size, cost, and power capacity of the chain-reacting unit itself may vary widely. A unit operating with ordinary uranium would be the cheapest in initial cost, but it would have to be comparatively large because of the low concentration of U-235 (0.7%). Other disadvantages would include its inability to operate at high temperatures and the fact that it rapidly loses efficiency and must be shut down after only a small portion of the U-235 has been consumed. By starting with uranium which has been enriched with additional U-235, a higher percentage of the U-235 would be consumed. The size of the unit could also be greatly reduced, and a much higher operating temperature would be possible.

Because of the extremely high cost of obtaining U-235, however, the initial cost of such a pile would be much higher than that of a pile utilizing normal uranium.

Estimates by prominent scientists of the time necessary to develop practical atomic power range from years to decades. Once developed, however, such applications will take many forms. The heat derived from atomic power units may be applied directly in manufacturing processes or may be converted into mechanical or electrical energy by steam engines or gas turbines. Another possibility is the development of devices which can utilize atomic power to produce mechanical energy or electricity directly. A valuable byproduct of all atomic power units will be a large amount of highly radioactive material, which may replace expensive radium for the treatment of cancer and for other medical uses. Other applications of atomic power may utilize its tremendous explosive power for various superblasting effects. It is doubtful, however, that the cost of producing atomic explosives can be reduced sufficiently to permit their competition with dynamite and other chemical explosives in ordinary mining operations.

Limitations On Atomic Power

One of the greatest drawbacks to the use of atomic power is the enormous quantity of dangerous radiations developed by the nuclear reactions—equivalent in the case of a large power unit to many tons of pure radium. The protection of human life from these extremely penetrative rays will involve surrounding the entire unit with a thick shield of solid concrete, steel, or lead. The very nature of these radiations makes highly improbable the development of a lighter, less expensive shield. For this reason, the minimum possible weight for such a power unit will probably be about 50 tons. This restriction alone will probably prevent the application of atomic power to the propulsion of airplanes and motor vehicles, although it is possible that ocean-going ships may utilize this source of energy.

The control of chain-reacting units may prove rather difficult under practical working conditions. Shutdowns of such units would be very costly; yet all operations must be carried on by remote control, with many possibilities of trouble developing in the control equipment. Due to the intense radioactivity, maintenance and repair work might prove nearly as impracticable after a shutdown as it would during actual operation of the unit. In addition, it must be remembered that atomic energy will not become practical until sturdy, fool-proof control systems are devised to exclude the possibility of explosions resulting from a breakdown in equipment or from operation by uninformed or careless personnel. The control of the nuclear reactions will be easier at high temperatures, but shutdowns will be more frequent because of the corrosion of the apparatus.

Cost may be another limitation to the use of atomic power. Research alone will be an expensive factor in the development of atomic power units, although much of the waste associated with urgency of the bomb project will be eliminated. Even excluding this item, however, it is apparent that the initial cost of power equipment and fissionable raw material will be very high. Offsetting this is the extremely low rate of consumption of the atomic fuel in comparison with the power delivered. After considering all of the numerous factors involved, many scientists believe that the cost of an atomic power plant in the forseeable future will be small compared with the cost

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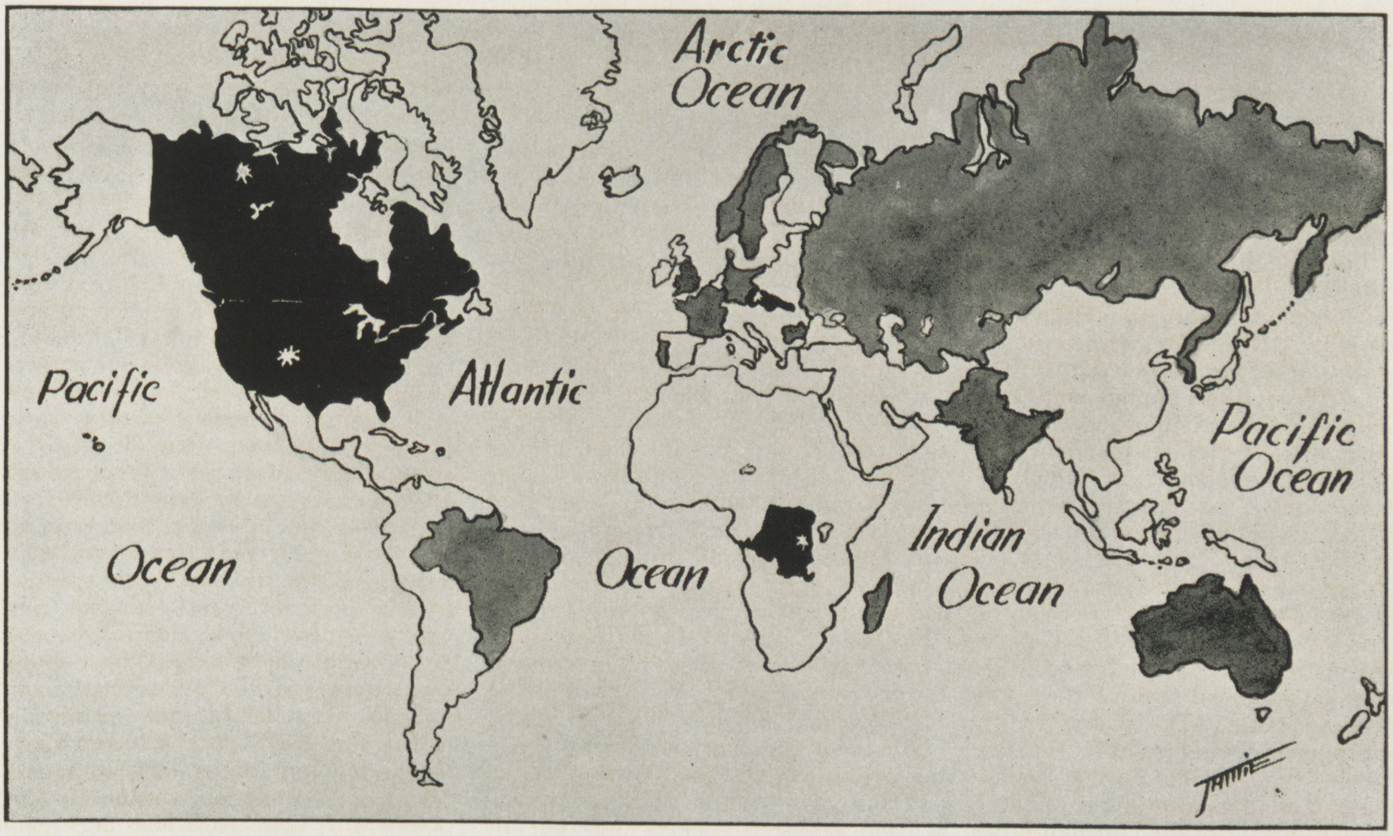

Uranium production of the world: Uranium rich nations are shown in black, with uranium-producing capitols shown as spots of white. Potential large producers of uranium are shown in gray. Nations shown in white have no known uranium resources.

Lockheed's P-80 Shooting Star. —*General Electric*

Jet Propulsion

by Norman Walls, soph., ch.e.

IN recent years many scientists and engineers have begun to think that propeller-driven airplanes are reaching their limits of speed and altitude, and that future progress will depend on the development of new types of propulsion. Recent developments strongly indicate that jet propulsion is the answer to this problem. Although jet engines were originally considered uneconomical because of their high fuel consumption and the frequency with which replacement of parts was necessary, technological progress during the war has greatly increased fuel efficiency and lengthened engine life.

Late in the war new American designs overcame the early German lead in the international race to develop jet engines. One of these, the Westinghouse 19-B, is one of the most powerful engines of its type and size in the world. For a weight, length, and diameter approximately one-half of that of the German types, it develops about 70% of their thrust. This type of engine has a special combustion chamber which provides complete combustion at the high air velocity characteristic of this design. These axial-flow engines are long and of relatively small diameter, lending themselves well to installation in sleek, high-speed aircraft.

Other American jet engines, such as the General Electric 1-16 and 1-40, are of the single-stage centrifugal compressor type in which the air is whirled off the compressor blades into channels leading into the combustion chambers. This arrangement leads to shorter and broader engines, but its proponents contend that greater power per engine weight has been obtained from them than from axial-flow types. The centrifugal compressor type is used in the Lockheed P-80 Shooting Star, which now holds the transcontinental speed record.

There has been much popular confusion between rockets and jet engines. The basic difference between rockets and jet engines is that the rocket type derives the oxygen needed for combustion from its own fuel supply, whereas the jet-type power plant takes oxygen from the atmosphere. Rockets are useful auxilaries for assisted take-offs for overloaded planes or for momentary bursts of speed in combat. Ultimately, rocket power may be harnessed to bridge the gap of low-speed inefficiency characteristic of all jet engines without propellors. In such a system, the initial rocket boost would project the plane to about 10,000 feet and above 400 m.p.h., at which point the jet engine could take over efficiently. Unfortunately, rockets capable of accomplishing this have not yet been developed. Meanwhile, reciprocating engines and propellers seem most feasible for operation at altitudes up to 25,000 feet and speeds in the range of 250 to 400 m.p.h.

Overlapping this sphere of operation are the new combination power plants with both propellers and jets; these are most efficient up to altitudes of 45,000 feet and speeds from

200 to 600 m.p.h. Pure jet propulsion may be reserved for that area of operation between 12,000 and 50,000 feet and for speeds from 450 to 750 m.p.h.

The Westinghouse 19-B axial flow type engine may be used as an example of the present status of jet propulsion. The 19-B engine can develop 1400 H.P. at modern plane speeds. A conventional aircraft power plant of the same power capacity has more than twice the diameter of this jet engine. In addition, the jet unit weighs only half as much as the corresponding piston engine.

The principles of jet propulsion may be summarized as follows:

1. Air is pumped in by a compressor.
2. The air is heated by burning the liquid fuel in it.
3. A portion of the energy of the hot combustion products, which have been expanded to several times their original volume, is used to drive a turbine, the sole purpose of which is to supply power to keep the compressor in operation.
4. The remaining energy is not delivered to a shaft, but appears in the form of a high-velocity jet. It is the reaction of this jet that propels the aircraft.

The jet has only one moving element. The compressor, the combustion chamber, and the turbine are arranged in line—an arrangement which accounts for the streamlined appearance of the unit. Another reason for the streamlined appearance of the engine is that the 19-B employs an axial flow type of compressor. In contrast to the centrifugal compressor, which utilizes centrifugal force to pump in the air and which requires a large diameter, the axial flow compressor is like a fan whose many blades push the air toward the combustion chamber. In this six stage compressor, the rotating blades revolve at a top speed of 18,000 r.p.m. The compressor delivers 50 tons of air per hour to the combustion chamber. In a reciprocating engine the "barn door" effect of air resistance at 500 m.p.h. may take up as much as 40% of the power which is available to propel the plane through the air. Less than 10% of the power of the 19-B is wasted in this manner.

The combustion chamber is similar to a perforated waste paper basket. The compressed air enters the burner baskets through these perforations. Fuel is sprayed in through a row of atomizing nozzles. An electric spark is used for ignition; but as soon as the flame is started, the ignition can be cut off, since the combustion is continuous. The air particles spend only 1/100 of a second in the combustion chamber. The rate of combustion is so intense that in a given space 1000 times more heat is released than in a conventional power plant boiler. The combustion products enter the turbine at a temperature of 1500°F. where they release much of their energy to drive the compressor. The extreme tips of the turbine blades move at 800 miles per hour, revolving so fast that the centrifugal pull on each blade is 50,000 times its own weight.

The large increase in the speed of air—from 300 m.p.h. as it enters the front of the engine to 1200 m.p.h. as it leaves the tailpipe—is caused by the increase in temperature. Since the volume of a cubic foot of air is tripled when the temperature is raised to 1500° F, pressure is developed when the air enters the combustion chamber. Since the air is confined in the engine, this expansive energy can find only one outlet—through the turbine and thence to the outer air through the exhaust nozzle of the engine. As there is approximately three times as great a volume of air trying to escape from the jet nozzle as originally was forced in at the front of the compressor, the only way it can get out is to increase its speed.

Basically, the thrust of the engine is the reaction to the force required to cause the difference in speed between the air mass as it enters the front of the engine and its speed as

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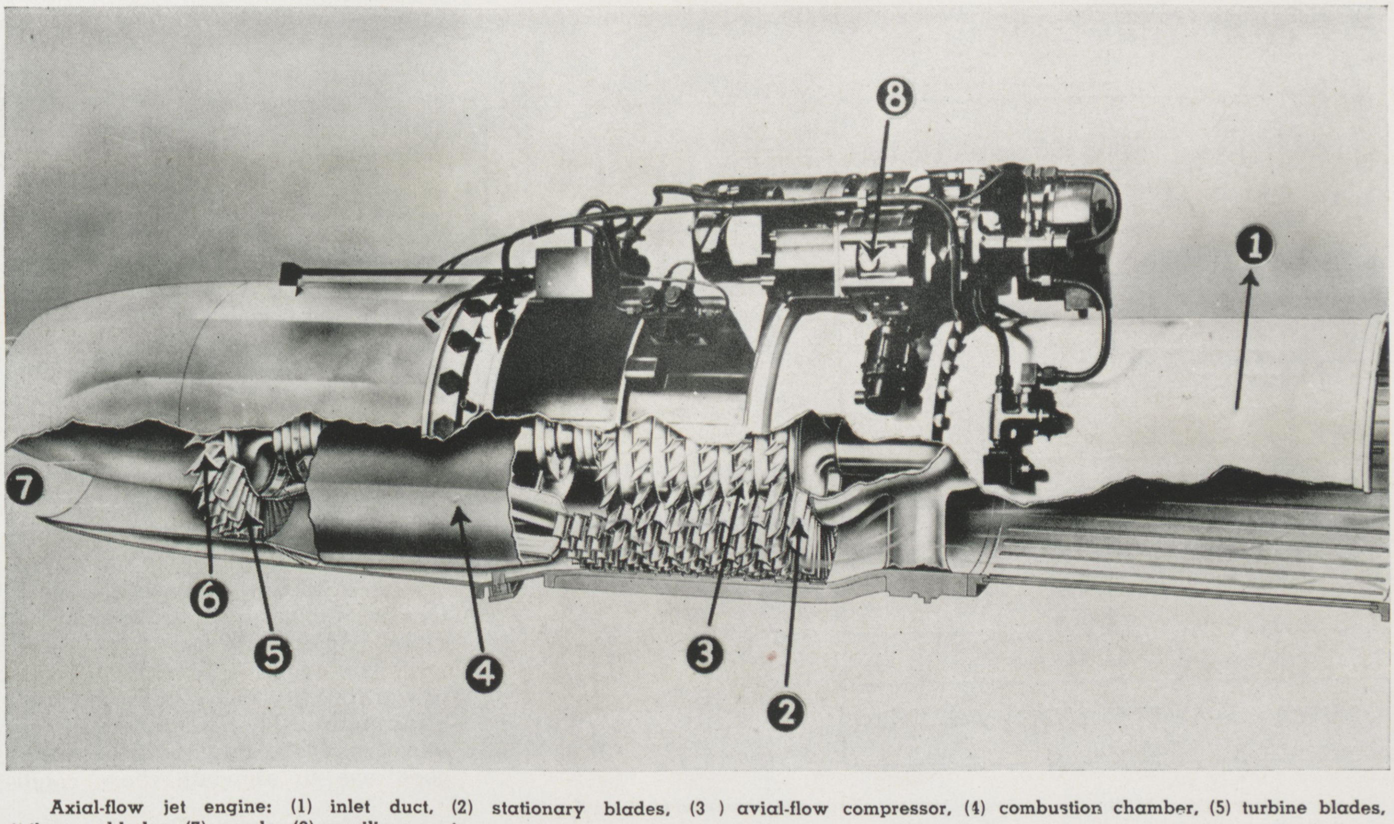

Axial-flow jet engine: (1) inlet duct, (2) stationary blades, (3) avial-flow compressor, (4) combustion chamber, (5) turbine blades, (6) stationary blades, (7) nozzle, (8) auxiliary parts.

—*Westinghouse*

A Technological League of Nations

by William K. Sharpe, soph., ch.e.

AT present each of the nations of the world is closely guarding the secrets of its scientific progress. The United States has developed the atomic bomb; Soviet Russia reportedly is experimenting with cosmic rays. So far as the rest of the world knows, other nations may be working in secret on scientific projects of equal or even greater consequences. Each nation is actually hindering its own progress by not sharing freely its ideas with others; however, nations believe that secret procedure is the only way to safety and self-existence. Obviously, such secrecy is alien to the establishment of world peace. Statesmen, however, seem to be blinded by their own fear of other nations' power.

It has been decided to have the United Nations Organization provide for a commission to handle the matter of atomic control. This plan should not overlook the fact that atomic power is only one of the expected scientific expansions. Progress in the applications of electronics and radar is equally important. It should be realized that the art of science is demanding an equal rank with the art of government. Applications of science now can affect far too many people to be handled under separate governments. Not only must there be an international governing body, but there must also be an international technological body.

The collection of all scientific knowledge under a technological body would aid greatly in the preservation of peace. The existence of any fear or tension between nations would be eliminated. It is hard for some nations to believe that this country, with an offensive weapon as deadly as the atomic bomb, really desires peace. If that is the case, it is all the more reason why a technological body should work hand in hand with the governmental body.

In the past, scientific knowledge has usually been shared throughout the progressive countries of the world. Some nations have tried to impose secrecy, but their efforts have always failed. Since the establishment of engineering as a profession, the engineers of the world have diffused knowledge among themselves. For example, new methods learned in the building of a bridge in England have not been suppressed, but have been made readily available to engineers in this country. German advancements in chemistry, especially theoretical chemistry, were published for the aid of all. Such conditions have aided the world in reaching the present high state of civilization.

Are nations now going to discard this practice that has been so successful in the past? Are nations going to close their gates against each other in the exchange of scientific knowledge in the manner not unlike that of the middle ages? Under such conditions, the progress of science would be tremendously handicapped. Several engineers would be forced to work separately at a given goal, thus duplicating each other's work. Progress, of course, might be made under such conditions. However, it would be a poisonous competitive progress which might lead to its own destruction.

A technological league does not mean that scientists would be *required* to work together in an international laboratory. Such a condition would be equally as stagnating as the other extreme. Such a league simply means that the scientists should pool the knowledge that they collect while working independently in their own laboratories. The league would insure that such knowledge would be collected by an international organization and not hoarded by each nation. Visualize the knowledge that would be available now if all the secrets of atomic energy, radar, electronics and cosmic rays were disclosed! Of course, one recognizes that these developments overlap one another. This fact is only more reason why the secrets concerning them should be pooled. New and undreamed of advancements undoubtedly could result.

People in some parts of the world now are living under deplorable conditions. In many cases these conditions have come as the direct result of war, but this is no excuse for their continuance. The less dramatic applications of science could be put to good use to alleviate these condi-

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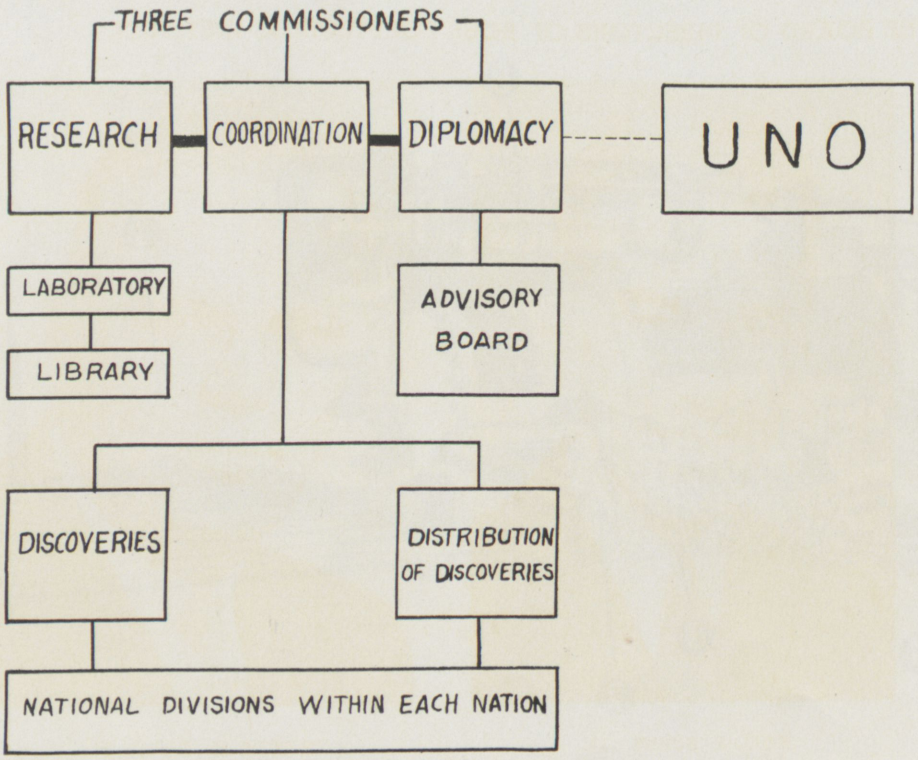


Proposed set-up for distribution and coordination of scientific knowledge throughout the world.

Alumni News

By William Blount, fresh.

The Grads Advance

'42 John H. Vander Veer, m.e., is working for the Sperry Gyroscope Corp. as a naval fire control equipment specialist. During the war Mr. Vander Veer was attached to Admiral Stark's headquarters in England. He also spent a year working throughout the Mediterranean theater with the island of Malta as his home base. Mr. Vander Veer has just returned from the shakedown cruise of the USS Princeton in Caribbean waters.

'45 Joe Durra, ch.e., is working for Plough Inc., at Memphis, Tennessee.

Steve Liddle, m.e., has a position with R.C.A. in Indianapolis.

In and Out of the Service

'37 Walter R. Snedeker, ch.e., has just been discharged from the Army. Captain Snedeker was a member of the Staff and Faculty at the Engineer School, Fort Belvoir, Virginia. Just prior to his discharge he was Chief of Basic Section, Department of General Subjects in charge of the instruction of the courses in Map and Aerial Photograph Reading, Military Sanitation and First Aid, and Chemical Warfare.

'40 Walter T. Zehnder, ch.e., is now ex-Lt. Commander Zehnder, U. S. Naval Reserve.

'41 Captain Joseph W. Dreher, e.e., has been discharged from the Corps of Engineers.

'42 Captain Leon L. O'Dell, ch.e., has been discharged from the Corps of Engineers.

'43 William T. Weinhardt, m.e., has just been discharged from the Army. He was a Captain in the Corps of Engineers and was in France, Belgium, and Germany.

Captain Jack Warrick, e.e., has just returned from C.B.I. and been discharged. He was also in the E.T.O.

Dean E. Albon, ch.e., a lieutenant in the Corps of Engineers stationed in Germany, is in the States on a forty-five-day leave.

Lt. Joe Valentine, e.e., is home from the E.T.O. on a forty-five-day leave.

Richard C. Ellsworth, m.e., with honors, has just been discharged from the Army. He was a tactical officer at the Engineer School, Fort Belvoir, Virginia.

Lt. Vinton B. Haas, e.e., with high honors, is home on furlough.

Lt. Robert D. Calvert, e.e., is home on a forty-five-day leave from the E.T.O.

Raymond I. Kopan, e.e., with honors, has been discharged by the Army. He was a captain in the Corps of Engineers and saw action in the E.T.O.

'44 Robert N. Thompson, m.e., received his naval discharge recently.

Marriages

William F. Rumbley, m.e., '43, was married to Miss Mary Lou Allen of Terre Haute on January 26.

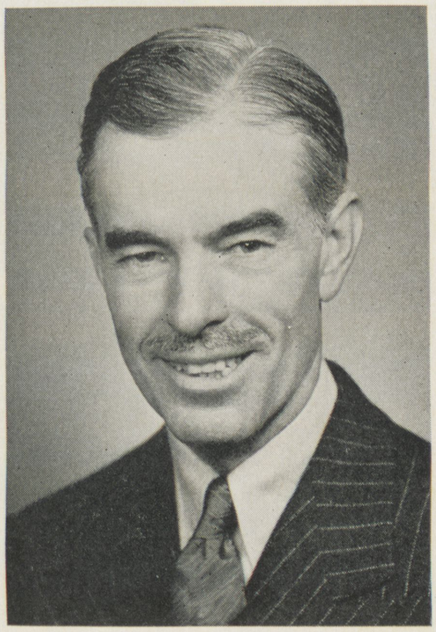
Births

A son, James Arthur, was born January 23 to Mr. and Mrs. James S. March. Mr. March graduated with the class of February '43 with a degree in mechanical engineering.

RECENT ADDITIONS TO THE BOARD OF DIRECTORS OF ROSE POLYTECHNIC INSTITUTE

WALTON L. WOODY, '14,

now Vice President and General Manager of the National Malleable and Steel Casting Co., Cleveland.



RUEL F. BURNS, '15,

now Production Manager of the Terre Haute Paper Co., Terre Haute.

CLAUDE M. GRAY, '21

now General Manager of the Public Service Co. of St. Louis.

Research and Development

by Orville Stone, fresh.

and

Dale Jeffers, soph., m.e.

ENIAC

The scientists of the past few decades, as they have made new discoveries in their respective fields, have been burdened by an increasing number of formulas and equations which, if worked out, have required staggering amounts of time for routine calculations. Some formulas require so much calculation that it is impractical to work them out. For instance, aircraft designers perfer to build scale models of airplanes and test them in wind tunnels rather than to make the lengthy calculations necessary for predicting airdrag theoretically.

Such time-consuming calculations have made evident the need for a machine to perform laborious calculations accurately and quickly. There are many mechanical computing machines in existence, but the performance of these computers is inadequate and too slow for modern needs.

To fill this need for a method of rapid calculation, a new electronic machine has been completed recently at the Moore School of Electrical Engineering at the University of Pennsylvania. This machine is called the Electronic Numerical Integrator and Computer, or simply the ENIAC. This machine is capable of carrying out computations a thousand times faster than the most advanced general-purpose calculating machine previously built.

The speed of the ENIAC is phenomenal. A problem which would have required one hundred man-years of trained computer's work was completed in two weeks by the machine. Only two hours of this time was spent in electronic computing, the remaining time being used in details of operation and review of results. If used to maximum capacity, the computer will perform in five minutes more than ten million additions or subtractions of ten-digit numbers. It can add two numbers in 1/5000 of a second and can perform a number of distinct additions simultaneously. A single multiplication by a ten-digit number is completed in 1/360 of a second, and a nine-digit result in division or square root extraction can be obtained in 1/38 of a second.

Dr. John W. Mauchly, a member of the faculty at Moore School, conceived the idea of electronic devices for solving problems involving lengthy computations. He was joined in developing the idea by J. Presper Eckert, a recent graduate of Moore School. Together they built the ENIAC with help and financial backing of the United States Army.

The ENIAC was built for the Army Ordnance Ballistic Research Laboratory at Aberdeen, Maryland, for the purpose of computing lengthy and complicated firing and bombing tables. The machine can compute the trajectory of a shell in less time than it takes the shell to reach its target.

The ENIAC—fastest general-purpose calculating machine ever built.

—*Science Service*

The computer is expected to solve equally complex peacetime problems, such as those of nuclear physics, aerodynamics, and scientific weather prediction. It is also expected to aid in effecting better transportation, radio, television, and other communications.

The machine was built in thirty months at an estimated cost of $400,000. However, this estimate includes the research and development work; future replicas of the machine can be produced much more cheaply.

The ENIAC makes computations after the problem has been set up in a special way for the machine. First, the scientist analyzes his problem and puts it in the form of mathematical equations. Then the problem is broken down into a sequence of additions, subtractions, multiplications, divisions, and square root extractions. This information is recorded on punched cards ready to be put into the machine. Finally, the machine is prepared to handle the problem. Switches are set, selecting the general outline of the problem, and for certain numerical combinations. Connections are established between

units of the machine for the communication of the outline of the problem and numerical information. Information is then sent into the machine in the form of punched cards, and the answer comes out in a similar manner. Two small auxilliary machines are used with the ENIAC. One feeds the punched cards into the computer and the other receives the cards when the computation is completed.

The ENIAC contains no moving parts, and performs all calculations by electronic devices. This feat requires the use of about 18,000 electronic tubes. The heat generated by the great number of vacuum tubes is dissipated by a blower system, which will be eliminated when the ENIAC is installed in its specially-designed air-conditioned building at Aberdeen Proving Grounds.

New Developments with the Betatron

The betatron (see *Rose Technic* for January) has opened up for laboratory exploration a new energy range, between 40,000,000 and 100,000,000 volts. Although this just reaches the lower limits of the cosmic rays, whose energies go up to billions of volts, many types of reaction in the atomic nuclei have been observed which could not be accomplished with lesser energies.

Using the new betatron, physicists in the G-E laboratory have produced artificial mesons, one of the chief consituents of the cosmic rays continually bombarding the Earth. The meson, hitherto known only through cosmic ray studies, is a particle considerably more massive than the electron, though lighter than the proton. Physicists have carried on many experiments during the past five years, attempting to find something out about the particles that continually bombard our fair planet. They found that the typical meson has a mass about 200 times that of an electron, although good evidence has been found that indicates some with lower masses.

The Wilson cloud chamber, important tool for the study of cosmic rays and nuclear particles has been used in the research of mesons. It is a glass-ended cylinder containing a mixture of gas and water vapor, in which a piston moves back and forth. As the vapor is expanded a particle such as an electron or a meson passing through leaves a thread-like trail of fog, consisting of fine droplets of water, which condense on the gas molecules which have been broken or "ionized," by the passing particle. Thus, the greater the ionizing power of the particle, the heavier the track it leaves. This is one way of distinguishing between different kinds of particles. The chamber may also be placed between the poles of a powerful magnet. This causes curves of the particles and tells more about the nature of them.

A number of tracks were photographed of intermediate density when the Wilson cloud chamber was used with the new betatron. No man can safely remain in the machine room during the operation of the betratron, so the chamber is automatically photographed. The paths of the mesons appeared in greatest numbers when the betatron was operated at voltages between 80,000,000 and 100,000,000. Most of the mesons studies were of mass between 100 and 200 times that of an electron, though some were detected of as low as 20 electron masses.

The new betatron has also been used on studies of fission in the nuclei of uranium and thorium atoms, the process utilized to release energy in the atomic bomb. With the higher energies available from the 100,000,000 volt betatron, strong evidence has been discovered for the existence of more than twenty new nuclear reactions, in which several particles including possible protrons and alpha particles as well as neutrons are produced from the bombarded atom.

Star Gazer

Scientists of the California Institute of Technology are now completing the world's largest telescope, the 200-inch giant installed atop Mt. Palomar in California. Work on the telescope was interrupted by the war.

Resumption of work on the telescope recalls many of the ticklish engineering problems involved in building the huge 500-ton mounting that will support the 200-inch mirror and optical system. Perhaps the toughest of these was the job of fabricating and machining the 317,000 pound horseshoe bearing on which the telescope will ride.

The bearing, along with the rest of the mounting, was built at the Westinghouse works in South Philadelphia. The task of machining the bearing to the specified tolerances required a boring mill with a diameter of 44 feet—larger than any heretofore used. Steel was pared off the bearing until it was within five one-thousandths of an inch of a perfect circle.

Engineers who worked on the bearing ran into many sorts of troubles. To begin with, the sun rays coming through shop windows swelled the bearing, sometimes as much as thirteen thousandths of an inch. After several partially successful efforts to solve the problem, en-

(*Continued on Page* 27)

The bearing for the Mt. Palomar telescope, shown as it started on its trip to California

—*Westinghouse*

Campus Survey

By George Staub, soph., e.e.

Brainy

In the scholastic aptitude test given to the freshmen of January, 1946 (Class M), Rose students' scores ranked very high in comparison with students of other engineering colleges. One man placed among the top 10 nationally (the top ½ of 1 percent).

	National Score	*Rose Score*
First Quartile (highest ¼)	115.	126.5
Median	95.00	110.
Third Quartile	77.5	92.5

(Figures represent lowest score allowable in each section. The lowest score at Rose was better than 9% of the National scores, and the average score was better than 2/3 of the National scores.)

Action

e^x, dy, dx — e^x, dx
Cos, sec, tan, sin—3.14159
Slip stick, slide rule, boogie factor two
State! State! to . . . with you.

Yes, the old yell rang out again on January 25, as the little "College Cuties" tugged dear old Rosie through the streets of Terre Haute. I say old, because there is an air of melancholy, lonely, tattered age about Rosie these days. The long years of war have left their inevitable mark on our old Rosie. She appears to have had a siege of hardening of the arteries, plague, middle-age spread, and lost week end, and is developing a severe case of dementia praecox.

"College Cuties" is a comparatively new expression in Rose circles which received its introduction when one of the members of Class K (then freshmen) received a scented envelope in the mail one day with this touch of sentiment on the flap:

Postman, Postman, do your duty,
Rush this to my College Cutie.

The poor fellow had to wear a sandwich sign for about a week with this expression neatly printed thereon:

I'M A COLLEGE CUTIE.
My girl says so.

Liberation

Liberation days are appearing fast and furious since new classes of freshmen have been entering every twelve weeks.

On Friday, February 15, Class L was liberated. It was hard to tell who was liberating whom, as the pants flew in all directions. To be liberated means to be granted the privilege of:

Going without your freshman cap,
Smoking on the campus,
Going without garters,
Not carrying matches and student handbook,
Going to school via the cinder path.

So, Class L fought with all the ferocity of a cornered commando.

Student Council

At their last meeting, members of the Student Council installed the following officers:

President .... Herb Bailey
Vice President .... George Staub
Secretary .... Frank Dorfmeyer

The Saint Pat's dance plans were also made, with the following men appointed to execute them:

Dance Chairman .... George Staub
Publicity .... Warren Havercamp
Tickets .... Keith Sutton
Programs .... Ted Blickwedel

Deming Hall

Fuses blew, lamp blubs exploded, pessimists stood by the fire extinguishers, the more sublime prayed, and the color organ (an instrument for varying the light color from red, to white, to blue, according to the frequency of the music being played) was finally adjusted, and the Dorm dance of February 9 culminated gracefully with the attendance of approximately 30 dormitory men and their ladies.

The fellows of the dormitory are very pleased with the gift of a subscription to Collier's magazine from members of the Faculty Wives club.

Scenes from the Foundry

A minor skirmish in the battle for liberation.

Camera Club

The members of the Camera Club, who so graciously furnish the pictures for this column, are conducting a contest among themselves, with the following standards as a basis for judging all pictures submitted:

(a) Composition
1. Over-all effffect by which the center of interest has been projected.
2. Utilization of high-lights and shadows.
3. Success with which the picture tells a story.

(b) Print and Negative Technique
1. Over- or under-development.
2. Choice of paper (grade and surface).
3. Stains, fingerprints, misuse of of toner, etc.

The contest ended March the 4th, and we hope to have some very interesting shots to display in the next issue of the *Technic.*

School Calendar

In case you would like to plan your between term vacations ahead of time, here is the school calendar for the rest of the year as published recently by Dr. Prentice's office:

March 30, Saturday, Winter Term ends.
April 3, Wednesday, Spring Term begins.
June 25, Tuesday, Spring Term ends.
July 1, Monday, Summer Term begins.
Sept. 21, Saturday, Summer Term ends.
Sept. 30, Monday, Fall Term begins.
Dec. 21, Saturday, Fall Term ends.

Alpha Phi Omega

Efforts have been made recently to establish a chapter of Alpha Phi Omega on the Rose campus. Alpha Phi Omega is a national service fraternity for college men who are or have been members of the Boy Scouts of America. At the first meeting of the group it was decided to promote several service projects on the campus before making application to the national headquarters for a charter. The purpose of this action is to be sure that interest will be maintained and to attract more members into the fraternity.

The Housing Situation at Rose

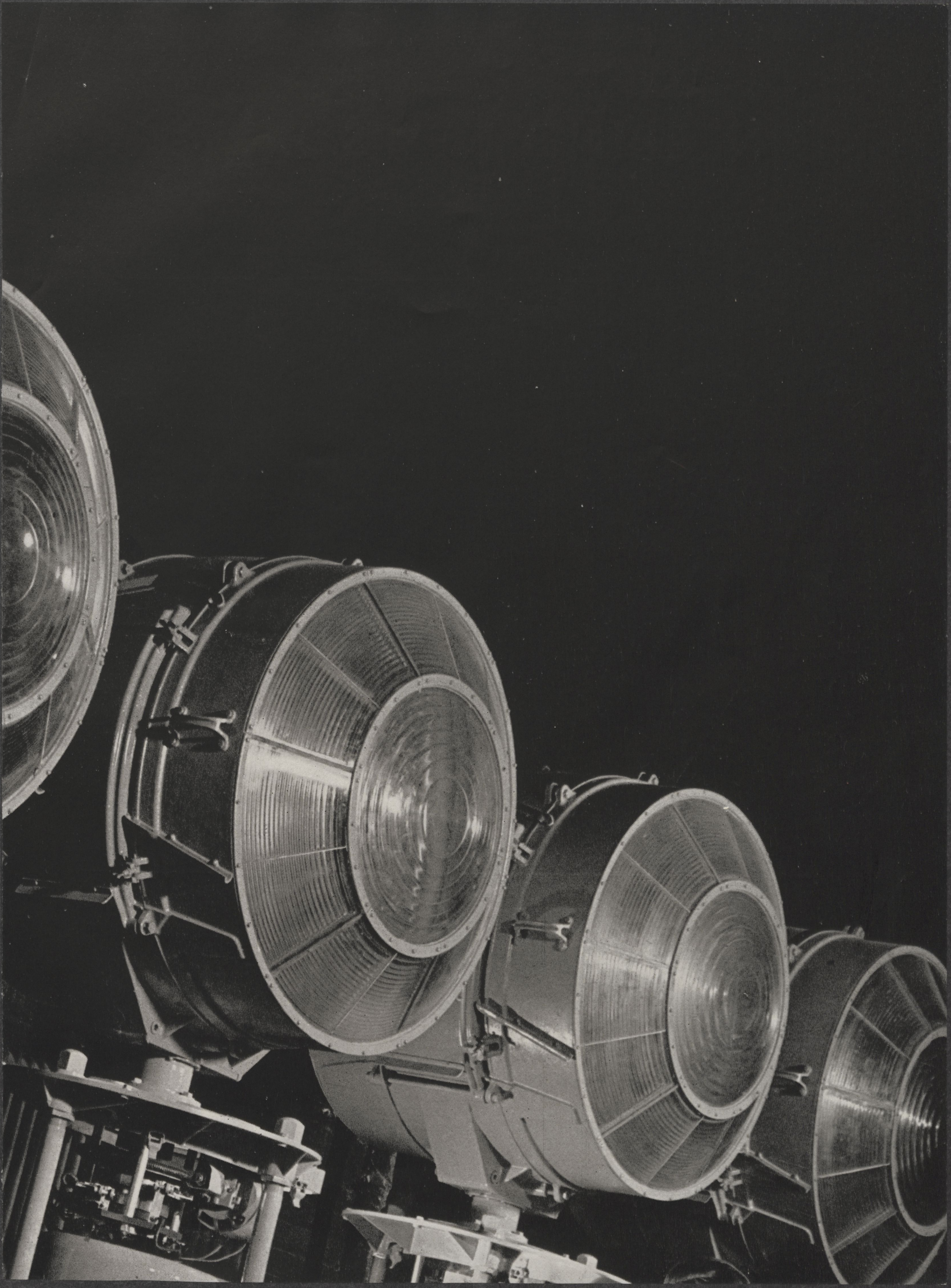
As in other engineering colleges, the housing situation at Rose is becoming acute. As a temporary alleviating measure, living accommodations for 30 are now being prepared at the ends of the Gym. In addition, a defense plant south of Terre Haute is being converted into a dormitory of two- and three-room apartments for married veterans, 34 from Rose Poly and a number of others from Indiana State. Inasmuch as the student body is expected to grow much larger in the near future, additional living accommodations are being sought.

The ROTC Band

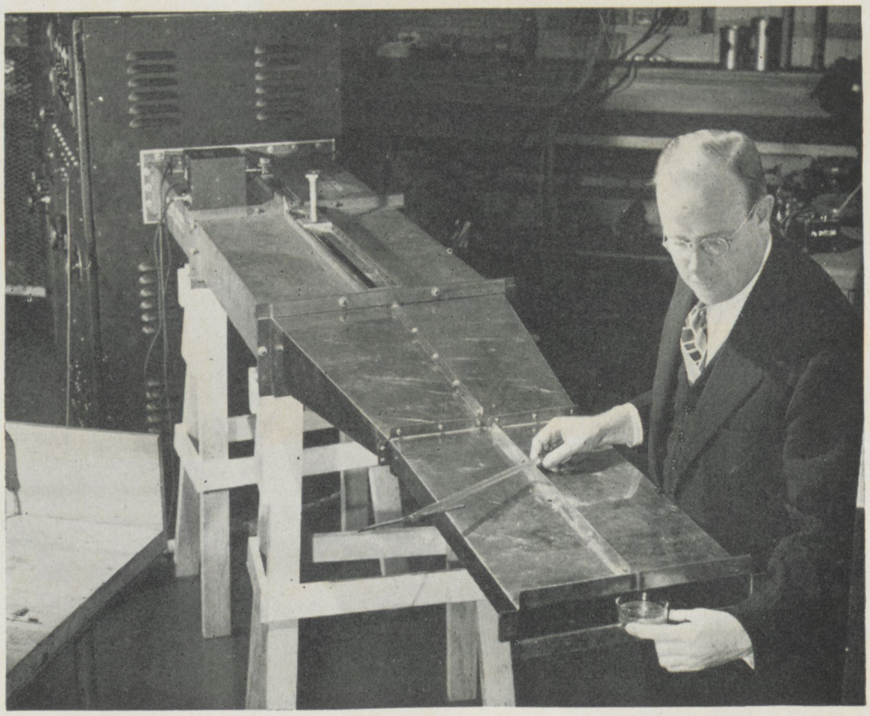
The ROTC Band, inactive during the war, has recently been reorganized. The director is Malcolm Scott (ch.e. '22), now Director of Music at Gerstmeyer Technical High School in Terre Haute. Although the band now numbers only 12, additional applications for membership are earnestly desired.

Freshmen parade Rosie up Wabash Avenue.

School yell at 7th and Main.



ENGINEERING NEWS PICTURES

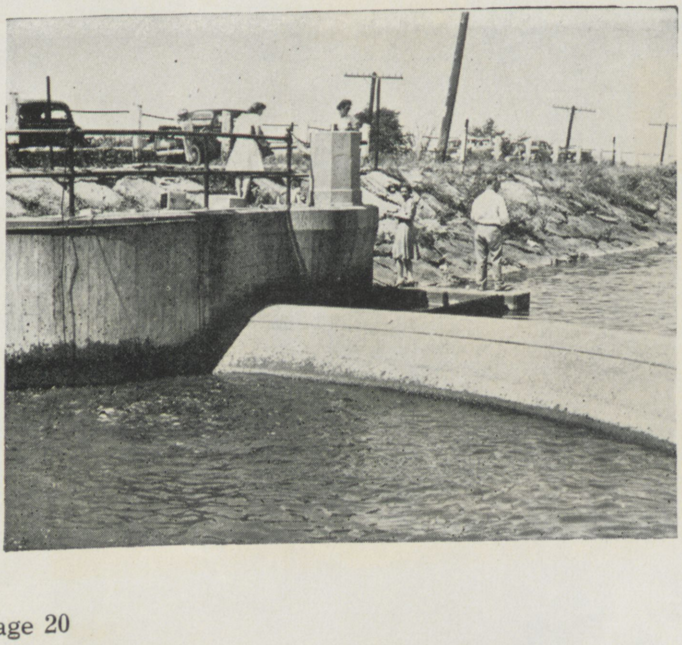


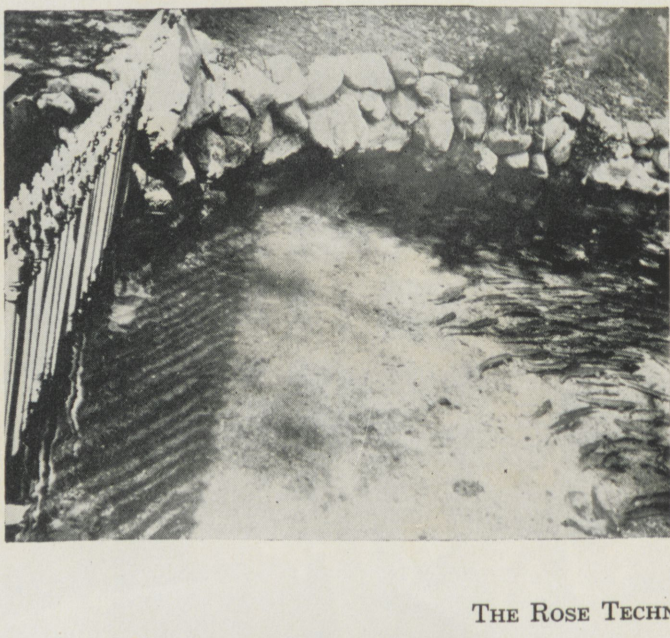
ELECTRONIC BLOW TORCH: This dielectric heating unit projects high-frequency electronic waves on the object to be treated. The liquid plastic shown in the picture will be polymerized to solid form within three minutes.

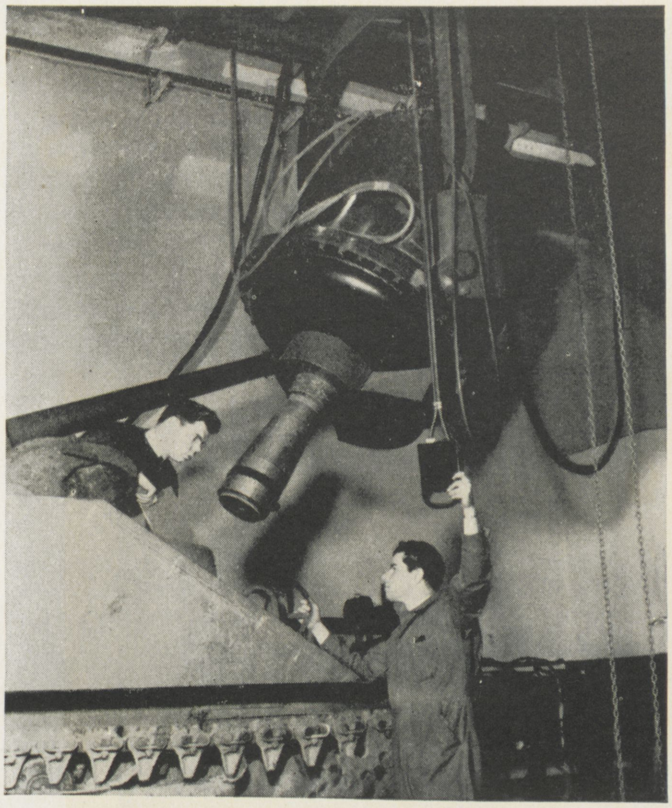
—*Westinghouse*

FISH FENCE: Fish at Pennsylvania's state hatcheries at Pymatuning Lake are prevented from migrating to open water by an electronic fish fence. Electronic impulses through metal rods give fish an effective but harmless shock which senls them back to a safe area. The new device helps to protect millions of hatchery fish for later "planting" in streams and lakes.

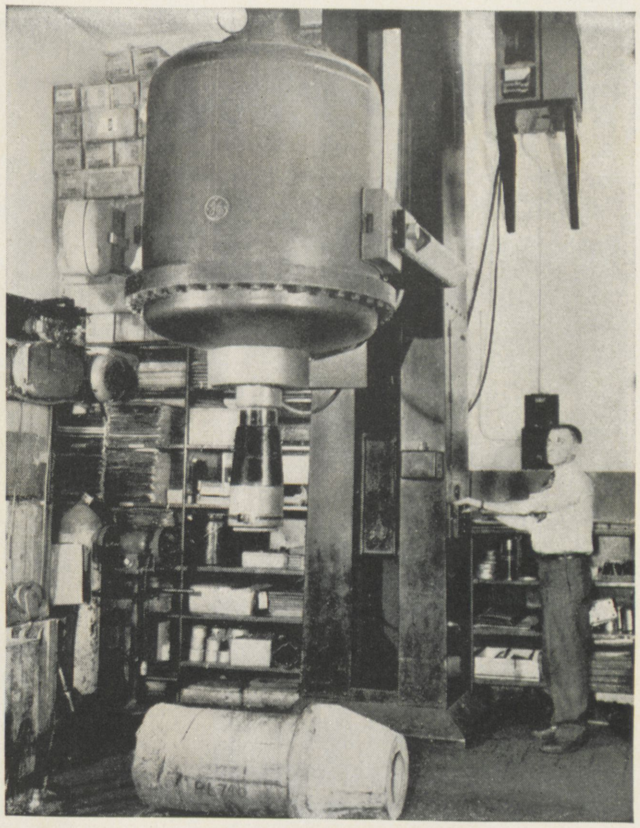
—*Westinghouse*







Steel structure of army combat tank being X-rayed for defects.

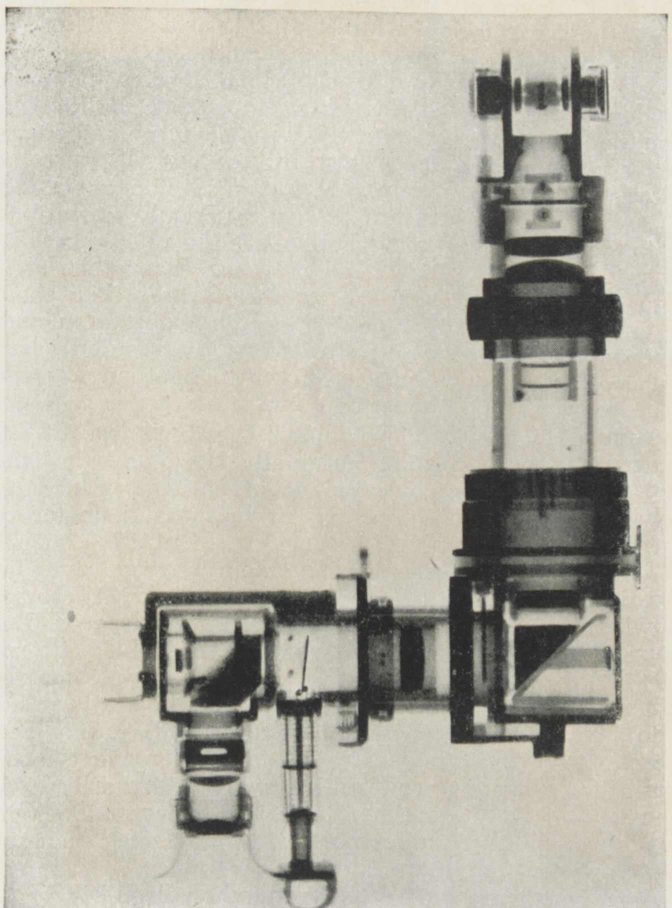


Adjusting a million-volt X-ray unit preparatory to taking an X-ray film of a huge brass casting.

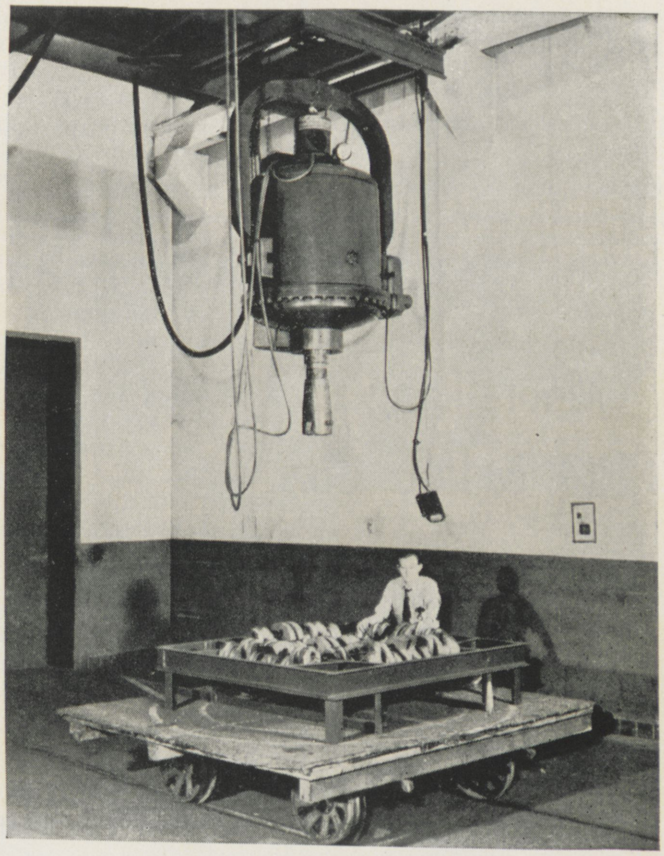
INDUSTRIAL USES OF X-RAY UNITS

—*General Electric*

X-ray view of German submarine periscope



Million-volt X-ray unit used to detect flaws in crackshaft castings. This room has 18-inch concrete walls to absorb harmful rays. Actual operation is always carried on by remote control.



Air compressor spindle for jet engine. This part revolves at 18,000 r.p.m.

—Westinghouse

JET PROPULSION

(*Continued from Page* 11)

it is "jetted" from the rear. Hence a jet propulsion engine is essentially a machine for increasing the speed of a mass of gas.

The components which comprise the accessory drive are the following:

1. An electric starter to bring the engine up to a speed at which it can maintain itself.
2. A fuel pump to deliver fuel to the combustion chamber.
3. An oil pump to circulate the oil to the bearings and to the oil cooler, which is mounted in the front of the engine where cooling air is available at all times.
4. An overspeed control to prevent the engine from "running away."
5. An electric tachometer to give the pilot a visual indication of r.p.m.'s.

Other accessories which serve the airplane are the following:

1. A generator to provide electric current.
2. A hydraulic pump to furnish high pressure oil to serve wing flaps, landing gear, etc.
3. A vacuum pump to operate the aircraft instruments.

After having gone through the turbine, the gases then enter the exhaust nozzle. Here the gases thrust forth in a steady, 1,200 m.p.h. flow to propel the plane forward. This push—nearly 1400 pounds—is equivalent to the total power of a score of automobile engines. To obtain this speed—450 m.p.h. faster than the flight of a 22 caliber bullet—the combustion chamber must release large quantities of heat. To raise the temperature of a million cubic feet of air an hour suddenly upward to 1,500° F requires the release of heat hundreds of times faster than it is released from the average household furnace. One engine liberates enough heat from its fuel in three and a half hours of flight to heat an average house for an entire winter.

The "baby" Westinghouse jet engine, originally designed as the power plant of an American buzz bomb, is just half the diameter of the 19-B engine. Only 9½ inches across, it yields a propulsive jet thrust of 275 pounds, or 275 horsepower at modern plane speeds. Because its diameter is halved, its rotational speed is approximately doubled. At full speed it turns at 567 revolutions per second. A modified model of this 9.5-A engine can be used as a small mechanical drive turbine to drive helicopters, cabin superchargers, and electric generators.

(*Continued on Page* 24)

There are certain fundamental characteristics which are typical of all jet engines. These characteristics determine the type of planes in which jet engines will be used. It should be remembered that at low aircraft speeds the efficiency of the jet is poor. The gases leave the plane with high velocity relative to surrounding air and this kinetic energy is simply wasted. Thus, the jet does not show its true value until plane speeds are over 550 m.p.h.

With conventional engines and propellors, there is sufficient constant power available to drive the airplane independently of airplane speed. The jet engine, in contrast, delivers essentially constant thrust; that is, the power is proportional to speed. This explains why the jet propulsion engine is not satisfactory for low aircraft speeds.

The jet engine is useful for fast fighters which do not require large range. Interceptor planes and high speed fightersare particularly suitable for jet propulsion. The jet plane also has decided possibilities for short, fast transport. It is believed that for any long range aircraft and any except extremely high-speed aircraft, the gas turbine propellor power plant will be the power plant of the future.

It appears that the reciprocating engine, although it is a marvel of engineering and manufacturing skill, has arrived at a point of diminishing returns. Larger horsepower is being accomplished only with increased numbers of cylinders and increased complexity. It should be realized that when present-day large piston engines are operating at high speeds fully 30% of the engine power is lost in dragging the engines with their nacelles through the air and in cooling for the engine. In contrast, gas turbines are reduced only 10% in efficiency.

Studies show that on a large plane the gas turbine should give performance superior to the piston engine in cruising range, maximum speed, rate of climb, pay load, and take-off distance. In addition, the inherent simplicity of the gas turbine, the fact that practically no cooling is needed, and the fact that vibration problems and noise are much reduced as compared with the piston engine should make the gas turbine and the gas turbine propeller drive extremely attractive for future aviation.

Thermal and mechanical efficiencies in the jet plane will be unsatisfactory unless the plane is permitted to travel with a velocity of about 600 m.p.h. The exhaust gases will have to travel thousands of miles per hour to attain this speed. Thermal efficiency, as applied to jet propulsion, is that portion of the fuel heat (theoretically available) content which is transformed into kinetic energy at the venturi, or nozzle. The ideal thermal efficiency of the cycle can be expressed by the formula

$$E = \frac{T - t}{T},$$

Where E=cycle efficiency,
t=final (absolute) temperature, and
T=initial (absolute) temperature.

If the final temperature approached absolute zero, the efficiency would obviously approach 100% for the cycle. With available temperatures, an efficiency of approximately 35% would be obtained with an initial temperature of 3000° F.

Velocity ratio efficiency is derived through comparison of the exhaust gas velocity with the airplane speed. The formula is

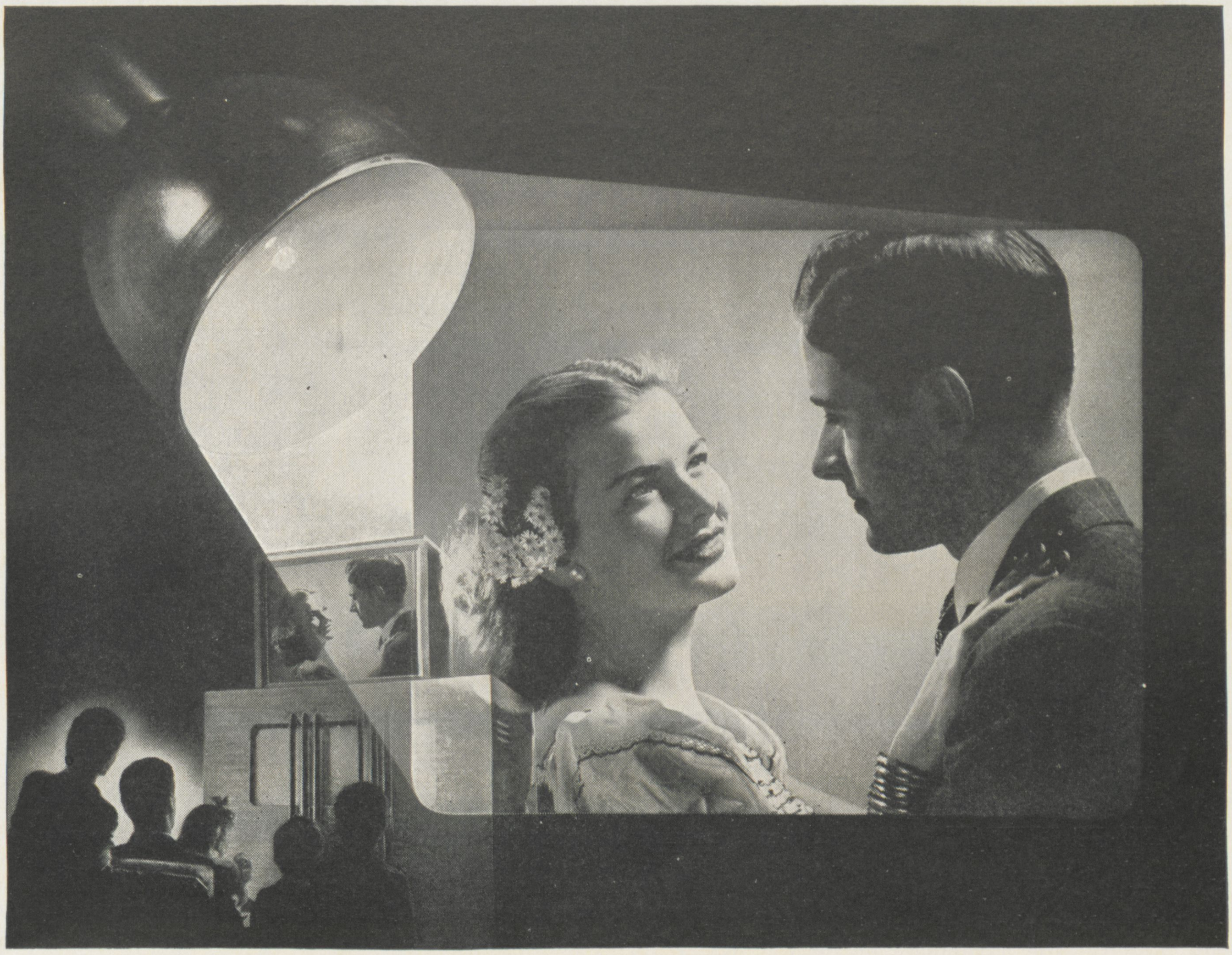
$$E = \frac{2V}{V + v},$$

Where E=velocity ratio efficiency,
V=velocity of airplane, and
v=velocity of the exhaust gases.

The maxium efficiency of a propeller on the present type of plane is almost 90%. If the speed of a jet airplane is 400 m.p.h. and the exhaust gases leave the jet at 1500 m.p.h., then by using the formula we obtain an efficiency of approximately 42%. This figure is lower than that of the propeller-driven conventional airplane. The efficiency, however, increases as the airplane velocity and altitude increase. The present airplane motor loses power at higher altitudes even with the use of a supercharger. The propeller also loses efficiency because the airstream mass is reduced at high altitudes.

Fuels for jet planes are now composed of various grades of kerosene from petroleum. Future developments in this line may include the use of alcohol or even such gaseous fuels as hydrogen and acetylene.

There seems to be an extremely bright future for the gas turbine in the field of aviation. Wartime jet engines are being adapted to peacetime uses, and new advances are being made constantly. The major disadvantage of the jet engine is its high fuel consumption, but much progress has been made toward the solution of even this problem.



RCA Laboratories provides another great achievement in television—the "mirror-backed" Kinescope, or picture tube.

New "searchlight brilliance" for home television !

Now, large screen television pictures are twice as bright—yes, *twice as bright* as ever before!

You can "count every eyelash" in the close-ups. You'll almost want to shake hands with the people on your television screen—so great is the illusion that they are actually in your living room.

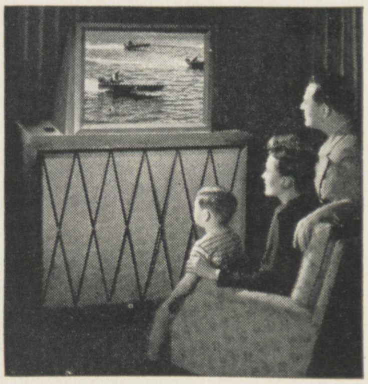
This new sharpness and brilliance is achieved through the new RCA "mirror-backed" Kinescope, or picture tube, perfected at RCA Laboratories.

It has a metallic film—eight-millionths of an inch thick. This metallic film acts as a reflector, allowing electrons to pass through to the screen but preventing light rays from becoming lost through the back of the tube. Just as the reflector of a searchlight concentrates its beam—so does this metallic film reflector double the brilliance and clarity of detail in home television receivers.

Similar progress-making research at RCA Laboratories is being applied constantly to all RCA Victor products—assuring you that anything you buy bearing the RCA monogram is one of the finest instruments of its kind science has achieved.

• • •

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 4:30 P.M., Eastern Time, over the NBC Network.



RCA Victor home television receivers will be available in two types. One model will have a direct-viewing screen about 6 by 8 inches. The other type will be similar to the set shown above—with a screen about 15 by 20 inches. Both instruments are being readied for the public with all possible speed and should be available this year.

RCA **RADIO CORPORATION of AMERICA**

ATOMIC ENERGY

(*Continued from Page* 9)

of a coal-burning plant of equal energy capacity. The advantages of the atomic power unit will also include a wide flexibility and easy control of the rate at which the energy is released and the absence of smoke and soot as undesirable by-products.

Another limitation to the use of atomic power is the possible scarcity of fissionable materials. It is fortunate in this respect that uranium is rather abundant in comparison with the other heavy elements. Although it is present in the earth's crust to the extent of only 0.00008%, it ranks 25th in order of abundance of elements, being only slightly less plentiful than copper. It is twice as abundant as zinc and four times as plentiful as lead. Uranium ores are found principally in the Belgian Congo, Canada, Colorado, and Czechoslovakia, although some ore is also mined in Portugal, Sweden, and Australia. Other potential producers are England, France, Germany, the Soviet Union, India, and Brazil. Under prewar conditions the demand for uranium was so small that only the Canadian and Belgian Congo ores were used to any appreciable extent. Should large-scale exploitation of atomic energy take place, however, the uranium ore supplies of the entire earth would be depleted rapidly. Under such conditions, uranium resources would probably last only a few centuries at most.

Future Developments

Of the 92 elements found in nature, only three seem satisfactory for the production of energy through nuclear fission in chain reactions. These are uranium, thorium, and protoactinium. (Plutonium, the synthetically-produced element No. 94, also undergoes chain-reacting nuclear fission easily.) Since protoactinium is extremely rare, thorium will probably be exploited as uranium resources run out. Thorium is a fairly abundant element (three times more plentiful than uranium) which is found in India, Brazil, Australia, the East Indies, and parts of the U. S. According to the Smyth report, thorium was considered for the atomic bomb project, but was rejected in favor of uranium. Research is even now being conducted to establish thorium as an additional source of atomic energy.

At the present, nearly all work on atomic energy is directed towards the production of nuclear fission in the heavier elements. It will be recalled that a similar release of energy also accompanies the synthesis of medium-weight nuclei from the nuclei of lighter elements. It is believed that nearly all of the energy of the sun results from the synthesis of helium from hydrogen by a series of nuclear reactions in which carbon also figures in a manner analogous to that of a catalyst. Although similar reactions have never been attempted on earth on a large scale, they have already been accomplished in the laboratory with minute quantities of matter. There are indications that it will be rather difficult to utilize these elements on a practical scale. If this can ever be accomplished, however, the world can obtain an inexhaustible supply of energy from these plentiful materials.

While the long-run implications of atomic power are tremendous, changes in present-day civilization will develop rather slowly except for the powerful military applications already demonstrated on a small scale. It is important to note that power costs constitute only a small fraction of the present cost of living, so that atomic power at its best can scarcely effect a revolution in living habits without other concomitant scientific developments. It is not expected that coal, water power, and petroleum will be outmoded as primary sources of energy, at least during the next generation. While useful atomic power plants may be developed in the near future, their full potentialities will not be realized for many years to come.

Research engineers inspecting flight control instruments.
—General Electric

RESEARCH & DEVELOPMENT

(*Continued from Page* 15)

gineers finally built a "sun-bonnet" around the bearing that reduced temperature fluctuations by 50 per-cent.

Then, because the bearing must support a million-pound load, engineers literally had to bend it out of shape so that it would be squeezed back into a perfect circle when the telescope rested on it. Some idea of the close tolerances engineers had to work with can be gained from the fact that the telescope must be sighted with an angle of error so small that at three miles two lines drawn from a single point would be only an inch apart.

A motor having less than half a horsepower could move the telescope and its supporting structure on its bearing, although they have the proportions of a six-story building. If conventional roller bearings had been used, the friction would have been 600 times greater—a measure of the infinite skill that engineers put into construction of the world's largest precision instrument.

New Instrument System for Controlled Flight

A new system of electrically coordinated instruments has been developed to give aircraft greater directional accuracy while flight is controlled by an automatic pilot. This system, known as a compass-controlled directional gyroscope, also functions in the reverse manner by furnishing the pilot and navigator with continuous, accurate data on directions while the plane is flown by a pilot. In this system the compass and gyroscope are coupled electrically to form a steady computing unit which automatically corrects errors present when either instrument is used separately.

For instance, the gyroscope operating by itself drifts slightly from a set course during flight because of the relation of the gyro to the earth's rotation. This makes it necessary for the pilot to reset the gyro at intervals to keep the aircraft on course. In the new system these corrections are made automatically by electric impulses from the compass.

Another source of error in auto-pilots operating without the new system is that the compass oscillates, causing the indicator to flicker back and forth across the desired heading. If these oscillations are balanced the desired heading is followed. However, because of this flickering, the auto-pilot connected directly to the compass tends to edge off the predetermined line of flight at fractional angles.

Both of these errors are eliminated by constructing the compass and gyroscope to work together as a unit. The two instruments are so connected that should one fail or be shot out the other will function normally when the pilot throws a switch in the cockpit.

Fraternity Notes

Sigma Nu

The Sigma Nu rush party was held Sunday night, January 20, at the Knights of Columbus lodge hall in Terre Haute. The evening was spent in bowling after which a luncheon was served.

The chapter pledged one rushee, John Richardt, of Basking Ridge, New Jersey, at its meeting Monday, January 21. Committees were appointed at this meeting to investigate the possibilities of a dance, a skating party, and a stag party. A committee was appointed to try to find a house for the chapter.

Several of the members enjoyed a bowling party Saturday afternoon, February 16, at the Vigo Bowling Alley. This party was one of the many social activities now being planned by the chapter.

Lambda Chi Alpha

Theta-Kappa is happy to announce that Albert Edwards of Lebanon, Indiana, has been pledged to the chapter. Brother Edwards received the formal initiation ceremony on Sunday, March 17 after a somewhat strenuous five days of informal initiating.

The chapter has had several visitors this term. They are Charles Bashe, Bill Mitchell, Phil Bowne, and Bill Lundy. Brother George Kyle is returning to school next term from the armed forces.

A stag party was held early in February at pledge brother Charles Hanley's home. This was such a success that a stag theater and bowling party was held on March 1. A party in honor of Founder's Day will be held at Edgewood Cabin on April 5. All Lambda Chis in the Terre Haute area have received special invitations.

The Lambda Chi Alpha All-State Dinner and Dance will be held at Indianapolis on April 13. Several Brothers from the local chapter plan to attend. The chapters taking part in this affair are from Franklin, Hanover, and Wabash Colleges and from Butler, DePauw, Indiana, and Purdue Universities.

Alpha Tau Omega

The outstanding event of the past month was the annual Provence XVII dinner and dance which was held March 9. The chapters from Purdue, Illinois, Indiana, and Rose were represented by approximately 200 persons. The dinner and dance was held at the Terre Haute House and Gamma Gamma was proud to be host to this gala event.

On February 22, Indiana Gamma Gamma held a dance celebrating Washington's birthday. Some of the honored guests were Capt. and Mrs. T. P. Palmer, Prof. and Mrs. Carl Wischmeyer, Mr. and Miss Eckerman, and Mr. and Mrs. Clarence White. The dance was a great success and the chapter has more social events of this type planned for the future.

On the morning of February 24, the chapter attended the services of the Central Presbyterian Church. The chapter was honored by visits from several recently discharged veterans, who were: Raymond Kopan, Richard Ellsworth, Joe Pipp, Leon O'Dell, Bill Hochstetler, Bill Mariette, Don Tyler, and Jean Boatman. Other members who have been discharged from the service are: Harold Bowser, Jim Brown, Vinton Hass, and Bill Kniptash.

SYNTHETIC RUBBER

(*Continued from Page* 7)

balloons, and other pneumatic-rubber products. Butyl is also manufactured from two petroleum products, isobutylene and isoprene.

GR-M (*neoprene*). This rubber was produced by the Du Pont Company in small amounts for some years before the war. Its high resistance to oil and chemicals makes it valuable for special cases where this quality is desired. The main raw material in its manufacture is acetylene gas.

Government Investment in Synthetic Rubber Facilities

The total investment of the Government for rubber program—inclusive of $36 million embodied in scrambled facilities— amounted to about $716 million. Practically the entire synthetic rubber industry is owned by the Government; privately-owned synthetic rubber plants have a capacity of only 32,550 tons annually. Privately-owned plants manufacture no GR-I, and only a negligible amount (1,800 tons) of GR-S. The private neoprene capacity, which is all owned by Du Pont, is equivalent to one-sixth of the Government-owned neoprene capacity. Two-thirds of the privately-owned industry is devoted to the production of GR-A, a rubber not made in Government-owned plants. This rubber is a copolymer made from styrene and acrylonitrile, and like neoprene it is resistant to oil and chemicals.

Private Industry's Contribution To the Rubber Program

As has already been mentioned, synthetic rubber had been produced for several years previous to the war. Although the production was not great, much time and costly research had been put in on synthetic rubber by private industry, and it was only natural that the possessors should look for a return on their investments. But when the Government asked them for help they not only turned over their carefully guarded secrets to the Government but also to their competitors.

The companies, with the help of the Department of Justice and the Commissioner of Patents, pooled their entire technical resources of knowledge, facilities, and manpower. This transaction was immediately performed, subject only to necessary secrecy orders issued by the Commissioner of Patents. The question of whether this program would proceed after the war was not involved. With this cooperation the rubber program was off to a rapid and sound start.

The Chemist's and Chemical Engineer's Part in the Rubber Program

Before the production could begin, much building and research had to be done, as this program called for the largest operation that had yet been attempted. This undertaking was crowded into a short twenty-four-month project, a job that in normal times would have taken twelve years. Pilot plants were started, and runs had hardly begun before production was started on the full-sized scale. All this had to be done under stress and with expedition, as the outcome would weigh heavily on the execution of the war.

It is this miracle of chemistry and chemical engineering, and of the co-operation of the chemical industries, that the profession is indeed proud. And thus it is that America has achieved its rubber independence!

The Economic Problem

The synthetic-rubber facilities have been located in three regions—the Southwest, the East Central, and Southern California. The location of petroleum has influenced the concentration of the synthetic rubber

Synthetic rubber plants require huge equipment. Right: Tanks containing three-day's supply of butadiene, sufficient to make more than 180,000 passenger car tires. Left: Nine fans which circulate a million and a half cubic feet of air per minute for cooling purposes.

There are two major factors in the speed which Gas brings to modern industrial and commercial operations. First there is the speed with which Gas comes on the job. It needs no gasification as do other fuels—Gas gives instant heat, swiftly reaching the temperature required by the setting at the control panel—and Gas maintains absolute fidelity to that setting.

Then there is the speed with which Gas imparts its inherent heat to the materials which must be processed or dried, for Gas utilizes the three basic principles of heat transfer—convection, radiation, conduction. Modern Gas research has developed equipment designed to transfer the heat of Gas at highest efficiency, with greater speed and depth of penetration.

The results of the research of the American Gas Association and Gas equipment manufacturers are made available to industry by the Industrial Gas Engineer of the local Gas Company. He can help secure faster, more efficient, more economical manufacture of improved products.

THE TREND IS TO GAS

FOR ALL
INDUSTRIAL HEATING

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE, NEW YORK 17, N.Y.

facilities, as nearly half of the country's total capacity is located in the Gulf area of Texas and Louisiana. The transportation of butadiene played a large part in drawing GR-S copolymer plants to the oil-producing areas. Butadiene, which is produced in plants adjoining large refineries, is a volatile, unstable compound and requires the utmost care in handling. It is transported in specially built pressure-type tank cars. For these reasons the plants are located near butadiene plants rather than near the processing plants.

The true economic test of synthetic rubber is yet to come, that is, its ability to compete with natural rubber both in price and quality. There is every prospect that within a few years the natural rubber supply could be built up to again take care of the entire American market. If only the economic aspect of synthetic rubber was considered, it might be argued that the plants be left to thrive or to die. The outcome of such free competition is not certain.

For the special purpose rubbers (GR-I and GR-M), for which the Government built three plants, the outlook is good. Their special qualities excel those same qualities in natural rubber. In the case of GR-S (the general-purpose rubber), the outlook is in some respects different. In tires the percentage of synthetic to natural has now been increased to around 85 percent synthetic to 15 percent natural. For light tires the percentage synthetic can be 100, and the product very serviceable. For heavy truck tires, however, synthetic rubber is less satisfactory, and much smaller amounts must be used. Therefore, the manufacturers of these tires would prefer natural rubber and would be willing to pay a premium to obtain it.

Much research has been done on synthetic rubber since the Government program has started, and it is very desirable that research of this kind be continued. Research has been done both on the processing of synthetic and on the search for new copolymers. Corresponding efforts to improve natural rubber will also be conducted, so that the final outcome with respect to the competitive position of the two can not be predicted.

The competitive position of GR-I and GR-M are fairly assured. Because of their special qualities, manufacturers will prefer them to natural rubber for special uses. The present demand will assure a market for some time.

The present price of natural rubber compared to synthetic is 22½ cents a pound for natural against 18½ for synthetic. The final price for the two rubbers are about the same, as the price for processing synthetic is about four cents more per pound. The average price of synthetic during the war was much higher because of the use of butadiene made from alcohol. Alcohol butadiene is much more costly than petroleum butadiene, which raises the cost of the product accordingly. The use of alcohol butadiene has been stopped and the three Government plants have been shut down.

At the present processing prices, synthetic rubber must be priced sufficiently below natural rubber of the same quality to compete with it on the market. The prices of neither, however, can be foreseen.

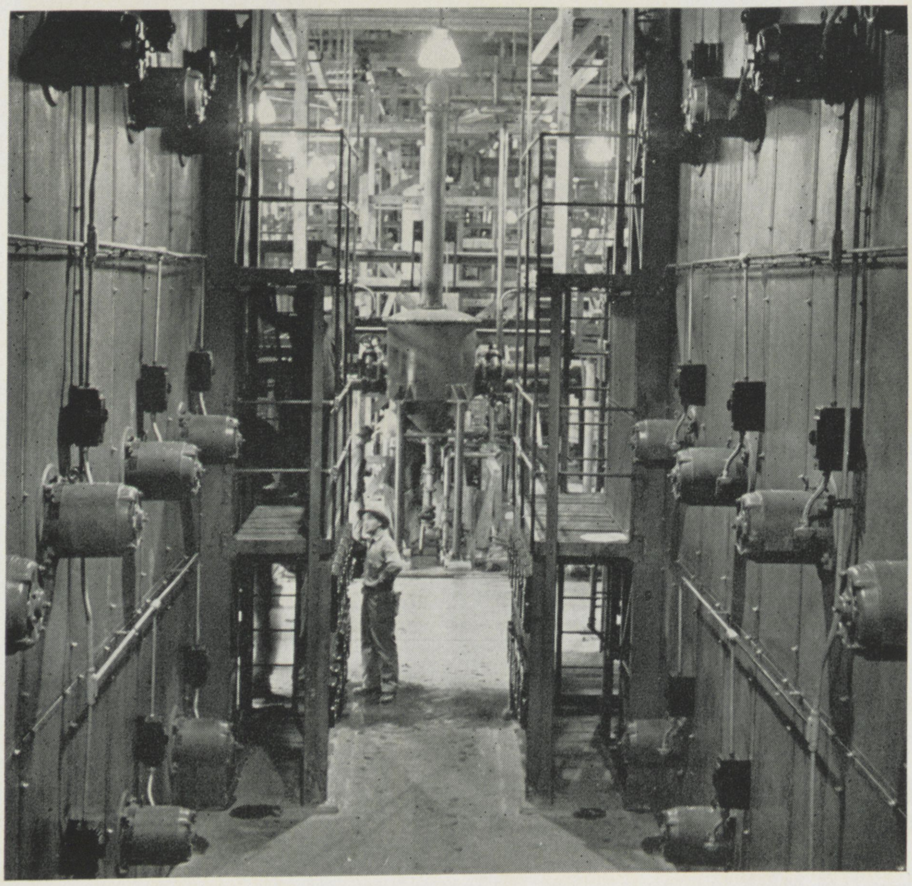
Future National Defense

The solution of the synthetic rubber problem can not be based solely on economic considerations. The experience of this war has taught America that it cannot again be cut off from a liberal supply of rubber. The questions that now present themselves are (1) what part of the total plants should be kept on both active and stand-by conditions, capable of use in case of an emergency; (2) what part of these should be active; (3) in what way can a market be assured for that part which we desire to retain in use?

The common proposal is to keep only a part in actual operation and to hold the rest in stand-by condition. There are objections to this, however, as rapid obsolescence is likely to occur. The decision as to the amount of capacity to keep for national defense depends on the size of the stock-pile, since an inverse relationship exists between the two.

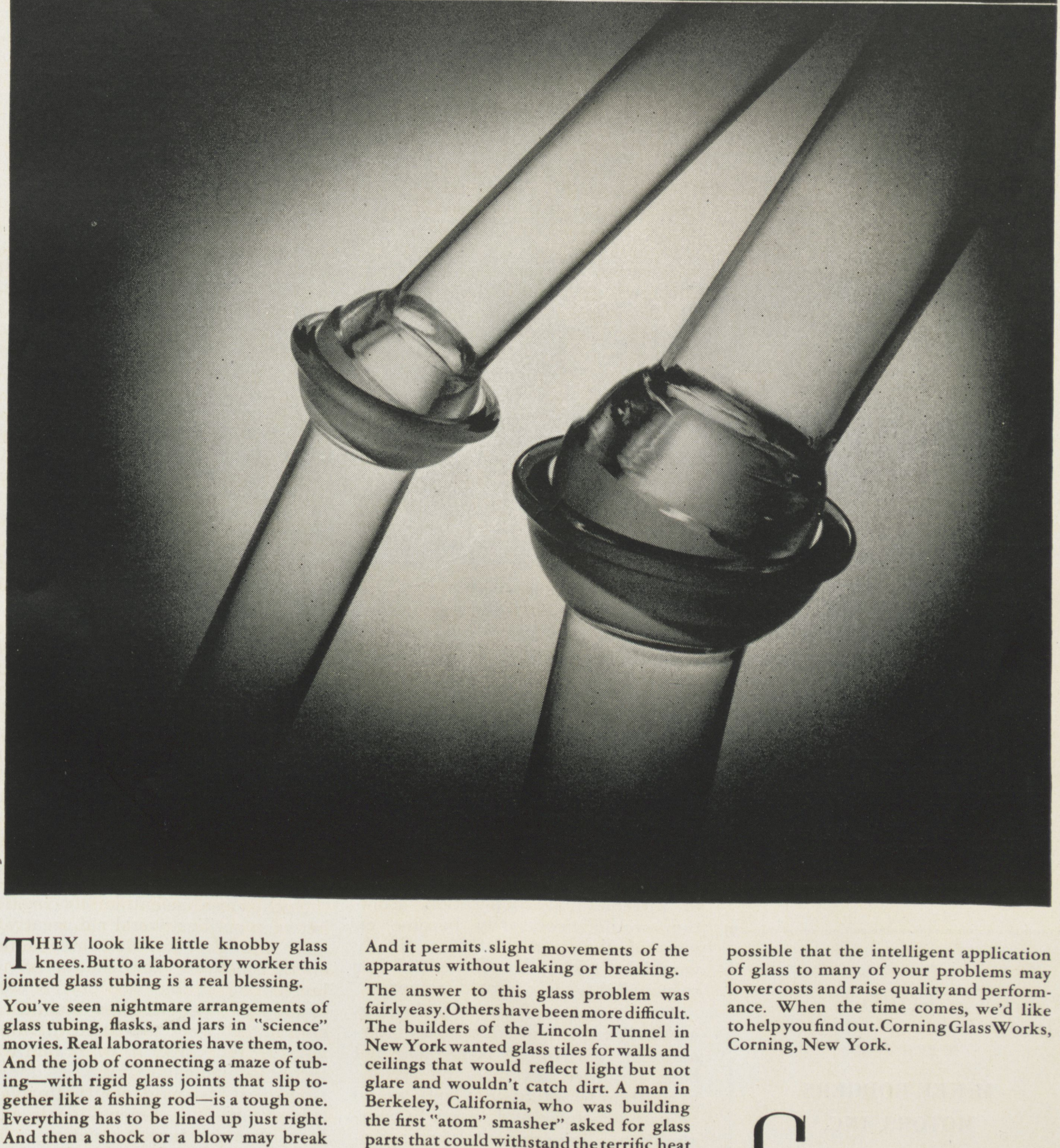
The Civilian Production Administration's Rubber Division in Washington, a committee of leading rubber manufacturers, agreed that the government should continue to own and control the war-born synthetic industry. They also agreed that at least 250,000 tons of synthetic rubber should be produced annually, regardless of costs or natural rubber available, and that facilities to produce another 350,000 tons should be retained in standby condition. It will, in the opinion of the manufacturers, hold a club over the British, Dutch, and French rubber growers that will check any price gouging.

There is also evidence that private business itself is not willing to buy the Government owned plants. The final decision however, will be left in the hands of the Truman Administration. It is the earnest desire of everyone that the rubber question be given the very best consideration for the future of America.



Driers for Buna S rubber. At full capacity 12 such driers evaporate 160 tons of water per day.

Have you heard about our "Glass Knees"?



THEY look like little knobby glass knees. But to a laboratory worker this jointed glass tubing is a real blessing.

You've seen nightmare arrangements of glass tubing, flasks, and jars in "science" movies. Real laboratories have them, too. And the job of connecting a maze of tubing—with rigid glass joints that slip together like a fishing rod—is a tough one. Everything has to be lined up just right. And then a shock or a blow may break the rigid tubing and you have to start all over again!

So laboratory people weren't displeased when Corning came out with a tough leakproof ball and socket joint. It sets up and takes down easily. Parts are interchangeable, due to precision grinding. And it permits slight movements of the apparatus without leaking or breaking.

The answer to this glass problem was fairly easy. Others have been more difficult. The builders of the Lincoln Tunnel in New York wanted glass tiles for walls and ceilings that would reflect light but not glare and wouldn't catch dirt. A man in Berkeley, California, who was building the first "atom" smasher" asked for glass parts that could withstand the terrific heat of 8,500,000 electron volts. Chemical manufacturers needed piping that would resist the corrosive action of hot acids.

Corning research and manufacturing skill solved these glass problems. Keep this in mind wherever you wind up after school. It is entirely possible that the intelligent application of glass to many of your problems may lower costs and raise quality and performance. When the time comes, we'd like to help you find out. Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

LEAGUE OF NATIONS

(*Continued from Page* 12)

tions. The prosperous sections of the world refuse to cooperate completely to this end. These countries are afraid they will overtax their own technological resources and thereby fall prey to others. Truly close co-operation is necessary to derive mutual benefit from the minor scientific developments. Sometimes the "minor" developments have the greater effect on the actual lives of the people. These developments — as commonplace as an improved kitchen range—would be of great use in relieving the down-trodden peoples of Europe and Asia.

Dr. Einstein goes a step farther. He advocates that a world government be established. Such a plan seems impossible at the present time when one considers the many different forms of government involved. However, it is interesting to study the benefits such a government would bring. It would automatically bring about the pooling of scientific knowledge. All existing fears among nations obviously would disappear. No group would have the economic power to menace the peace of the rest of the world. World government probably would lead to a common language among educated people, and thus materially aid in new developments. In fact, scientific development would enter a new era under such favorable conditions.

International scientific cooperation would be especially stimulating to the United States. If the United States were the only nation possessing several major scientific secrets, she would become all-powerful. Such a condition might eventually lead to the destruction of the nation in a manner not unlike the fall and destruction of the Roman Empire. The dangers from internal strife and foreign foes would become great. On the other hand, if America shared the secrets, she would hold herself in international cooperation. Isolation would necessarily become an idea of the past. America finally would be taking her place and her responsibility as a world power.

As yet an international technological body with rank equal to an international governing body has not been proposed seriously by anyone in position to act. Such a body would be easier to form and easier to operate than a governmental body. Scientific problems are not arbitrary, and scientists supposedly are not affected by national ties. In fact, during times of peace, scientists have actually worked informally as an international group. If they were given official power to act as a group and to control all scientific affairs, great benefits should be derived.

The organization of the group should be comparatively simple. The world's scientists should not find it difficult to pick the most eminent scientists of the time as their leaders. Unlike the accomplishments of a statesman, the accomplishments of a scientist are self-evident. These leaders should be picked solely by other scientists—certainly not by statesmen and probably not by the people. As a check on the power of the group, the very right of its existence could be voted on periodically by the people of the world.

The group should be small, consisting probably of no more than three of the world's highest ranking scientists. The group merely should collect knowledge, and not attempt to make discoveries on its own. The making of discoveries should be left to the individual in his own laboratory. However, a world laboratory could be established. Such a laboratory would contain the finest and most costly apparatus available. It would be more complete than any individual laboratory could possibly be. In the latter part of a scientist's research on a problem he could gain permission to work there, where no equipment would be lacking. Scientists from different parts of the world, who might be working on the same problem, could meet there and pool their efforts.

The duties of the three leaders of this body would be comparatively few. They would be responsible that all new scientific knowledge be revealed to all the nations of the world. On account of their high rank as scientists, they could act as consultants to work being done in the "world laboratory". In addition, they could do valuable work in coordinating research throughout the world. They would also control the different national scientific leagues.

Such close scientific cooperation between nations would aid greatly in maintaining peace. Economic differences between nations would be leveled off. Thus, one of the chief causes of modern war would be eliminated. Most important, it would not be too difficult to organize a technological league if it were understood that it would deal with scientific affairs only. Science deals with facts that are hard to distort in accordance with one's own views. The benefits derived from a league, however, would not be restricted to scientific affairs. Cooperation in science should lead to tranquility in world affairs in general.

Brain Twisters

(*Answers on request*)

1. In the following division problem, numbers have been replaced by letters. As in previous problems of this nature, a given letter represents the same digit throughout the problem, and likewise a given digit is always represented by the same letter. More than half of the letters have been omitted, since their presence is unnecessary to the solution of the problem:

```
           J H J C
A B C ) D E F B G H
        * * *
        -----
          * * *
          * * *
          -----
            * * *
            * * H
            -----
              * * *
              * * H
              -----
```

There is only one solution to the problem.

2. The following problem was submitted by R. John Schuchardt ('07), of St. Louis, Mo.:

A returned veteran is stocking his farm. He has allowed himself only $100 to do so, and he wants exactly 100 head of stock.

Calves cost $10 each.
Shoats cost $3 each.
Lambs cost $0.50 each.

How many of each of these does he buy?

For those who prefer mathematics to trial-and-error methods, Mr. Haverkamp's discussion of diophantine equations in the October, 1945, issue of the *Rose Technic* may (or, more probably, may not) be helpful.

3. Five men—Brown, Perkins, Turner, Jones, and Reilly—are engaged in a poker game.

Their brands of cigarettes are Chesterfields, Camels, Luckies, Old Golds, and Kools, but not necessarily in that order.

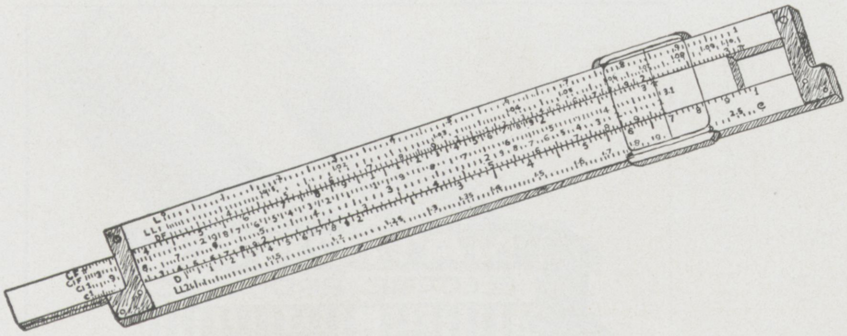
At the beginning of the game the number of cigarettes possessed by the several players was 20, 15, 8, 6, and 3, although not necessarily respectively.

Later in the evening the following conditions obtained at a certain time:

(1) Perkins asked for three cards.
(2) Reilly has smoked half of his original supply, and has smoked one less than the number Turner has already finished.
(3) The Chesterfield man originally had as many more, plus half as many more, plus two and a half more cigarettes than he has now.
(4) One of the men draws to an inside straight after absentmindedly lighting the tipped end of his fifth cigarette.
(5) The man who smokes Luckies has smoked two more than anyone else including Perkins.
(6) Brown drew as many aces as he originally had cigarettes.
(7) No one has smoked all of his cigarettes.
(8) The Camel man asks Jones to pass Brown's matches.

How many cigarettes did each man have originally, and what is each man's brand?

—*From a Tau Beta Pi entrance examination*



Sly Droolings

by Derald Heady, fresh.

The girl took the bracelet that the man brought her and said: "How lovely! Is this the result of a nice thought?"

* * *

Some Surprise

Si Harper raised a bumper crop of 'taters last summer, and he felt so prosperous after collecting for the last load that he decided while in town to buy a complete new outfit of underclothes, suit and shoes. He tucked the package containing the new duds under the seat of the buggy and started homeward. On the way he crossed the bridge over the Bigbee River and on impulse stopped the mare, saying, "Belinda, we'll just surprise Marthy, eh?" So he stripped to the bare hide and threw the old clothing into the river. Then he reached under the seat for the new outfit, only to discover that it had jolted out along the road and been lost. He scratched his head for a moment, jumped in the buggy, grabbed up the reins, and then said, "Giddap, Belinda; we'll surprise Marthy anyway."

* * *

"Do you smoke?"
"No, I don't smoke."
"Do you drink?"
"No, I don't."
"Do you neck?"
"No, I don't."
"Well, what do you do?"
"I tell lies."

* * *

A: "See that girl? Her neck's dirty."

B: "Her does?"

* * *

Him is a goof
Him is a gink
Him personality,
It stinks.
Me luff him,
Tho' him's face is funny!
'Cause dearie,
Him's got money!

Little Willies

Willie on the railroad track,
The engine gave a squeal.
The engineer just took a spade
And scraped him off the wheel.

* * *

The young bride had an extra fine cut of meat, and a friend inquired how she managed. She answered: "Well, the way to my husband's heart is through his stomach, so I make love to the butcher."

"All I could think of was my Nylons!"

* * *

To kiss by phone, I must admit,
Is not most men's desire.
They say it lacks a certain warmth
And of it soon they'd tire.
But I am one who disagrees
A lover most uncouth.
My girl and I we manage fine—
When in the same phone booth!

* * *

Need money? Then try this one:

A man wants three dollars and has only two smackers. He pawns the two bucks for $1.50 and sells the ticket to another fellow for $1.50. Now he has three bucks. Simple!

The three salesman wanted to discuss some things at lunch but couldn't find an empty table. They sat at one where a little, elderly woman was eating. One says: "You know, boys, it's been three weeks since I've been able to take a bath." The second caught on quick and said: "Hell, it's been six weeks since I've had a bath." "Shucks, you guys are plumb clean. I haven't had a bath since last August."

They waited to see what would happen. The little old woman finally piped up: "Will one of you stinkers please pass the salt?"

* * *

A middle-aged woman lost her balance and fell out of a window into a garbage can.

A Chinese, passing, said: "Americans vely wasteful. Woman good for ten years yet."

* * *

A country lass was milking a cow one evening near the fence by the road. A traveling salesman came by and asked the girl for a glass of milk. The girl insisted she must get permission from her mother. When she told her mother the circumstances her mother said, "You say he is a traveling man? Then come in this house and bring the cow with you!"

* * *

Then there's the guy who sat around night clubs for months on end, waiting for a fan dancer to sneeze or hiccough.

* * *

Professional Jealousy

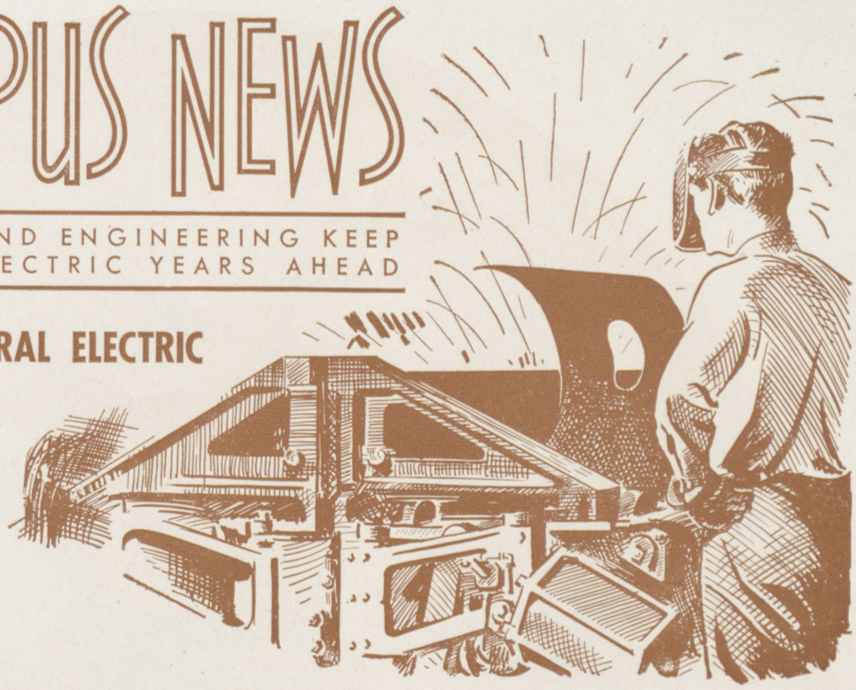
Two bloated oysters reposing in a stew,
"Ah," said one, "I am fatter, sir, than you!"
"Liar!" said the other, "Listen, twerp!
You couldn't even make a midget bwerp!"

* * *

"I told him I worshipped my figure, and he tried to embrace my religion!"

CAMPUS NEWS

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD



AIR CONDITIONING AT GENERAL ELECTRIC

NOW that the war is over, many builders and home owners are considering installing some form of air conditioning or automatic heating equipment—or both. Industrial plants are now finding new uses for air conditioning and refrigerating equipment daily; activity in this field was tremendously accelerated during the war. In the light of these conditions, it can be said that a man who is seeking a career should find in this field ample opportunity to learn a business and establish himself.

Heating and Cooling

Air conditioning has grown into a steadily increasing business. In spite of the depression of the early thirties and the expense of making and installing equipment, General Electric and other manufacturers showed their confidence in air conditioning by developing and placing on the market many kinds of air conditioning equipment from giant units for stores and theaters to small units for room conditioning.

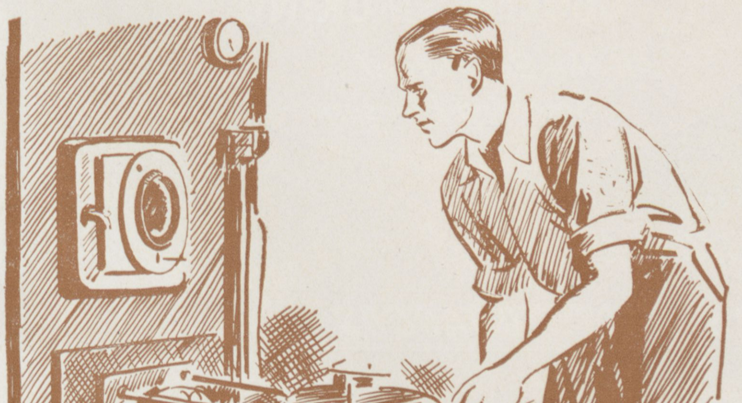
Paralleling the development of gas and oil as furnace fuels was the development of furnace electrical control systems. The market for automatic heating will be huge. Commercial refrigeration will be important as long as people want food to eat. And commercial air conditioning will continue to find new uses.

"Slide Rule" or Sales Engineering

Manufacturers need good engineering talent—for designing, application, and for commercial engineering activities. If a man feels that he has some talent for influencing people as well as manipulating a slide rule, he might consider becoming a sales engineer, selling air conditioning and refrigerating machinery, or becoming an installation and service manager.

The sale of air conditioning and refrigeration equipment to factories and mills has always required competent sales and application engineers. Here the market is expanding so rapidly that contractors may find it advisable to consider the use of "practical" engineers who have apparent but unpracticed sales ability.

The scope of activity is very broad, and hundreds of opportunities will be open for both experienced and inexperienced men. *This advertisement is one of a series discussing opportunities for young men in fields in which General Electric has made important contributions. General Electric Co., Schenectady, N.Y.*



GENERAL ELECTRIC

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C COOLER SMOKING
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