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The WISCONSIN ENGINEER

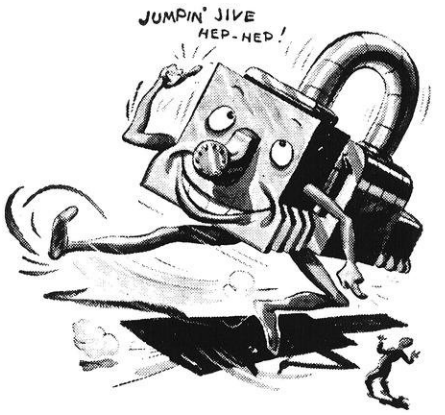
resenting

Electrical
ngineers

January, 1942

Lightning ★ 100 Octane Fuel ★ Lighting

Once there was a jitterbug that weighed 800 tons!

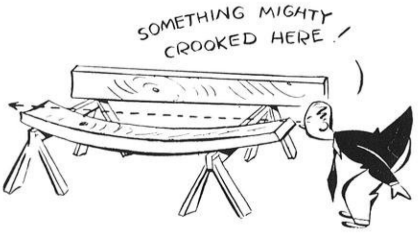


How Westinghouse Engineers Made Vibrating Turbine Generators Calm Down

WHEN the two-pole turbine generator came along, it was hailed as a great thing. And it was. It delivered enormous amounts of amps and volts, did a titanic electrical job. But . . .

Its rotor vibrated and endangered the alignment of the bearings, collector rings, and brushes. Its stator vibrated and made the foundations tremble. And, to make bad things worse, the vibrations were different from those found in the four-pole 1800-rpm machines—and they couldn't be eliminated by the usual balancing methods. Engineers had a tough problem on their hands.

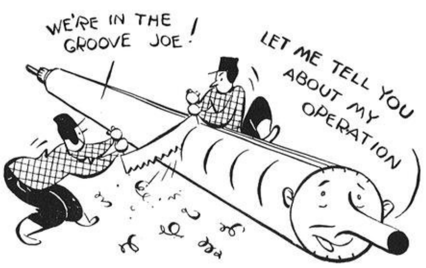
► Westinghouse engineers studied the rotor and found that it was acting like a two-by-four piece of wood. A two-by-four sags more lying flat than lying on its edge. It was the same with the long, slender, two-pole rotor. It sagged more lying one way than another.



This was why: Along two sides of the rotor, deep lengthwise slots were cut for the field windings. Naturally, the rotor had more give on the slotted sides than the solid sides. So, as the rotor turned, the give in the slotted sides made the downward force on the rotor supports change twice each revolution. The result: the rotor made the machine vibrate 120 cycles a second.

► What to do?

Dummy slots in the solid sections of the rotor would have equalized its rigidity. But Westinghouse engineers did something better. They cut several grooves across the solid sections. These grooves made the rotor's rigidity equal on all sides, ***without disturbing the magnetic flux.*** The turbine generator worked at top efficiency, the vibration at the supports was reduced 88%, the rings, brushes, and collector rings didn't take such a shaking-up.



► That took care of the rotor. But Westinghouse engineers also had to figure out what to do about the stator vibration.

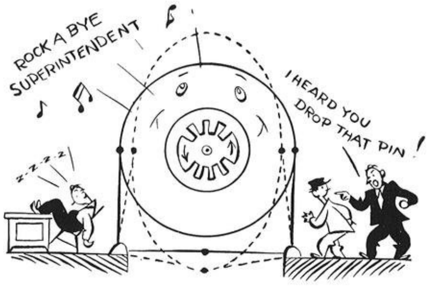
Massive as it is, the stator was being pulled out of shape, first on top and bottom, then on the two sides. The 400,000-pound magnetic force of the two-pole rotor was doing the pulling as it turned.

► Of course, the change in the stator's shape was too minute to be seen. But it could certainly be heard. For this change in shape was transmitted to the stator foundation as a 120 cycle vibration. From the foundation this vibration travels to floor and walls, making them hum.

To put a stop to it, Westinghouse engineers developed a special, flexible mounting for the stator. It is as though the stator were supported on two sets of links. One set goes along with the stator when it vibrates horizontally, but doesn't budge when the stator vibrates vertically. The other set goes along with vertical but not with horizontal vibrations.

► The effect of this ingenious arrangemen is that there is no motion at all where the links are attached to the stator foundation! The vibration at the supports is reduced by 75%, the noise lowered to less than ordinary power station noise levels!

The job was done. Stator vibration was absorbed. Rotor vibration was calmed down. Westinghouse engineers had 3600-rpm, two-pole turbine generators pouring out great electric power, and making no more vibration than machines running at half their speed.



► The electrical industry was through with that vibration trouble for good.

* * *

This is a typical Westinghouse story. It's typical because it's a story about engineers.

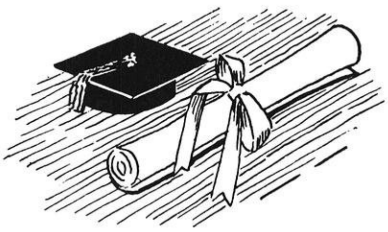
► There are 3500 engineers in Westinghouse. They're in all branches of the business . . . management, research, sales, design, service, testing. They shape the company's attitude toward its work.

Engineering is the heart of our business. Engineers create our products. Engineers solve our problems. Engineers determine our success.

WESTINGHOUSE

Westinghouse

"An Engineer's Company," Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa.



When the war is over, machinery of all kinds will be closely scrutinized for its ability to meet the changed conditions. Thousands of machines will be redesigned to give them higher speed, greater precision and lower operating costs in order that their users will be able to compete at a profit.

The greatly increased use of Timken Tapered Roller Bearings will be one of the most important factors in securing these results. In many machines—previously only partially Timken Equipped—Timken Bearing advantages will be extended to every rotating member. Many other machines will be given new and higher standards of performance through the use of Timken Bearings for the first time.

When you have gained a thorough understanding of Timken Bearings and their application you will be able to solve any bearing problem you may encounter and get 100% results. Begin to acquire that knowledge now; send for a free copy of the Timken Reference Manual.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

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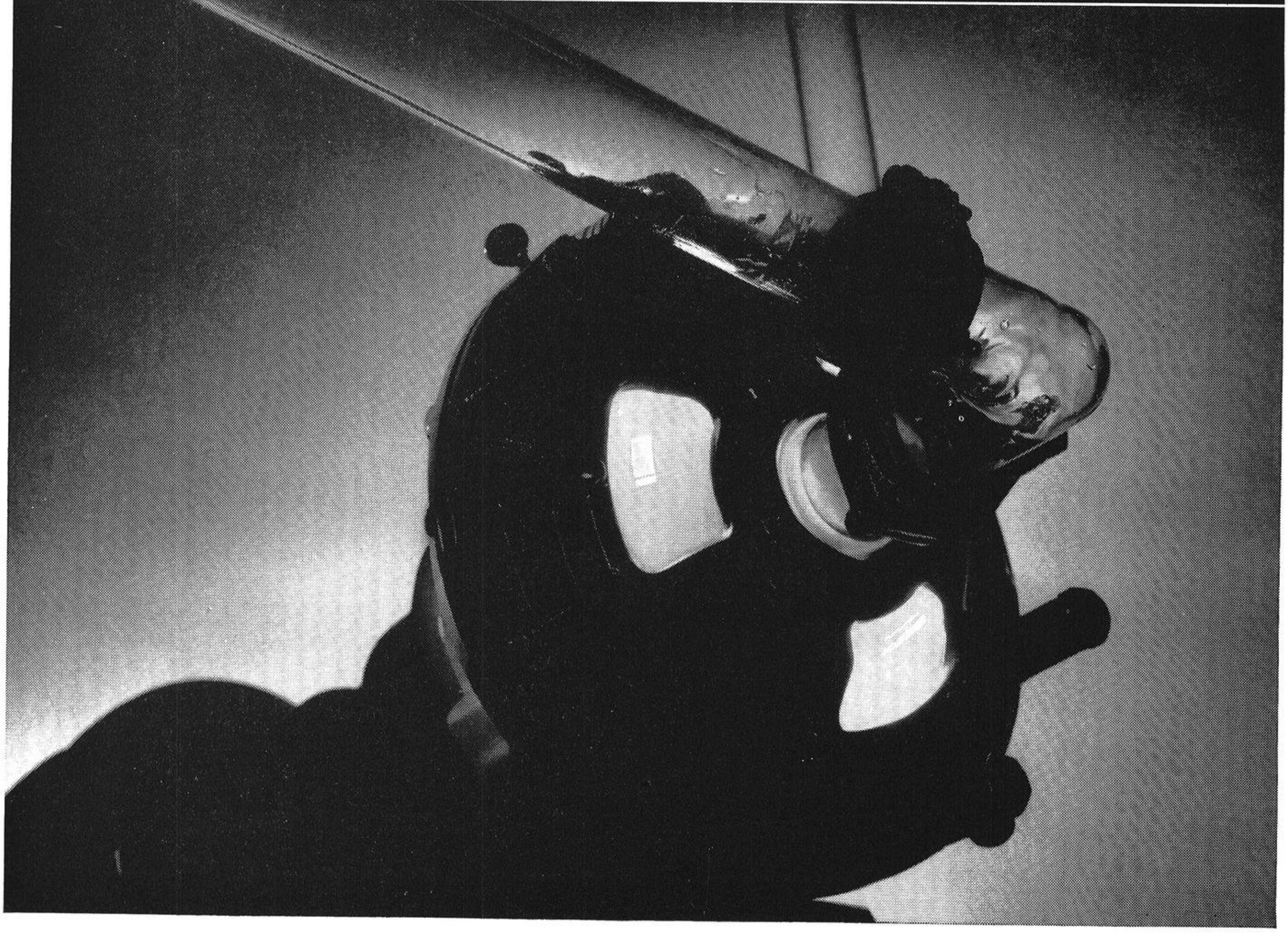
Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

Here's the Glass pump that couldn't be built...



THE ENGINEER from the Chemical Works had one of his usual headaches.

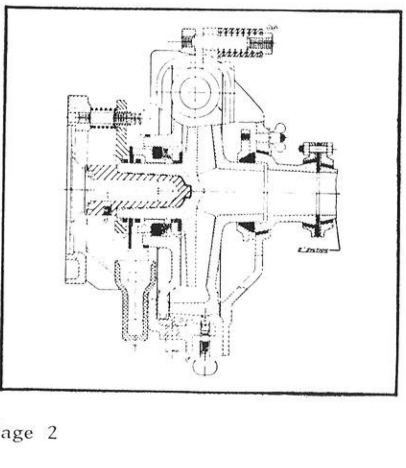
"We're pumping hot corrosive acids through your glass pipe, and it lasts for years," he moaned, "and the works bogs down because the pumps can't take it! Can't you people build a glass pump?"

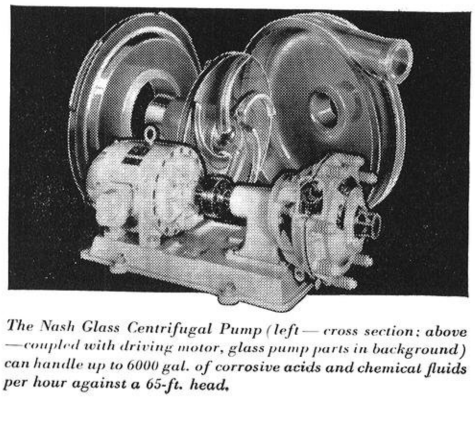
It sounded impossible. Pump makers said it couldn't be done. Such a pump required not only highly resistant glass but also intricate parts, accurate to thousandths of an inch! Even Corning had doubts but decided to tackle the problem.

Pooling its ideas with Nash Engineering Company's knowledge of pumps, Corning devised new methods of glass manufacture, even a new type of glass for certain parts.

And today chemical, food and beverage plants, and other industries handling corrosive solutions have a glass pump that works like a charm. Resistant to corrosion, it eliminates a cause of product contamination and undesirable chemical reactions. Resistant to heat shock, it may be cleaned with hot acids. Transparent, it permits constant visual inspection for cleanliness, color, sedimentation.

In the same way, Corning research for three quarters of a century has licked such glass problems as the bulb for Edison's first lamp, cooking ware for housewives, and tiny glass springs for chemical equipment. And in these days of metal-conservation, Corning ability has reached a new high in usefulness as engineers and production men use glass to solve their new problems. Industrial Division, Corning Glass Works, Corning, N. Y.





The Nash Glass Centrifugal Pump (left — cross section; above — coupled with driving motor, glass pump parts in background) can handle up to 6000 gal. of corrosive acids and chemical fluids per hour against a 65-ft. head.

CORNING
— *means* —
Research in Glass

The WISCONSIN ENGINEER

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In This Issue . . .

To start the year right we're studying the manufacture of **high octane** gasoline, which is good, the effects of **lightning,** usually bad, and **fluorescent lighting,** which is illuminating.

The **electricals** get the nod this month, and we are introduced to that department by **Professor J. W. Watson,** chairman. That branch of the college is more prominent than mechanicals care to admit.

Les Elmergreen has turned out a fine article on lightning research, past and present. We're sorry we didn't have room for a picture of a **Fulgurite,** a quartz "root" formed when lightning struck a sandy beach, fusing an odd-shaped crystal, but see Les if you're interested.

If, after the furor caused by Mr. Ickes, you're wondering about the actual status of the petroleum industry and its methods, see **100 Octane—But Quick,** by Roger Lescohier.

Now that your interest is aroused in this efficiency-improved dark-corner dispeller, perhaps you'd like to see some comparative operational data on a **Madison** installation of **fluorescent lighting,** compilators Ken Hornberg and Warren Lindsley.

Pack mules of the marine service, **Cargo Ships** today and tomorrow will play a vital if occasionally mundane role in the Victory Program.

Not because we think it will help you carry a carbine in China, but because it may help you learn and earn more to "Buy Defense Stamps and Lick the Other Side," ponder **Ju Gee Sheng's** interpretations of Oriental philosophy. **Be a two-footed bird.**

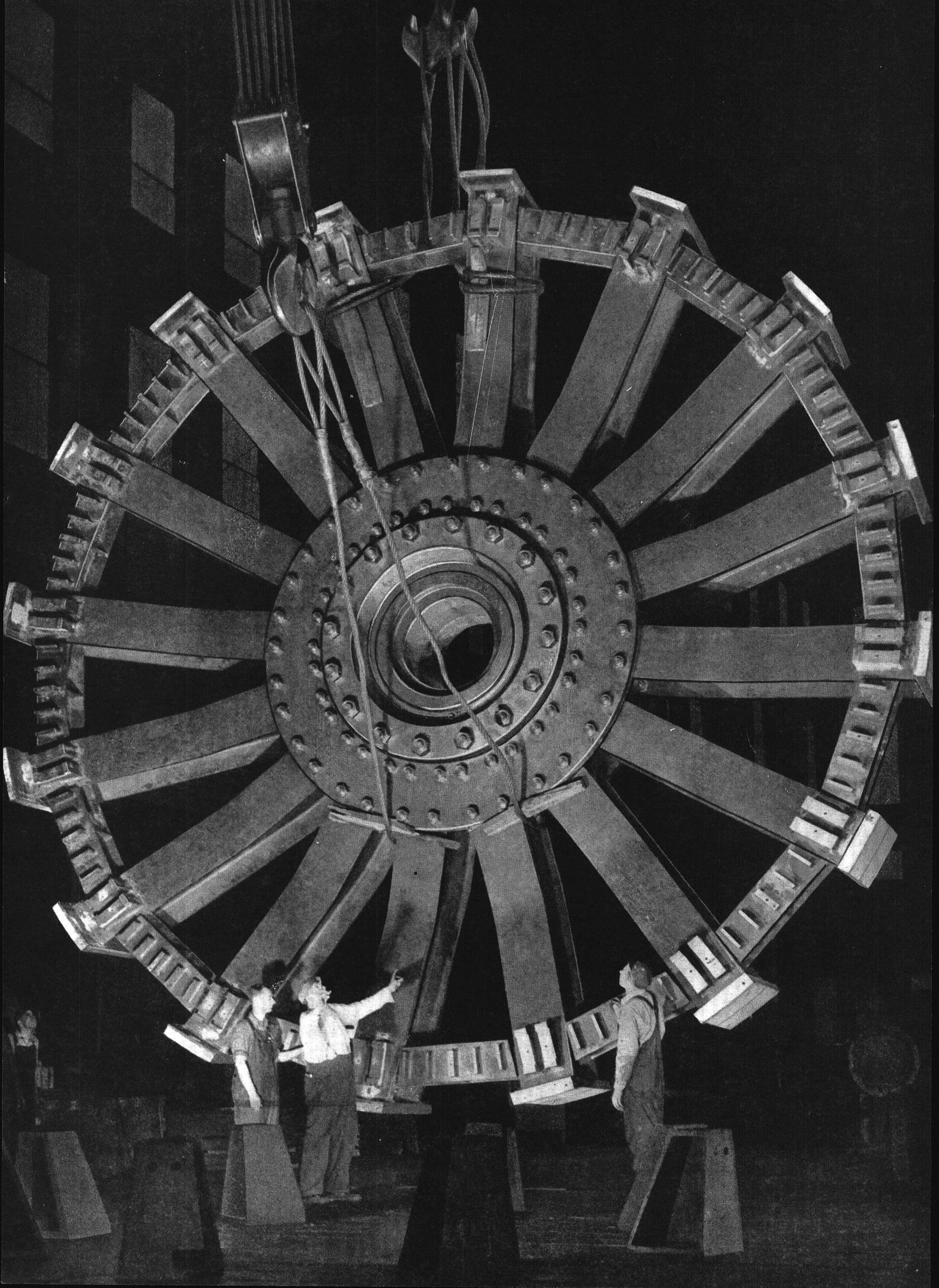
Engineers, particularly upperclassmen and graduates, are required to make extensive use of **library facilities** everywhere. **Professor Volk** has explained the usual reference systems, page 14.

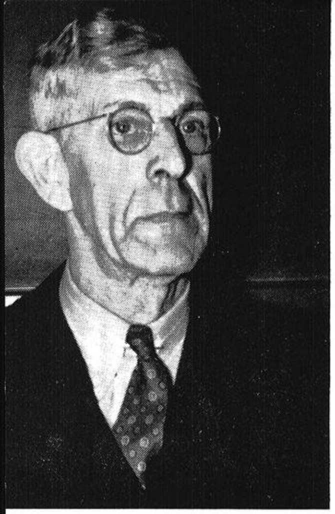
We notice with ever-mounting chagrin and humiliation (and a certain amount of frustration after all our careful efforts at proof-reading, checking, rechecking, etc.) that we gave authorship of last month's submarine article to one Malcolm Feed, rather than Malcolm Fell. F-E-L-L. OK, Mac?

Our frontispiece, courtesy of Allis-Chalmers Electrical Review, is the rotor of a large hydro-electric generator.

The cover illustration, taken in the Electric Laboratory, shows an EE, Hank Nettesheim, '43, in his element.

See you next month.





The Department of the Month

ELECTRICAL ENGINEERING

by J. W. Watson

Chairman, Electrical Engineering

COURSES in theoretical electricity were first offered in the fall of 1889, but it was not until three years later when Mr. Dugald C. Jackson, then division engineer with the Edison company, was appointed Professor of Electrical Engineering that the development of an Electrical Engineering course really began. This new branch of engineering proved to be so popular that by 1894 the enrollment was about as large as the older Civil and Mechanical courses combined.

Several noteworthy changes in the curriculum have occurred since the first one was formed. During the early years practically all phases of Electrical Engineering were included in the required course of study but the very rapid growth of the industry soon led to the introduction of specialized electives, especially in the fields of telephone and power plant engineering. At the turn of the century a group of courses on Electrochemistry were split off under the leadership of Professor C. F. Burgess to form a new department of Electro-chemical Engineering which later became the present Chemical Engineering department.

An extensive poll of the nation's technical graduates, conducted in 1922 by the S.P.E.E., revealed the need of a more liberalized course of study in the engineering colleges. As a result the department in 1924 modified the course of study so as to require work in Speech and a minimum of twelve elective credits to be chosen from the fields of the Social Sciences, Literature, etc. It is interesting to note that in more recent years the majority of the leading technical schools have followed the example initiated here.

The E.E. department in its recent absorption of the former Department of Engineering Economics is now carrying, under the direction of Professor Ayres, a considerable part of the burden of responsibility for offering opportunities to the engineering student to obtain some appreciation of an acquaintance with the business and economic side of engineering enterprise so essential for leadership in our present mechanized world.

The research work of the department has been extensive and varied but the chief emphasis has been in the field of circuit studies where, under the able direction of Professor Edward Bennett, many important investigations have been carried out. As long ago as 1909, for example, Professor Bennett, in cooperation with Professor Terry of the Department of Physics, carried on some of the pioneer work in radio from which emerged the present University station WHA, "the oldest station in the nation." Since the death of Professor Terry in 1929, the technical supervision of the state's radio stations has been under the direction of Professor Bennett and Professor Koehler. At this time also, the radio courses, started by Professor Terry, were taken over by the Department of Electrical Engineering under the direction of Professor Koehler.

In 1913, as a result of the "Wisconsin Idea," a cooperative arrangement was made between the Regents and the Railroad Commission of Wisconsin (now Public Service Commission) for the establishment of the Electrical Standards Laboratory. One function of this laboratory was to provide an electrical standardizing service for Wisconsin similar to that furnished by the U. S. Bureau of Standards, with emphasis on standardization of meters used by the electric utilities of the state. Another function was to provide laboratory facilities for electrical engineering courses and research.

Under the direction of Professor Royce Johnson, additional activities were developed during the last decade in branches of appliance testing and consulting fields where the testing work could not have been done in other laboratories or where the work in the consulting field would have required the creation of another state position. Practically all of the Electrical Engineering services for the State Bureau of Engineering and State Architect have been furnished by the Standards Laboratory for all state institutions since 1931. Both the Standards Laboratory and Radio Station WHA have provided the opportunities for a great many students to gain valuable experience while earning an appreciable part of their expenses.

As a result of these cooperative activities and a policy of gradual expansion, the laboratory has continued to grow in usefulness and importance where similar laboratories in other institutions have declined or have been discontinued altogether.

The 4-year Electrical Engineering curriculum has been laid out with the object of providing the best possible training in fundamental subjects with a limited amount of specialization possible during the senior year. Extended specialization is now provided for by industry or through graduate study.

The equipment in the various laboratories is complete and up-to-date but housed in deplorable quarters. Fifty years ago the dynamo laboratory was located in a portion of the Machine Shop building. It is there today.

LIGHTNING

by Lester Elmergreen, e'42

Illustrations Courtesy General Electric Company

LIGHTNING, nature's most awe-inspiring phenomenon, has come through the ages as one of the greatest of mysteries. The deafening roar of thunder and the flash and crackle of lightning coming from the heavens in its most ominous condition has meant only death and destruction. In the minds of the ancients, the power of lightning was so great that only the king of the gods had the right to use it. The mightiest of the Greek gods, Zeus, was reverently called the "cloud gatherer" and the "thunderer." Thor, the king of the Norse gods, produced lightning and could direct its bolts by merely throwing his great retrievable hammer. Publilius Syrus expressed the accepted feeling when he wrote as one of his maxims, "It is vain to look for a defense against lightning."

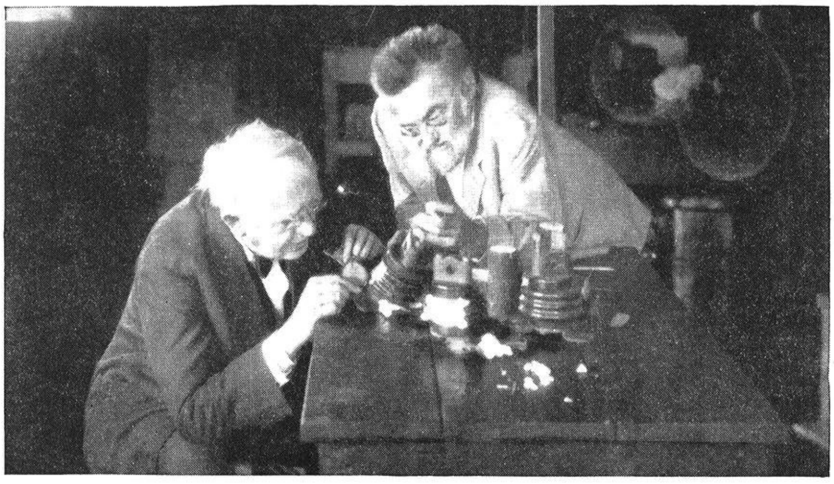
Benjamin Franklin, being a Yankee, didn't believe that anything was impossible and while experimenting with the comparatively new laboratory plaything called electricity, he saw a similarity between lightning and the small discharges he obtained from a Leyden jar. In his experiments with the Leyden jar he stumbled across the principle of the lightning rod and his far-sightedness led to the development of the lightning rod as we use it today. To substantiate his idea that lightning was a type of electricity, Franklin performed his famous kite experiment in 1752 and wrote a paper for the Royal Society in which he identified lightning with electricity.

For almost two centuries, Franklin's work was accepted for what it was worth and no further discoveries were made. In this period the Industrial Revolution had gotten under way and the advancing world was solving its problems as they arose. The absence of lightning hunters in this period can be laid to the fact that there was no need for protection other than that afforded by Franklin's lightning rods. In 1881 Edison began supplying downtown New York with electricity from the world's first electric power plant. With the rapid growth of the use of electric power, many problems concerning the transmission and distribution of electricity arose. These problems led Dr. Charles Steinmetz, the great mathematical wizard, to start the investigation of lightning, and to this end he decided to produce artificial lightning for the purpose of study. The first artificial lightning generator was built in 1921, and while it produced a potential of but 120,000 volts, it gave a form of lightning that could be controlled.

Realizing the great promise in this field, Steinmetz did some outstanding work with artificial lightning before he died, but it remained for those who followed to carry on the investigation. Today some of the world's best equipped laboratories and most highly trained men are engaged in the study of lightning discharges from both natural and artificial sources.

Transmission Line Problems

Transmission lines are designed and insulated for the existing voltages. When lightning strikes a line, the voltages rise progressively until an insulator is reached. At the insulator, the voltage is usually high enough to permit a breakdown, allowing the lightning to jump to the tower structure and then be carried to ground. The arc thus formed will ionize the air, allowing the normal current of the line to follow, effecting a short circuit on the line and interrupting service. This phenomenon is known as a "flashover," and in many parts of the country as many as forty flashovers a year have been observed for every hundred miles of line. If the excess voltage produced by a lightning stroke is not sufficient to cause a flashover, it may be carried to the power plant or to other parts of the system and cause considerable damage to equipment. The result of either may leave a whole city with its hospitals, factories and homes helpless without power.



Steinmetz and Edison inspecting an insulator that had been shattered by artificial lightning.

While the protective devices used on high lines today are not infallible, they represent a great deal of progress in the study of lightning. These devices are of three main types. They either intercept the lightning before it can reach the power line, provide a grounded path for the surge on the line to follow, or effect an automatic disconnection of the station or the equipment on the line until the disturbance has ceased. Thus, by a combination of the three methods of protection the high lines now are reasonably safe from the destructive results of lightning.

Artificial Lightning

Insulator and bushing design, research in high line protection and curiosity keep the lightning hunters busy at their work. At this time, twenty years after Steinmetz built the first artificial lightning generator, we have generators capable of producing discharges which are very close to natural lightning. The ten million volt generator displayed at the New York World's Fair is an example of the equipment available today.

All artificial lightning machines copy nature to some extent. Natural lightning is a discharge occurring between the clouds and the earth which arise from an accumulation of charge, built up with the formation of the clouds. When the charge is great enough to produce a potential difference between the earth and the clouds which is capable of breaking down the air, a flow of electricity takes place with its accompanying flash and thunder. Steinmetz's generator consisted of a condenser built up of glass plates and tin foil which was charged until the potential difference was great enough to cause a discharge between the electrodes.

The types of generators in use today include the surge generator, which is merely a bank of condensers with a unique spark gap arrangement which allows the condensers to be charged in parallel and discharged in series. By charging the condensers in parallel, all condensers are fully charged by a source of supply whose voltage is equal to the voltage rating of a single condenser. Discharging them in series adds all the condenser voltages to give a discharge across a potential difference equal to the product of the condenser voltage rating and the number of condensers in the bank. The surge generator belonging to the University of Wisconsin Electrical Engineering department has ten 25,000 volt condensers and produces a surge of a quarter million volts. Other generators of this type have been built to give surges of 4,000,000 volts and some portable units have been built for field studies on high lines in service.

Another type of generator was developed by Dr. Van de Graff at Massachusetts Institute of Technology and carries his name. The Van de Graff electrostatic generator consists of a large spherical electrode and a rapidly moving belt. A charge is sprayed onto the belt from a source of supply and is carried into the electrode and deposited there. A single sphere can be charged to very high potentials, the amount of charge depending upon the dimensions of the apparatus and the relative rates of charging and leakage. Dr. Van de Graff's first machine consisted of two spheres 15 feet in diameter mounted upon 25 foot textolite columns. By charging one sphere negatively and the other positively, twice the potential difference could be obtained than was possible with similar apparatus with one electrode at ground potential. This machine produced a discharge of 7,000,000 volts and others have gone higher since.

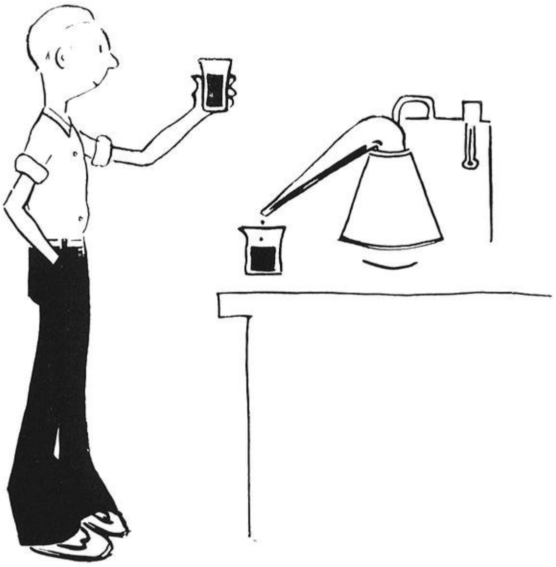
A switching station, electric lines and an oil derrick form attractive lightning targets.

The Physics department at the University of Wisconsin has a Van de Graff generator which is used for atom smashing or the accelerating of protons to produce disintegrating bombardment of materials. This machine operates in a tank under about 100 pounds pressure and in this way the leakage by corona is reduced and the maximum charge is increased. The maximum voltage obtained from this generator was 4,500,000 volts which is quite high for this purpose.

Observe Lightning

Lightning investigators have all resorted to artificial lightning and have supplemented their findings with the observations made of natural lightning phenomena. Even Franklin followed this exact procedure. His Leyden jar

(continued on page 18)



Aircraft Need

100 OCTANE ---BUT QUICK!

by Roger Lescohier, ch'43

WORLD WAR II is a war of mechanized forces. It is a battle of machine against machine. And just as a chain is no stronger than its weakest link, so a machine, whether tank, airplane, or truck, is no better than its engine makes it. Similarly, the power and speed of the engine is limited by the quality of the fuel it burns. For a given size of engine, the higher the quality of fuel available, the greater can be the speed and power output of the engine. Though other factors are involved, the efficiency of gasoline engines is directly proportional to the compression ratio. Then it is desirable to have a high compression ratio, because the corresponding high efficiency means less weight of fuel must be carried in the tank or airplane. If less fuel is required, more bombs or more ammunition can be carried. But the compression ratio increase is limited by the anti-knock value of the fuel. At high compression ratios, Otto cycle engines develop auto-ignition, or knock. Thus the emphasis on "High-octane" fuels. The octane rating of a gasoline is a measure of its anti-knock quality; the higher the octane rating, the less will be the fuel knock, and consequently the higher may the compression ratio and efficiency be.

Considering airplanes alone, where weight is at such a premium, it is easy to see that it is desirable to have the engines in military craft develop the maximum power for a given weight. If 1000 pounds is allowed for the engine in the design of a certain fighter plane, more power will be developed by an engine designed to use 100 octane gasoline than one designed to burn 87 octane fuel. This increased power for the same weight (considering other factors equal) will allow the first plane to fly both higher and faster than the second. If the pilots are of equal ability, and the same number of planes are involved on both sides (which, of course, is seldom the case) the side having planes of greater performance is logically apt to obtain air superiority. Thus it can be seen that high quality fuels are of prime importance in a mechanized war effort.

Important for Bombers

Military strategists now agree that air supremacy is prerequisite to any successful land operation. If the United States is to supply the means for the successful termination of the war on the part of England and Russia, we must build more and faster ships than the Axis. Apparently the strategy of the Allies is to use the vast resources of the United States in making and supplying fuel for airplane engines which will carry bomb loads higher and faster than German and Japanese planes. It is significant that among recent large orders for bombers given United States manufacturers was one for 1000 bombers to travel in the sub-stratosphere, or at 15,000 feet. The present-day bombers powered with 87 octane fuel cannot go above 12,000 feet with a normal load. Tests on gasoline from German planes recently shot down showed their fuel to be 75-91 octane. If the United States can produce adequate quantities of 100 octane fuel and enough engines to fully utilize it, Allied airmen will be able to establish air superiority by greater height and speed, and thus control the air and surface at any point[1].

Granted now that the production of high octane gasoline is essential, let's look briefly at the means of producing it. Just how do they make high-octane gasoline? Gasoline is, of course, made from petroleum oil, of which the United States alone produces about 60%. Petroleum oil is composed of so-called hydrocarbons—compounds of hydrogen and carbon. These hydrocarbons are of many forms and their properties differ everywhere from those of natural gas to those of heavy lubricating oils and tars. The crude oil is a more or less homogeneous mixture of scores of these hydrocarbon compounds. It was discovered about a hundred years ago that the various constituents of petroleum oil could be roughly separated by distillation, the components coming off in order of their volatility. In the early days this procedure of "straight distillation" was satisfactory. The demand for gasoline was low, the most important distillate was kerosene; and there were few standards of quality for either one.

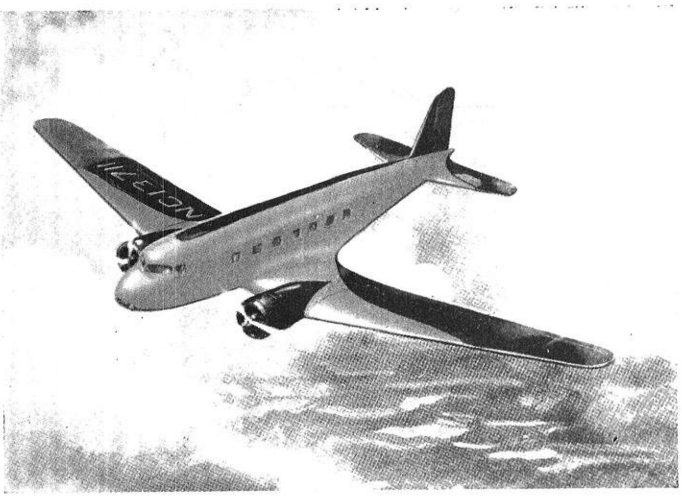
At the present time the demand for gasoline far exceeds the amount which could be obtained by straight distillation. Thus cracking, polymerization, and other pyrolytic processes are resorted to in order to increase both the yield and the quality of the product. Cracking is a high temperature, high pressure process for breaking down large molecules into smaller ones. Polymerization, on the other hand, puts them back together again; that is, it makes larger molecules out of molecules too small for gasoline. Thus by combining the two processes in various ways, heavy fractions may be cracked into light molecules. Then these light components and the very volatile material that was taken off the top of the distillation tower at the start may be polymerized to octane and other molecules in the gasoline boiling range. Much of the gas from a cracking plant is composed of unsaturated hydrocarbons containing 2 to 4 or 5 carbon atoms to the molecule.

Polymerization Process

The first tower of a polymerization unit is usually a hydrogen sulfide scrubber to remove this constituent from gases coming from cracking plant. The gases next are heated up to about 400 F. Before heating, the gases have been compressed to a pressure of about 500 pounds per square inch. The heated gases then go to two catalyst towers in series. These units contain solid phosphoric acid as the active catalyst. The gases leaving the catalyst towers pass into a stabilizer where the mixture is stripped of those components whose volatility is too high to be useful, and the components of suitable volatility are condensed. While the catalyst is inclined to decrease in activity as time goes on, merely increasing the original compression of the gas tends to overcome this. In a test recently run over a five month period, the catalyst was found to have changed from 88 to 84% conversion efficiency and during this time had yielded somewhat in excess of 70 gallons per pound of catalyst. Depending upon the compression of the gas used in the polymerization unit, the yield of polymer gasoline varies from 12 to 20 gallons per 1000 cubic feet of gas used. In addition, this fuel is of high quality from the standpoint of anti-knock — having an octane rating of 80 to 85[2].

Making Iso-octane

It is generally true of the aliphatic hydrocarbons in petroleum oil that compounds having a branched chain have better anti-knock qualities than corresponding straight-chain compounds. Thus it has been found that iso-octane (the branched-chain saturated aliphatic of eight carbon atoms) has much better anti-knock performance than straight-chain octane. Iso-octane has, in fact, rather remarkable anti-knock properties and is an important constituent of most 100 octane fuel combinations. Its manufacture is considered an essential part of the new government plan to greatly expand production of 100 octane gasoline. One of the best ways to make iso-octane is to use a mixture of 50% butane and 50% butene from the stabilizer tower of a cracking unit. This mixture is compressed to 700 pounds per square inch, heated to 250-325 F. and passed through a catalytic unit similar to the one already described. The product from the towers is largely iso-octene, which is an unsaturated 8 carbon branched-chain hydrocarbon. There are formed in addition do-decenes and cetenes, which are 12 and 16 carbon atom chains. These compounds are too low in volatility, so the product is distilled in a fractionating column to obtain the iso-octene. This is compressed to 70 pounds per square inch, heated to about 325 F. and passed over metallic nickel in contact with a stream of hydrogen. Thus it is hydrogenated to iso-octane. In this step the nickel is very finely divided and is on a suitable support to give it porosity. Iso-octane is then blended with iso-pentane and straight run gasoline to improve volatility and give an octane number of 100 or better[2]. The production of iso-octane is a rather complicated and costly task, and building plants for it will be a major undertaking.



100 octane makes them fly better

Alkylation Process

Alkylation is another type of process for making high octane gasoline. In these processes a high octane product is made by combination of an iso-paraffin and an olefin. Alkylation may be conducted as a selective process in which a definite olefin is made to combine with a definite iso-paraffin, with very few side reactions, or it may be conducted as a non-selective process in which a number of iso-paraffins combine with a number of olefins. In the latter case a wide variety of hydrocarbons is produced, most of which are in the gasoline boiling range. An illustration of the simplest form of alkylation which may be performed by the sulfuric acid catalyst process at low temperatures is the combination of butene and iso-butane to form iso-octane. The same type of equipment operated at higher temperature will polymerize unsaturates to octylene, an excellent blending fuel. The octylene, which is an unsaturated 8 carbon atom hydrocarbon, may be hydrogenated to produce iso-octane as an aviation fuel.

From a thermal standpoint one of the most outstanding alkylation processes is the one by which ethylene and iso-butane are combined to form neo-hexane. Neo-hexane

(continued on page 20)

Observations on Fluorescent Lighting

At the National Guardian Life Insurance Building, Madison, Wisconsin

by Kenneth Hornberg, e'42 and Warren Lindsley, e'42

PARTLY because of its efficiency and architectural possibilities, and also because it is, to a large degree, a new commercial application of a rather involved energy transformation process mysterious to the lay public, fluorescent lighting has become an increasingly popular form of artificial illumination since its commercial introduction in 1938. In fact, fluorescent lights have been instrumental in raising illumination values from the 5 foot-candle average of 15 years ago to the 50 foot-candles or more of today in many modern installations.

Such a high level of illumination is featured by the fluorescent installation in Madison's new National Guardian Life Insurance Building. Completed on June 1, 1941, and covering 7,480 square feet of shore frontage on Lake Mendota, this three-story, fireproof building of Bedford stone laid against concrete is completely air-conditioned (except for complete humidity control) by means of pinhole ventilation through the ceiling. Law, Law and Potter were the architects, with Mr. Paul Nystrom of their staff responsible for the lighting. Electric contractor was Mr. O. T. Havey.

Practically shadowless illumination is accomplished by means of fluorescent tubes recessed in continuous ceiling troffers equipped with controlling lenses mounted flush with the ceiling. This type of lighting is maintained throughout the building with the exception of the main vestibule in which incandescent cove lighting is used for decorative purposes, and in a few minor rooms such as store rooms and the garage. Altogether there are 1918 linear feet of troffers, or over a quarter of a mile of installation. The troffers were manufactured by the Architectural Lighting Company to fit in with the acoustic ceiling sections. The same Libbey-Owens-Ford Flutex lens was used with all single and double tube troffers. Proper location of the troffers plays an important part in obtaining balanced illumination.

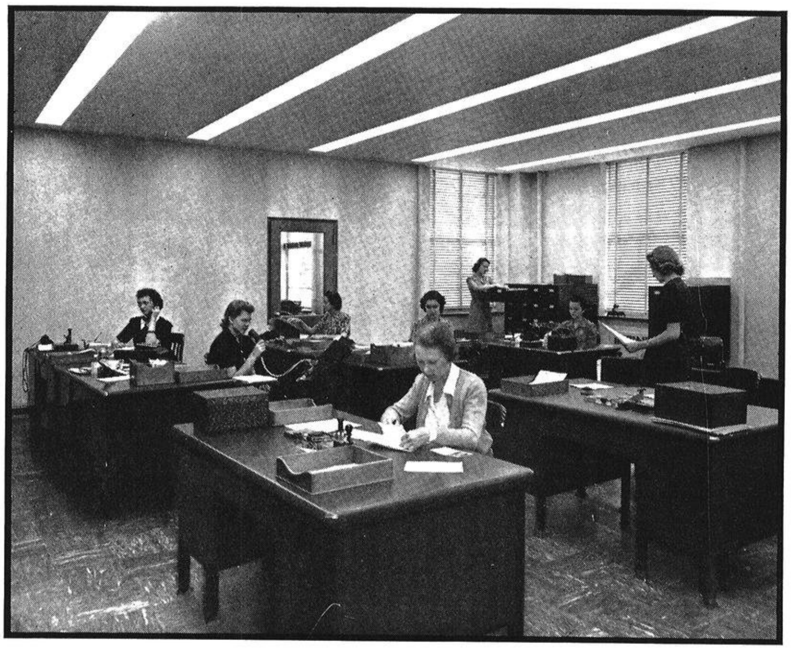
This system required the following troffer units properly located to produce the desired uniformity of illumination. Average separation of troffers was about 5 feet. Additional pertinent data on the lamp efficiency and losses are included. 3500° white lamps were used.

				Tube Lumens*			Total Watts**	
Quantity	Unit	Length	Tube Size	110 v.	120 v.	125 v.	At 120 Volts	At 125 Volts
172	Single tube	48″	40 watt	2100	2140	2230	50	54
304	Double tube	48″	40 watt	2100	2140	2230	100	107
11	Double tube	24″	20 watt	860	877	916	30	32

*Taken from data in August 1, 1941, Mazda lamp price schedule. Lumens output are after 100 hours operation. At 70% of rated life (rated at 2500 hours) the output has decreased approximately 15%.

**Based on data in General Electric Co., Nela Park Engineering Department, Booklet B. Values are approximate and differ somewhat for various makes of ballast units.

The 48 inch double tube units were used in peripheral parts of the ceiling as shown in Figure 1 to help produce uniform illumination over the entire floor. The 24 inch units were used for cove lighting and in the filing office to provide the proper distribution of light. To further improve visual effectiveness, the walls were finished with a special Nela-Park green.



Troffer arrangement in general office.
Courtesy of Cantwell Printing Co.

Construction Statistics

Building costs amounted to $159,000, of which $18,329, or 11.5%, was spent on electrical work, a large part of which was devoted to the fluorescent lighting installation; the total cost of the fluorescent installation being $11,779, of which $9,341 was spent for custom built troffers and installation, $1,598 for glass, and $840 for the lamps. A total floor area of 11,730 square feet was lighted by the fluorescent system, amounting to a unit cost of $1.00 per square foot.

The original design called for a typical semi-indirect and indirect incandescent lighting system with a 25 foot-candle average, using 500 watt lamps in the offices. This part of the installation with incandescent lighting would have cost $1,584, or roughly $0.135 per square foot, for a connected load of 52,900 watts.

The fluorescent lighting load amounts to an average of 3.35 watts per square foot, based on the total load at 120 volts.

The incandescent installation in the area actually equipped with fluorescent units would have been 4.5 watts per square foot.

Operating Costs

The connected load consists of 39,330 watts of fluorescent lighting (at 120 volts) including auxiliary losses, and about 14,000 watts of incandescent lighting, with about 8 horse-power in motors for auxiliary services and distributing cooled or warmed air. The maximum metered demand and energy consumption data for the period from July 1, 1941, to December 31, 1941, are as follows:

Month, 1941	Kw Demand	KWH Consumption
July	——	5280
August	29.2	5440
September	34.4	5760
October	33.2	6160
November	32.0	5760
December	32.8	6160

It is interesting to observe the relatively constant monthly demand and energy use. This is explained by the fact that the artificial lighting is so effective that it is used nearly as much in the summer as during the dark days of autumn and winter.

At this point, if not before, an engineer will inquire as to how the operating costs of this installation compare with those of the incandescent system originally specified. Unfortunately, for purposes of this comparison, the exact hours of operation of the lighting equipment are not known. Consequently, to compare the operating cost of the two types of lighting, it will be simpler to consider one or two typical offices such as that of the President on the north corner of the first floor and a general office on the southeast end of the same floor. For the sake of completeness, an incandescent installation providing approximately the same amount of light as the fluorescent installation will also be considered.

A table of the pertinent data for making these comparisons follows:

DATA FOR COST COMPARISON

	President's Office	General Office
Dimensions	14′ x 23′	28.5′ x 32.5′
Ceiling Height	9′-10″	9′-10″
Area, Square Feet	322	926
Fluorescent Lamp Installation:		
Rated Lamp Watts	1080	2120
Total Fixture Watts	1350	2650
Originally Specified Installation:		
Incandescent Lamp Watts	1000	4500
Hypothetical Incandescent Lamp Load for 50 Foot-Candles	2500	5500

COMPARATIVE COSTS FOR TWO ROOMS
At 4 Hrs. Use per Day for 300 Days Annually

	President's Office			General Office		
		Incandescent			Incandescent	
	Fluor.	Original	Hypothetical	Fluor.	Original	Hypothetical
KWH per Year	1560	1200	3000	3180	5400	6600
Lamp Cost per Year*	$14.26	$2.16	$5.40	$27.98	$9.72	$11.88
Fixed Costs At 10% of Inv.	32.20	4.35	10.88	92.60	12.50	15.30
($1.00 per sq. ft. for fluorescent; .135 per sq. ft. original incandescent.)						
Energy plus Lamp Cost per Year:						
0.8c per KWH	$26.74	$11.76	$29.40	$53.42	$52.92	$64.88
1.0c per KWH	29.86	14.16	35.40	59.78	63.72	77.88
2.0c per KWH	45.46	26.16	65.40	91.58	117.72	143.88
3.0c per KWH	61.06	38.16	95.40	123.38	171.72	209.88
Total Cost per Year:						
0.8c per KWH	58.94	16.11	40.28	146.02	65.42	79.98
1.0c per KWH	62.06	18.51	46.28	152.38	76.22	93.18
2.0c per KWH	77.66	30.51	76.28	184.18	130.22	159.18
3.0c per KWH	93.26	42.51	106.28	215.98	184.22	225.18

*40 watt fluorescent lamps at $1.10, 2500 hr. life.
500 watt incandescent lamps at $.90, 1000 hr. life.
No labor charge for replacement. Lamp costs are 20% less than retail price.

It is evident from the tabulated energy and lamp costs that, because the incandescent lamp renewals are less expensive, the greater efficiency of fluorescent lamps will not compensate for their higher cost if energy is cheap enough.

It is also evident (although not tabulated) that with longer hours of use per year, the energy savings with fluorescent lights will balance the higher fixed costs at lower rates per KWH of energy. In other words, the more a fluorescent lighting installation is used, the lower is the unit cost of energy at which it is more economical than a corresponding incandescent lamp installation.

Performance

A study of lighting conditions was made in rooms which required different seeing tasks such as executive work, general office work, and filing. Illumination values were taken corresponding to actual working conditions such as night and day to show the influence of natural light.

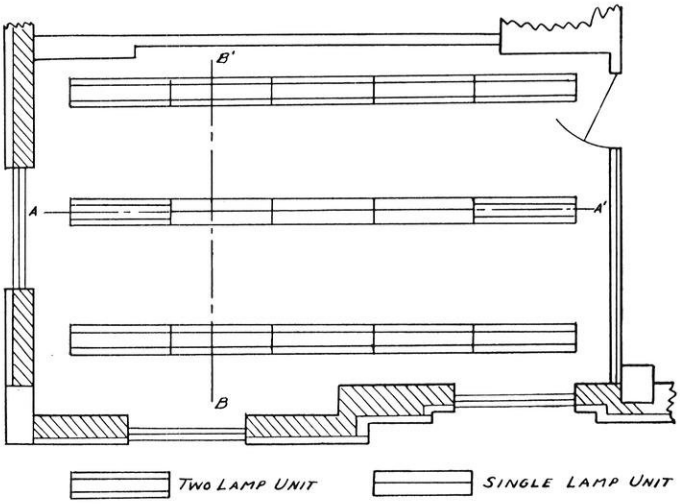


Fig. 1—Fluorescent installation plan in the president's office.

The main executive office of the president, Mr. George Boissard, offers a fine example of uniform and pleasant

(continued on page 22)

SEA OTTER II

Automobile Engines . . . Vertical Propeller Shafts

RECENT trials have been completed in Gulf Coast waters on a novel development in cargo ship design which is being sponsored by the Navy Department as at least a partial answer to the submarine threat of the North Atlantic. The first full size vessel of this new type built for experimental purposes is the 257-foot SEA OTTER II. Since the results of the trials will not be known for some time, the Navy Department has curtailed all but a brief announcement of the details of the vessel.

The basic design, from which variations have been proposed, has the following general characteristics:

Length overall	257 feet 6 inches
Length between perpendiculars	250 feet
Breadth, molded	40 feet
Depth, molded	21 feet
Load draft (exclusive of propellers)	11 feet
Load displacement	2250 tons
Deadweight capacity	1622 tons
Brake horsepower	1760
Speed	12 knots

The vessel is all welded construction using rectangular plates which require practically no bending except at the bilges. The hull construction uses 3/8″ plate while the flat keel requires 1/2″ plate. The hull is divided by two longitudinal bulkheads and transversely by eight watertight bulkheads. Since the vessel in loaded condition is low in the water and will be awash most of the time at sea, a sponson has been erected at the bow to provide extra buoyancy and better seaworthy qualities.

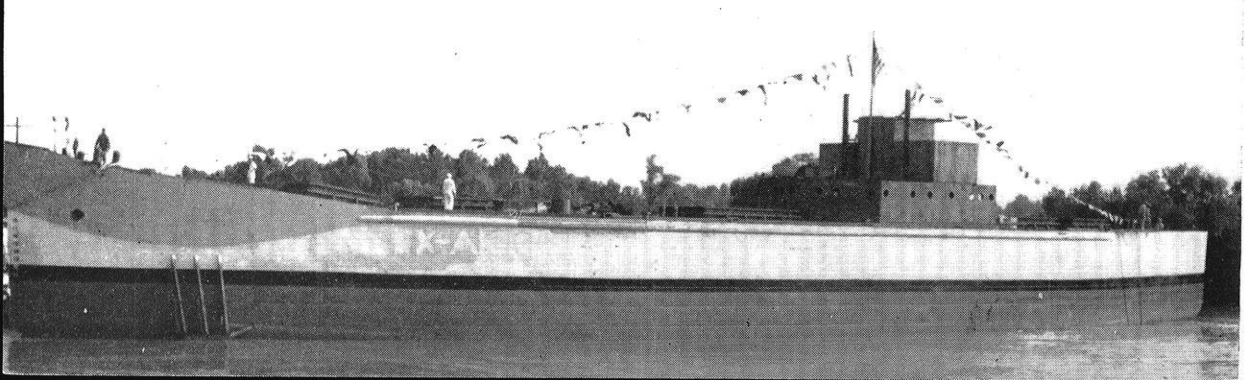
A single deckhouse located aft of midships provides living accommodations for 15 persons, and space for the wheel house, gun platform, and signal station. One lifeboat is carried. The crew consists of the captain, three quartermasters, two engineers, one radio man, and one cook, making a total normal crew of eight men. The engine room is also located aft of midships.

Evidence of the minimum of labor and materials required for construction is demonstrated by the building of the Sea Otter II in two months. Long range fuel capacity is 182 tons which at 11 knots gives a cruising radius of 9050 nautical miles, and at 12 knots, 7419 nautical miles. Normally the vessel will carry 95 tons, providing a cruising radius of 3700 nautical miles at 12 knots. Fresh water tanks carry 5040 gallons; fuel oil for oil burning heater, 390 gallons; lubricating oil, 890 gallons. The hull is equipped with a hydraulic steering gear and an electrically driven capstan.

The greatest innovation of this strange vessel is its propulsion system consisting of sixteen 110-horsepower six-cylinder Chrysler gasoline engines of the type used in automobiles. Four batteries of four engines each are arranged to drive four propellers through vertical shafts extending through the bottom of the hull. The four propellers are located transversely across the flat bottom of the vessel in much the same manner as outboard motors, except for the fact that they are suspended just aft of midships and not in the stern. Four engines hydraulically coupled to a ring gear are arranged radially around each shaft opening thus providing 440 horsepower to drive each propeller. The thrust is not excessive and is easily taken by vertical shaft housing in much the same manner as taken by outboard type motors. The two-bladed propellers have a diameter of 70 inches and a pitch of 84 inches. The propellers and transmission units can be lifted while under way for repairs, or to reduce draft when necessary to give a maximum draft of only 11 feet. Current for lighting and auxiliary purposes is generated by a gasoline motor driven generator. The vessel carries in spare one complete power transmission, two propellers, and four engines. It has a turning circle of 1000 feet with a 32 degree rudder.

While the Sea Otter II was built at a cost of $250,000, it is estimated that vessels of the same size produced in quantity will not cost more than $100,000 each. It is contemplated on using a number of the Sea Otters as coastal vessels and trawlers, and the likelihood is that many will be used in Atlantic service for the duration of the emergency, since, with shallow draft and low free board, they will offer small targets for air or submarine attacks.

Because of the speed of construction and availability of propulsion machinery, the Maritime Commission contemplates the construction of a number of vessels of this type as tankers to relieve the existing oil shortage.



Cut and specifications— Courtesy of Marine Engineering and Shipping Review.

我的目光中的工程師

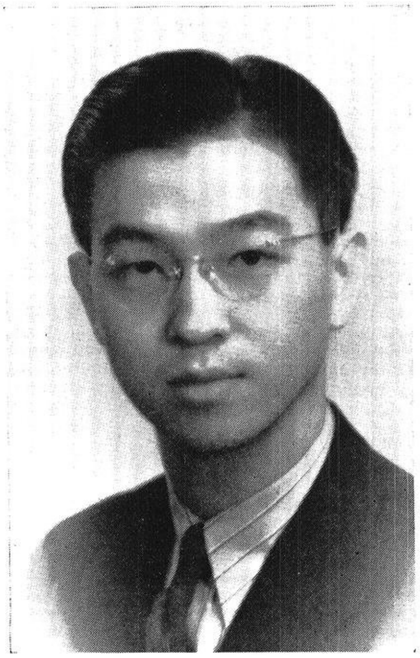
THE ENGINEER --- AS A CHINESE SEES HIM

by Ju Gee Sheng, e'43

Eta Kappa Nu, honorary electrical engineering fraternity, received this interesting pledge paper in Chinese. The author has translated it for publication in the Wisconsin Engineer.

I FIND a striking resemblance of views between the groups of old scholarly people at home in China and some people in the United States on the question of whether an engineer is an educated man. Both maintain that his education is very much limited.

The China group, which has been practicing philosophy, literature, and fine arts since Emperor Yao in the year 2357 B.C. (he also wrote the oldest poems extant) thinks that an engineer is no more than an artisan who builds steel bridges instead of stone arch ones. They have not liked the new things which have interfered with and disturbed their living. They would not like to call a man educated "simply because he learned a few tricks from abroad." As our proverb says: "Know nothing; say nothing." Let them face the facts and discover what they are. And those in the United States presumably know what an engineer is, and know "how limited" his education in colleges. They refuse to recognize him as a well educated man, because they find he was "trained" in a special field in the colleges.



Ju Gee believes that an end to present strife will enable him to return home within the next year.

It is impossible to learn enough of everything to be of any importance. It is in the college that we start to specialize in some field. I am not familiar with curricula of high schools in the United States. The government-specified curricula of Chinese middle schools consist of no less than twenty different subjects in three years of study. Having passed the government supervised examinations, the student knows a little of everything, but not much of anything. Likewise in the college, a student may take Latin, French, Spanish and German. What does he know when he gets out of college? To count the numbers one to ten in different language? There are exceptions. Leonardo da Vinci lived once; it is very doubtful whether the world will see another.

A physician, a lawyer, a psychologist or anybody else who is normal is no more educated than an engineer is. They are in different fields. People do not expect a physician to tell why a suspension bridge failed, or a lawyer to cure diabetes. Why should an engineer be expected to investigate what made Napoleon so ambitious or to discuss comparative constitution?

I do not mean to say that people should stick to their own business and be unaware of things around their life. But there are men, educated men, who are very ignorant of common things near to their life. Few people realize that the frequency of alternating current makes not only the tuning of their radios possible but also their electric clocks accurate. Few realize that carbon dioxide can put out their lives just as easily as it puts out fire. Few realize that "calorie" is a unit of heat, not ounces of potato or gravy. The biggest human desire is to know what one does not know. Everybody is curious and anxious to find what hides behind that screen of mystery. A smile of triumph comes only when one is satisfied.

The knowledge in the entire universe is like an immense field, both wide and long. It cannot be mastered by a single man. An engineer stands on a part of the field, a section that may not be beautiful but is practical. He may occupy his own section with opened eyes, seeing all four corners. He may then benefit the neighboring harvest. But he makes no attempt to raise all by himself. Another one jumps across the field over many places. He harvests little.

"Be a two-footed bird (completeness), rather than a three-footed cat."

How to Best Use the

ENGINEERING LIBRARY

by F. E. Volk, Librarian

A LIBRARY is a storehouse of information. It has also been described as a public utility attempting to supply its varied clientele with such intellectual fare as may be desired. A college library is also an educational institution. In performing these functions many problems arise, and to solve their difficulties librarians have evolved and standardized certain methods and procedures. It is hoped that a discussion of some of our problems and procedures will be helpful to those who use the library.

The clientele of the Engineering library comes from all parts of the University campus. A recent check showed that the number of borrowers from other college faculties on the campus exceeds by more than thirty per cent the total roster of the faculty of the College of Engineering. Nevertheless, by far the greater part of our service is to students of the College of Engineering. At the present time most of these men are upper classmen, and it seems desirable that students begin to use the library earlier in their career.

Engineering students are too busy to undertake anything which does not contribute to their regular studies. The following suggestions are therefore confined to ways in which the library can be of use in the regular work and of how to get what is wanted with the least consumption of time and effort.

F. E. Volk

If you have tested some piece of apparatus in the laboratory you may want a book to explain the principles involved or to supply comparative data by which to check your results. If you have the problem of designing a dam, investigating a waterpower plant, building a transmission line, a railroad, or any other project the library can help.

Students are frequently referred to the library by their instructors. If the reference is to a handbook or to a book which has been reserved for class reference it is only necessary to ask for the book at the desk and it will be found for you. The same is true for a specific reference to a periodical. At other times topics or problems are assigned which involve a search for material. For such a search the student needs to know something about library organization and methods.

As a storehouse of information a library would be a hopeless failure if it failed to keep its information up to date. This is especially true of a scientific library because of the very rapid progress being made in that field. Such a library must keep abreast of developments in order to anticipate the future needs of its clients. It must collect today what they will demand tomorrow. With a limited budget and the present flood of published material the question of book selection is a big problem.

In our library suggestions are invited from all members of the faculty, and book reviews in a large number of technical magazines as well as publishers' lists are systematically checked. A library committee composed of one member from each department of the college then winnows these suggestions and we purchase as many of the most desirable books as the available funds will permit.

When these books are received how can they be listed and filed so as to make their contents quickly and easily available to users? Sometimes a reader knows the name of the author, the title or the publisher of a book which will answer his questions. Usually he can give only the subject in which he is interested. For this reason librarians have grouped books according to content, i.e. brought together on the shelves all the material on a given subject, and related material is placed nearby. This process is called "classification."

Most libraries in the United States use the "Dewey Decimal" classification. This divides all knowledge into ten classes, each class into ten divisions, each division into ten sections, and each section into ten subsections. When needed additional subdivisions are used. Where this system has been adopted a new book can be readily assigned to its class, division, etc., and placed on the shelves with similar material. Of course someone must read enough of the book to ascertain its character, then mark it in a way to reveal its content and insure correct placement on the shelf not only the first time but whenever it has been removed from the shelves for use.

Dewey arbitrarily selected ten classes so he could assign a digit to each. He did the same for the divisions and sections. In this system the figure denoting a class occupies the hundreds place, that representing the division the tens place, and a section the units place. If a more detailed classification is needed the further dividing is shown as decimals; e.g. a subsection would be represented by a digit in tenths place.

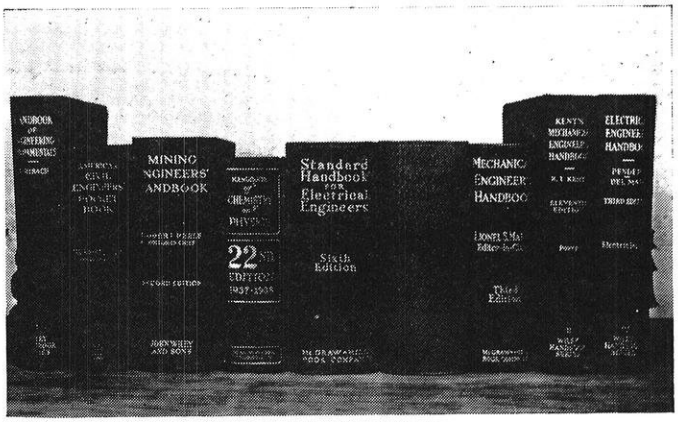
The "Dewey Decimal" classification is not used in the University of Wisconsin libraries. We use a modification of the "Cutter" expansive classification. This system differs from the "Dewey" system in that the letters of the alphabet are used as indicators instead of the Arabic numerals. In the "Cutter" system there are twenty-six classes, twenty-six divisions of each class, etc., and the arrangement of the classification is alphabetic instead of numerical. Otherwise the operation of the two systems are quite similar. The "Cutter" system was adopted here long before the "Dewey" system became so popular. To change would be very expensive and of doubtful value.

It is necessary to arrange the books alphabetically by authors in each group in order to be able to find any book quickly. To make the alphabeting easy each book is assigned and marked with a "Cutter" or "Author number," based on the author's name. The first part of this number is the first letter of the author's name and this is followed by a number assigned by reference to Cutter's alphabetic order table.

The call number of each book therefore consists of two parts—the classification number and the author number. On the book and on the catalog cards the two parts are usually written one above the other, but they are always separated by a period before the author number so they can be written on the same line without confusion. Thus MKG.G94 shows plainly which is the classification and which the author number. The "point" or period is an integral part of every call number and should always be included when writing or speaking a call number.

The card index is an essential part of the system. When a book is classified the cataloguer also makes author and joint author cards and as many subject cards as are necessary to bring out the chief characteristics of the volume. If the title is distinctive, a title card is also made. These cards are filed alphabetically in a dictionary type of combined author and subject index. Each card carries the call number, the author's name, the title of the book, the date and place of publication, and often a good statement of contents. It is often easier to select the book you need from the cards in the index than by examining the books on the shelves. One advantage of using the index is that in it you will find not only all of the books in a given classification that cover the subject but books in other classifications which have something about the matter will also be listed under the subject. In this index all of the books by any author are listed together under his name, and all the books on a given subject are listed alphabetically by authors under the subject. One can therefore seek the desired material from either the subject or author standpoint. Having found the card for the desired book one has only to copy the call number, the author's name, and the title of the book, to be prepared to go to the stacks for the book himself or to ask the library attendant to get it for him.

The Engineering Index, covering the entire engineering field, was the first of its kind. Wisconsin should be proud of this piece of work for it was started by one of our former deans, J. B. Johnson, back in 1884. Dean F. E. Turneaure, then a young instructor, helped with the work for several years. Articles from more than twelve hundred technical publications from all over the world are listed in this index. It is now published by the American Society of Mechanical Engineers, and we have a complete file. Each annual volume now contains more than fifty thousand separate items.



The Industrial Arts Index, started in 1913, also covers the entire engineering field. It indexes material from more than two hundred and fifty magazines, most of them in the English language, and the majority of them published in North America. It is issued monthly and regularly cumulated so it enables a searcher to easily bring his information up to date. It is the most used of all our indexes.

Chemical Abstracts has been published by the American Chemical Society since 1907. A cumulated index is issued every ten years. It is the most extensive and finest piece of work of its kind being done anywhere, and is a splendid help to the chemist.

Science Abstracts, a British publication, covers the field of physics and electrical engineering. It was started in 1898. Like Chemical Abstracts it is what is known as an abstract journal. Both of the publications contain quite comprehensive abstracts of the articles listed. Frequently these abstracts give all the information needed. They are especially valuable when the original article happens to be in a foreign language.

Briefly the arrangement of the material in the library is as follows. Reserved books, which includes dictionaries, handbooks, general references, and books reserved for class reference are in the reference alcove and are to be called for at the desk. Complete lists of these books are in the "linedex" bulletin board beside the desk if one wishes to know what is reserved.

Indexes are tools for uncovering the wealth of our storehouse. May the engineers soon become proficient in the use of these tools and discover rich treasures of information.

Beginning February 4, the library will be open until 10 p.m. week nights and Saturday afternoon.

ALUMNI NOTES

by Roy McIntosh, met'42

Civils

LEVIN, JACK D., '27, gives his address as "Care of Warden, Federal Reformatory, El Reno, Oklahoma," but don't jump to conclusions. He is a construction engineer for the U. S. Treasury Department and builds postoffices, as a rule. In this case, however, he is construction engineer and superintendent on the construction of an "industries building" for the Department of Justice. He reports the arrival of a son, Victor Alan, on November 22.

KURTH, JAMES A., '35, is an ensign in the U. S. Naval Reserve. He is in Washington, D. C., as a fire-control officer in the Bureau of Ordnance.

PAPE, VICTOR G. O., '35, and his wife, Starling, are located at Anchorage, Alaska.

ANDERSON, BOYD G., '36, is with the Navy Department as assistant engineer in structural design, located at Washington, D. C.

BRUNS, EDWARD G., '37, is principal inspector for the Constructing Quartermaster at Camp Shelby, Miss.

MALDARI, JOE A., '38, is a lieutenant in the 22nd Engineer Battalion, 5th Armored Division at Fort Knox, Ky.

MAXFIELD, JACK H., '38, is chief of party for the Illinois Division of Waterways at Springfield, Illinois, under **THOMAS B. CASEY**, '17, chief of the bureau of rivers and lakes control.

SCHLUTER, ALBERT S., '38, is an ensign in the U. S. Naval Reserve at Pearl Harbor. He came through the Jap raid safely.

SCHNEIBLE, DOUGLAS E., '38, is junior hydraulic engineer with the hydraulics laboratory of the National Bureau of Standards at Washington, D. C.

SCHEERAR, LEWIS L., '38, is engineer with the Wisconsin Valley Improvement Association at Wausau.

SPERLING, ARTHUR F., '38, is a structural engineer in the bridge department of the New York Central Railroad in the Chicago office. The group of Wisconsin men in the office includes: **MAHLON J. PLUMB**, '39; **MAX H. SPINDLER**, '98; and Prof. Kinne's son, William Jr., who is a graduate in architecture from the University of Illinois.

WENDT, MARTIN B., '38, is at Sabine Pass, Texas, as construction engineer on a naval base.

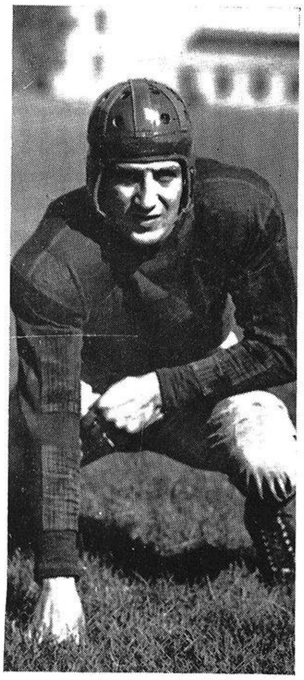
TAMM, WILLIAM H., '39, is a junior engineer with the U. S. Engineer Office at Norfolk, Va.

Mechanicals

DUWENEEL, W. A., '24, called on old acquaintances in the Mechanical Engineering Building this week. He is Chief Engineer of the Standard Distributing Corporation, 406 East Wells St., Milwaukee.

REX, HARLAND E., '29, engineer with the Carrier Corporation of Chicago, was in Madison this week and called on a number of his old instructors at the Mechanical Engineering Building.

BENNETT, LT. HERBERT L., '37, is with the 57th Signal Battalion at Camp Edwards, Massachusetts.



LT. J. E. LOEHRKE

LOEHRKE, LT. JOHN E., '38, was killed in an airplane crash at Macon, Georgia. Lt. Loehrke won his letter as an end on the Wisconsin football team for 3 years, in 1936, 1937, and 1938. He completed his air corps training at Randolph Field in Texas on Oct. 9, 1940 and had been acting as a training officer for several months.

ROSENBERG, A. A., M.S. '38, was married on Dec. 7 to Miss Gussie Ethel Haskewitz. Mr. Rosenberg is in engineering work with the U. S. Government. They are living at 1009 West Wyoming Ave., Philadelphia.

SCHEIN, HENRY, '40, is now employed as a tool designer with the Link Belt Co. of Milwaukee. He was formerly with the Tractor Division of Allis Chalmers Co.

WAGNER, LT. WALTER J., '41 (February), is engaged in Squadron Engineering with the U. S. Air Corps at Mather Field, California. He received his 2nd Lieutenant's commission Dec. 19, 1941.

REICHENBERG, 2nd LT. HAROLD E., is doing Squadron Engineering with the U. S. Air Corps at Hamilton Field, California.

Miners and Metallurgists

HOLM, HOWARD G., MS '37, has resigned his position at the Battelle Memorial Institute, and is now with the A. O. Smith Corp., Milwaukee.

GERVAIS, ART, '39, recently returned from Alaska where he was employed on a gold dredge at Fox, and later connected with the Civil Aeronautic Authority at Anchorage. Art and his wife are now making their home in Beloit, Wisconsin where he has purchased a business.

OLSON, GILBERT L., '39, has returned to the Globe Steel Tube Company in Milwaukee, having left the Steel & Tube Co., Cleveland, Ohio.

CARTER, SAM, MS '41, is with the American Cast Iron Pipe Co., Birmingham, Ala.

ANDERES, JOHN R., is employed in metallurgical contract work at the Belle City Malleable Iron Company, Racine, Wis.

Electricals

BELL, LT. A. L., MS '34, is situated at Schofield Barracks, Territory of Hawaii.

KONKEL, LT. ARDIE, '34, is also at Schofield Barracks, Territory of Hawaii.

KRANCUS, LT. A. F., '41, commands a detachment of 12 men on the NW part of the island of Oalua at a place called Kawailoa. This is at the Schofield Barracks in the Territory of Hawaii.

BONCYK, CLARENCE J., '40, left the Interstate Power Company, where he was District Engineer, to enlist in the Army as of about Jan. 1, 1942.

HANSEN, CORWIN A., '41, upon completion of his training at the Naval Research Lab, Washington, D. C., will be stationed at Pearl Harbor.

LIGHTNING . . .

(continued from page 7)

and laboratory equipment constitutes a small electrostatic generator and a means of storing a charge until it was large enough to be used. Following up his observations in his laboratory, Franklin went out in a thunder storm and verified his conclusions. Modern lightning hunters do not resort to such a dangerous method as did Franklin, but instead use electrical instruments and photographic equipment.

Work has been done in observing and recording the effects of lightning discharges that have struck power lines, and oscillograph records have been made which have recorded the transient currents caused by lightning strokes. This work has been of great value in predicting the magnitude of the discharge and in the design of protective equipment. Several laboratories have been established for the sole purpose of observing natural lightning. The best known of these observatories is the one on the top of the Empire State building. Being the highest building in the area, the location is ideal as any discharge in the vicinity of downtown New York will be drawn to this high point. The observatory consists of recording apparatus at this location and a photographic laboratory five blocks away. Obtaining advance notice of an approaching storm, the operator turns on the equipment at the top of the Empire State building and then goes to the photographic laboratory and awaits the storm.

At the high voltage laboratory of the Westinghouse

Lightning is a constant threat to power transmission.

Company at Sharon, Pennsylvania, a method of comparing, cataloging, and fingerprinting lightning has been developed. This laboratory has prepared a large file of specimens that have been subjected to artificial lightning discharges of different types. By comparing these specimens with those formed by natural lightning, the type and intensity of the stroke can be estimated. The investigators at this laboratory have divided lightning discharges into two distinct types which occur together in varying amounts. "Hot" lightning discharges are those of low current and long duration and produce specimens that show signs of fusing, burning, and melting. "Cold" lightning discharges have relatively high currents and short duration and shatter or crush whatever they strike.

Lightning Is Cheap

Results of measurements and calculations of the magnitudes of natural lightning discharges show that enormous potential differences exist and that very high currents flow in a discharge. F. W. Peek of the General Electric Company has estimated a potential of 1,000,000,000 volts and a current of 80,000 amperes in a typical discharge. Calculations of the magnitude of discharge from a hypothetical cloud 2,000 feet in diameter and 5,000 feet high give potentials of about 150,000,000 volts and currents between 180,000 and 500,000 amperes. This latter calculation also gives an instantaneous power of 10,000,000,000 kilowatts but a duration of discharge so short that the total energy is less than 0.15 kilowatt-hours. At the prevailing base energy rates in this district, the value of a lightning discharge of this magnitude would be less than a third of a cent.

All the investigations and research of the lightning hunters has taken place during the last two decades. This work is only started and the future will bring achievements comparable to the 200 inch telescope which was once an impossibility.

Nature's secrets are falling, one by one, before man's ever moving thirst for knowledge and the great mystery of lightning is being solved so that we now respect it instead of fearing it as a great unknown.

GASOLINE . . .

(continued from page 9)

has an octane rating as produced of about 94, and can be leaded within Army limitations to about 115. This product may also be made catalytically. It is of particular importance from the standpoint of conservation of natural resources as it uses a lighter gas than is generally considered feasible for commercial alkylation processes[3].

Expansion Program

Now that we have seen the importance of high octane gasoline in the war effort and something of how it is manufactured, the question comes up, "What is being done to assure an adequate supply of 100 octane fuel for the next few years?" First, let us get some idea of the present productive capacity of our refining industry. Our refineries are now turning out finished products at the rate of 3½ million barrels a day. This rather incomprehensible figure can better be understood by saying that a single day's production would fill a train of tank cars 141 miles long. Another way of stating it would be to say that a day's production would fill a 10 inch diameter pipe line stretching from London to San Francisco and on out into the Pacific nearly to the Hawaiian Islands. The daily gasoline production is about 2,000,000 barrels a day, or enough to fill a train of tank cars over 80 miles long.

For England and Russia

Of this tremendous output only about 40,000 barrels a day are 100 octane gasoline. It was originally felt that a 50 to 100% increase in production would amply care for our needs. However, since the lend-lease bill was passed, and in view of recent developments in the war, it is now expected that the United States will supply itself, England, Russia, and possibly a Polish and Free French Army with all the 100 octane fuel they require. England's need for 100 octane gasoline is said to have increased from 5000 barrels per day at the start of the war to 36,000 barrels per day at present. Russian needs have grown to 25,000 barrels per day. The needs of the United States at the end of 1942 are estimated at 50,000 barrels daily. Thus the requirements total 111,000 barrels a day, most of which it is expected will be used in aircraft, though a considerable quantity is certain to be consumed by tanks and other land motorized equipment.

Secretary of the Interior Ickes has asked the oil industry to expand the productive facilities for 100 octane gasoline until 120,000 barrels can be turned out daily. This is a tripling of the present capacity. Can this be done? The oil industry says emphatically, "Yes." They say that, since the present daily output of all grades of gasoline is about 2,000,000 barrels, it will be no problem to obtain sufficient light fractions for charging stocks in the high octane polymerization plants. The bottleneck is in building the expensive and complicated equipment and plants required for this large production.

Who Is Paying for It?

Mr. Ickes has stated that the necessary money will be provided under the lease-lend law. The industry estimates that approximately $150,000,000 will be required, and that, given top priority on materials, it will still take from 8 months to a year to erect and equip the necessary plants. One plan calls for fifty widely scattered plants, each costing $3,000,000. These plants, it is expected, will be built near cracking units and refineries already in operation, so that the charging stocks for the new plants need not be transported very far. This means that the new units will likely be scattered throughout the South and East, mainly in Texas, Oklahoma, and Louisiana, with some spreading farther north. The expansion is moving rapidly, and the oil industry is confident of its ability to meet the new demands. Mr. W. T. Ziegenhain, writing in the March Oil and Gas Journal, says, "The refining industry will supply still better automotive and aviation fuels in whatever quantities demanded, and will provide basic chemicals for peace or war. By whatever standards judged, refiners stand girded for any emergency".[4]

[1] W. T. Ziegenhain—Oil & Gas Journal—Oct. 2, 1941—pp. 10-11
[2] E. A. Arnold—STEEL—June 30, 1941—pp. 70-71
[3] T. B. Leech—Oil & Gas J.—Oct. 2, 1941—pp. 40-41
[4] W. T. Ziegenhain—Oil & Gas J.—Mar. 27, 1941—pp. 52-54

SOCIETIES

At a recent meeting, Gaines Post of the History department spoke to the civils on "The Technology of War in the Early Modern Period." In the future, sometime in April or May, Frank Lloyd Wright will speak to them. The date has not been fixed, but Mr. Wright has accepted the invitation to speak.

The senior section held a banquet with Marquette A.S.C.E. shortly before Christmas vacation. Dr. Byers of the University of Chicago (you know, what we used to run the ball clear 'round) spoke on Meteorology, Weather, and War.

•

The S.A.E. is collaborating with the A.S.M.E. in planning a dance which is tentatively placed early in the second semester.

•

At a recent meeting, the A.S.M.E.'s, S.A.E.'s, and C.A.A.'s (no W. P. A.'s) were shown movies by the Wright Aeronautical Corporation of Patterson, New Jersey. It concerned the fine points and the precision required in making modern aircraft engines. A magician kept things humming after the movies.

Colonel Walsh addressed a joint meeting at which he explained the importance of engineers in national defense.

•

The A.I.E.E. had two technical meetings during the month which featured the General Electric "House of Magic" and Col. James L. Walsh's address on "Engineers Against Time."

In addition, the EEs joined with the Art Eds in a get-acquainted party. Believed to be the first of its kind on the campus, the party was intended to promote closer and more intimate relations between the mutual occupants of the EE-Art Ed building.

On Friday, January 16, the A. I. E. E. will sponsor a farewell banquet for the EE seniors who are graduating in February.

•

At the December meeting of the A.I.Ch.E. Forrest Anderson, a partner of Wilkens Anderson Scientific Co., spoke on "Industry's Challenge to Chemical Education." The speech was unique in that he constructively criticized various departments of universities.

•

At the Christmas meeting the miners showed that one develops an appetite swinging a shovel and treated themselves to a turkey dinner—with all the proverbial trimmings. Bradley Booth of the Jackson Iron and Steel Co., of Jackson, Ohio, spoke to them on silvery pig iron.

LIGHTING . . .

(continued from page 11)

lighting. It is a corner office on the first floor overlooking Lake Mendota, about 14′x23′, and is equipped with 3 troffers running lengthwise as shown in Figure 1. The

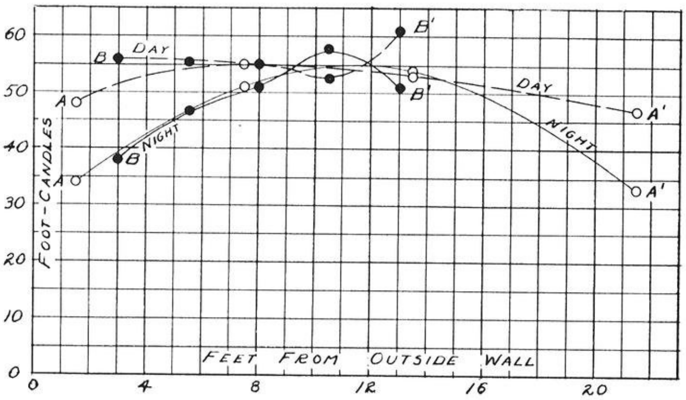


Fig. 2—Illumination in the president's office. Curves A-A[1] along line A-A[1], Fig. 1. Curves B-B[1] along line B-B[1] in Fig. 1.

uniformity of the lighting is indicated by Curve 1 of Figure 2. The apparent discrepancy of more light at night is due to the fact that the Venetian blinds were closed at night and partly open in the daytime. At those times when the weather conditions are such that artificial lighting need act only as a supplement to natural illumination, the center troffer alone is used.

Brightness of the lenses were measured for both the single tube and the double tube units at different positions. These values are given as follows:

	Single Tube Unit	Double Tube Unit
Below, vertical:	673 milli-lamberts	870 milli-lamberts
Along troffer, 45° to vertical:	460	737
Crosswise, 45° to vertical	192	393

These values indicate how the brightness of the unit varies with the position of the observer.

A test of the illumination in the general office showed that there was an average of 40 foot-candles upon the working plane, while there were 27 foot-candles on the horizontal draw shelves in the filing office. The filing cabinets were so placed that they did not receive the full benefit of the light.

Average operating illumination values are different than initial installation values, and to ascertain this difference, measurements were taken in a sample room using old tubes and new tubes. The new tubes produced an increase of 9.1% in illumination, the voltage being the same for both measurements. The old tubes probably had been used less than 1000 hours.

There is no doubt that fluorescent lighting will supersede incandescent lighting for general interior use in the future. As with other new products, the cost will decrease and minor imperfections will be eliminated; while the fluorescent tube replacement costs, which are relatively high, compared to incandescent lamp costs, will undoubtedly decrease as production increases. Lamp efficiencies, judging by the long time improvement of incandescent lamps, will also be further improved. Because of these anticipated improvements, there is good reason in a new building or in remodeling for seriously considering a well-engineered fluorescent lighting installation even though at present it may be somewhat expensive.

Acknowledgement

It is desired to acknowledge the splendid cooperation and assistance in obtaining data of Messrs. George Boissard, President, and L. J. Larson, Secretary-Treasurer, of the National Guardian Life Insurance Company; Law, Law and Potter, architects; Mr. O. T. Havey, electrical contractor; Madison Gas & Electric Company; and Professor Royce E. Johnson.

THE SECOND DISCOVERY OF AMERICA

In America, science is discovering a vast new world—a stupendous world that Columbus never dreamed of. This new America is boundless. Its riches are infinite, thanks in large measure to the magic of *synthetic organic chemistry.*

One of the discoveries in this field is an amazing series of synthetic plastics—"Vinylite" resins.

In one form or another, these astounding materials appear in such diverse essentials as food-can linings . . . and tank-car linings; as airplane cockpit covers . . . and non-flammable insulation for vital electrical wiring; as corrosion-resistant wrappings for cross-continental pipe lines . . . and welders' goggles; as the thin film on paper which is put inside bottle caps . . . and as the invisible interlayer in the sandwich of safety glass.

"Vinylite" resins can be formed, drawn, laminated, and bonded. In basic form, they are odorless, tasteless, and non-toxic, and range from non-flammable to slow-burning. They can be made stiff or flexible . . . hard or soft . . . colorless or almost any color under the sun . . . transparent, translucent, or opaque. And the result is resistant to oxidation . . . waterproof . . . alcohol-, alkali-, and acid-resistant.

These unusual properties have created a heavy demand for "Vinylite" resins, particularly to meet defense needs. This is why it is not possible, at present, to supply all manufacturers of articles for personal and home use with all the "Vinylite" resins needed. Against the return of more normal times, when larger quantities for normal uses will again be available, manufacturers are invited to test these new plastics . . . to develop new and improved things to be made from them . . . so that all can benefit from the discovery of "Vinylite" resins.

• • •

"Vinylite" resins and plastics are supplemented by the well-known products of Bakelite Corporation. The resins themselves are produced by Carbide and Carbon Chemicals Corporation. Certain elastic sheetings and films are made from these resins and marketed by National Carbon Company, Inc., under the trade-mark "Krene," while other compounded forms useful in electrical insulation are marketed by Halowax Corporation. The manufacture of all these products has been greatly facilitated by the metallurgical experience of Electro Metallurgical Company and Haynes Stellite Company and by the metal-fabricating knowledge of The Linde Air Products Company. All of these companies are Units of Union Carbide and Carbon Corporation.

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation

30 East 42nd Street UCC ***New York, N. Y.***

Producers of Synthetic Organic Chemicals

Here's some . . .

STATIC

. . . for exams

(This is the fourth in a series of articles introducing prominent personalities in the College of Engineering.)

Who is that guy on the right? Gad, man, take a good look! We're sure you have seen him before, last June perhaps. Yes, that's you and your roommates. Or if it isn't, it had better be, or else . . .

But you can't sit down like that and look at a book all the time. You must keep in good physical condition by eating vitamin pills regularly, and you must do something for that perennial feeling of indifference which haunts you. Here are your instructions: Cut the vitamin pills from page 34, and take one pill three times a day. For your morale, close your eyes and have your girl friend read you the remainder of the Static.

•

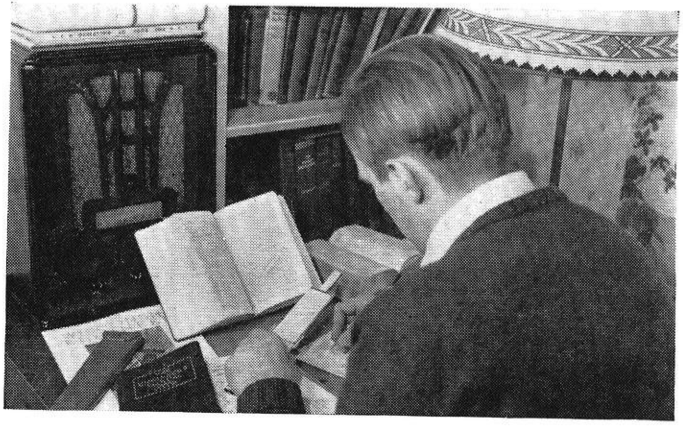
English doctor examining recruit noticed a picture of the King and Queen tatooed on his chest.

"Well, I'm glad to see you're patriotic."

"That's nothing," replied the recruit, "I'm sitting on Hitler."

•

A Canadian newspaper carried the following: "The body lay in state at the family home here today, while thousands of friends and admirers passed the beer."



LOCAL BOY MAKES GOOD

We were thrilled to hear that Bob Lewis, editor of the Daily Cardinal, had tea with Mrs. Roosevelt during Christmas vacation. And when asked how he would have his tea, our Robert pondered a minute, giving full consideration to the pending economic upheaval, the effect on the ever struggling masses, and the injustice of it all—but forgetting about the existence of lemon, cream, or sugar. Then he modestly and efficiently dropped the bottom from The Crow's Nest.

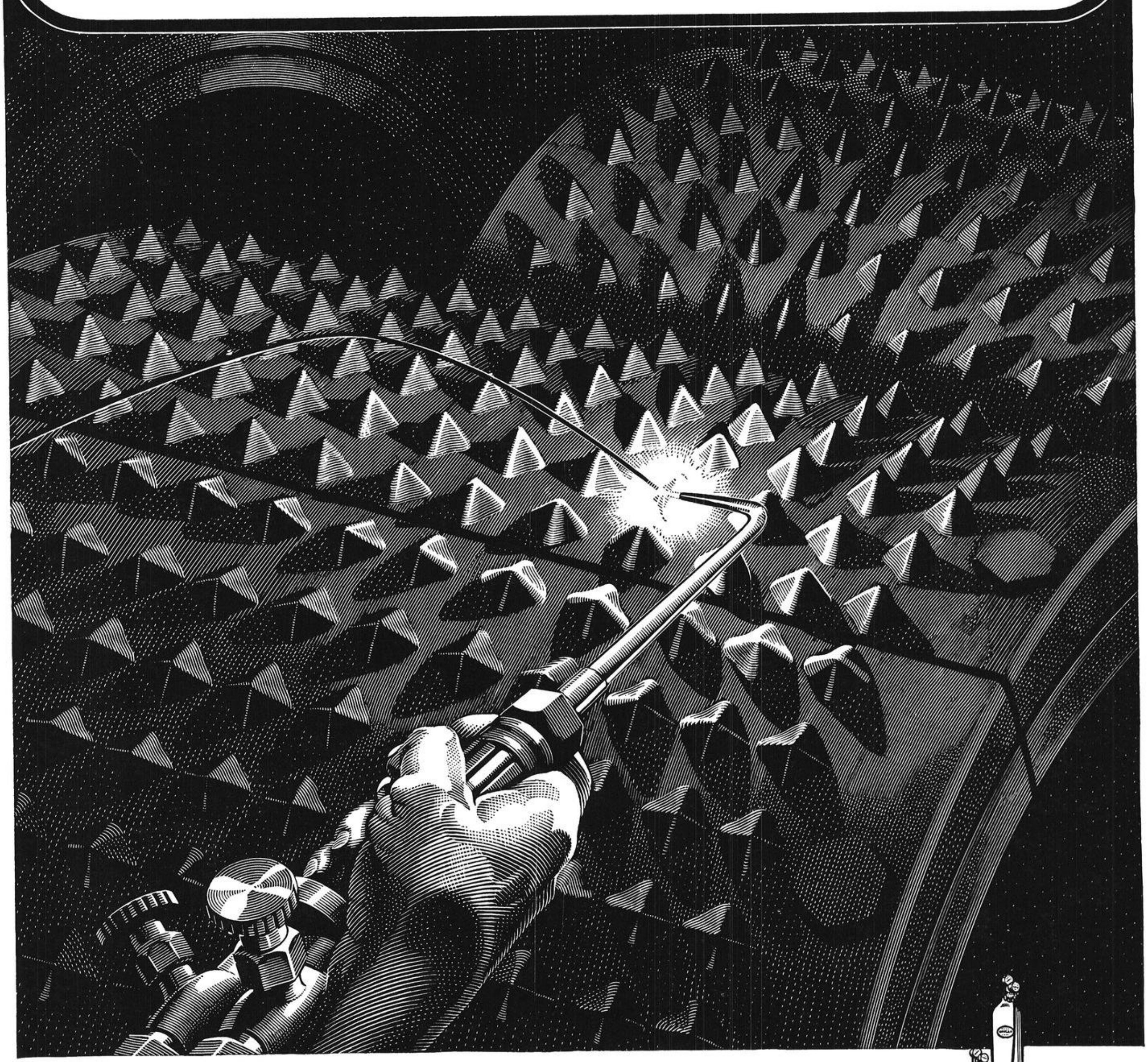
"I'll have mine just average," he replied.

•

A true lover of music is a man who, upon hearing a soprano voice in the bathroom, puts his ear to the keyhole.

(continued on page 26)

"FACE-SAVING" 20th CENTURY STYLE



WORN teeth no longer render crushing equipment useless, nor do they mean long, costly delays. Today there is a simpler, faster, less expensive way — hard facing with the Airco Oxyacetylene Flame. Reports indicate that teeth built up by this proved Airco process last longer, yet cost only 25% of a new segment. Cost of replacing the entire crusher is, of course, far greater.

Airco Hard-Facing is a versatile process. Wearing parts of varying shape and size can be rebuilt economically, speedily. Standard oxyacetylene welding apparatus is employed.

Not only for maintenance of equipment, but on thousands of production lines, the Airco Oxyacetylene Flame is on the firing line speeding countless defense products to completion. It has been drafted to cut steel to any desired shape, to flame harden metal parts for longer life, to weld two or more metal parts into a strong, lasting unit, to machine metals with unrivaled speed, to clean and dehydrate metal surfaces for lasting paint jobs.

A pictorial review "Airco in the News" shows in an interesting manner these many uses of the flame. Write for copy.

AIR AIRCO REDUCTION

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60 EAST 42nd STREET, NEW YORK, N. Y.

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ANYTHING AND EVERYTHING FOR GAS WELDING OR CUTTING AND ARC WELDING

DON'T MISS THIS STATIC . . .

There were two men waiting in the railroad station for the train. Since neither had anything to do, one decided he would see what he could do about the situation, and asked the second, "Say, how about a game of poker while we're waiting?"

"No thanks, tried it once and didn't like it."

"Well, how about a game of pool?"

"No thanks, tried it once and didn't like it."

"Well, how about a game of bridge? There are a couple of fellows over there who would probably play."

"No thanks, tried it once and didn't like it."

"Well, how about having a drink with me at the bar across the street?"

"No thanks, tried it once and didn't like it."

"Well, how about a cigarette?"

"No thanks, tried it once and didn't like it."

"Well, how about a show?"

"No thanks, tried it once and didn't like it. But I'll tell you what, my son is coming along any minute now, and maybe he'd go with you."

"You have just one son, I presume."

•

On a train headed West a very strange thing happened to a conductor. While collecting tickets, he noticed drops of water trickling from a passenger's coat. Walking over and inspecting more carefully he caught on.

Conductor: "Scotch?"

Passenger: "Airdale."

CHEMICAL ANALYSIS OF WOMEN

Symbol:—Woo. Thought to be a member of the human family.

Atomic Weight:—Accepted at 120, though known isotopes vary from 100 to 180.

Occurrence:—Found both free and combined, usually with man.

Physical Properties:—Seldom found in a pure state. All colors. Surface usually covered with a film of paint or oxide. Boils at nothing, and freezes without reason. Unpolished specimen tends to turn green when in the presence of a highly polished one. All varieties melt with proper treatment. Very bitter if not used correctly. Density is not as great as is generally supposed.

Chemical Properties:—Highly explosive and dangerous in inexperienced hands. Extremely active in the presence of man. Possesses great affinity for gold, silver, platinum, and precious stones. Has the ability to absorb great quantities of the most expensive foods. May explode spontaneously when left alone with man. Undissolved by liquids, but activity is greatly increased when saturated by a spirit solution. Sometimes yields to pressure. Fresh variety has great magnetic attraction. Ages rapidly.

Uses:—Chiefly ornamental. Efficient cleaning agent. Acts as positive or negative catalyst in the production of fevers. Probably the most powerful (bank account) reducing agent known.


This is a piece of
ZINC ORE
A LUMP OF ZINC ORE—unattractive, insignificant, commonplace!
But with the light of science shining upon it, let your imagination visualize the reflections which emanate from it!
In defense: on land, on sea, in the air, Zinc is an essential in the construction of ammunition, armament, battleships, airplanes. In industry, Zinc enters vitally into the construction of engines, tools and machinery. In agriculture, Zinc in one form or another protects homes, crops, orchards, animals. In ways almost infinite in variety, Zinc is used to effect economy, increase efficiency, improve safety, augment profits.
It pays to KNOW about Zinc. It is essential in defense. In the period of America's greatest industrial development, Zinc has rendered indispensable service; it is reasonable to expect that it will be utilized even more extensively in the greater developments yet to come.
An interesting mine-to-market story of Zinc is told in "The Zinc Industry," a booklet that will be sent free to any teacher or student who asks for it and gives the name of the school with which he is connected.
AMERICAN ZINC INSTITUTE
Incorporated
60 East 42d St., New York, N. Y.
THE ZINC INDUSTRY

Editorially Speaking

At Your Service

THE WISCONSIN ENGINEER is feeling happier this year, despite war and prices. Jumping from the undernourished 16-page issue of last March to the 32-page Exposition Issue of April, the magazine has been bigger and better since. Last spring the engineering student body voted its willingness to support its magazine through an addition to the regular university fees. Though the regents did not accept the plan, the spring campaign served its purpose. This fall the student subscriptions were double last year's. The increase more than justified the decrease to a dollar of subscription rates since it improved the advertising situation considerably. It was a much needed pat on the back for the Engineer board and staff members who had donated many hours to the magazine. So with our financial worries solved for the time we now are prepared to give what you ask, rather than ask that you give. If this magazine can be of any special service to you during the coming months, let us know. At all times the Wisconsin Engineer represents an equipped and staffed organization ready to serve its college and its country.

With the advent of war this magazine does not intend to operate on a business-as-usual basis, but rather on a more-business-than-usual one. Every day the new importance and significance of engineers are being more fully appreciated. Our College of Engineering is coming into its own as a training camp for the young men who must turn the wheels of American industry. Now, and in the years to come, the Wisconsin Engineer can be of more importance in a college which is becoming more important and is striving for greater unity and esprit de corps.

Just Keep on Studying

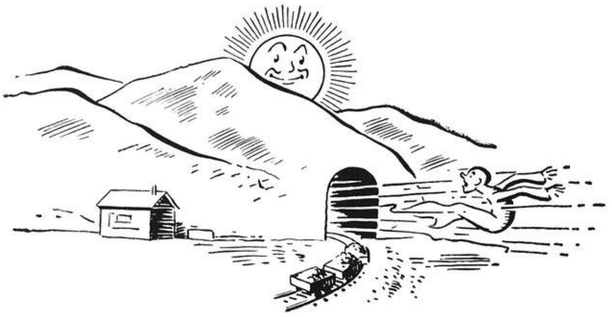
HOW is the war going to effect student engineers? So far it has resulted in a general speed up with elimination principally of spring vacation and the shortening of exam periods. Rumors concerning two-year courses, student subsidization, and year round instruction are so far only rumors and likely to remain so. An extension of the summer engineering instruction would be logically expected, though the university is in a poor financial condition to do so. Developments may be expected within a few weeks.

The importance of engineering graduates to our country at war is thus emphasized. You are much more necessary as an engineer than as an enlisted or drafted man in the armed forces. Do not leave school for any such reason without consulting your advisor or the dean. Do not assume that as a freshman or sophomore you will not be allowed by draft boards to finish school. Do not accept a 1A draft classification as final. **It is your patriotic duty to complete your training as an engineer. Use every university facility to do so.**

We Protest

WE WERE a bit sickened at heart when four of the Japanese cherry trees in Washington were cut down by some misguided person. But more than that we violently protest the actions of one of our engineering professors in spending class time to foster and promote the same kind of unreasonable and unintelligent attitude. If there is ever to be a peace we must begin to prepare for it now as engineers of reconstruction. As future engineers we must study hard and diligently now to prepare for our foremost duty—to help win and close this second world war. We are going to cause bloodshed and suffering, but only because it is necessary to prevent a greater infliction of bloodshed, suffering, and loss of liberty and statehood upon the greater part of the world. Preaching hatred and murder, however, not only will not win the war, but it will prevent a lasting victory. In times like these it is hardly possible to remain emotionally calm and to preserve many thoughts and privileges which detract from the immediate war at hand. Nevertheless, we should not have to listen in class to any man who asks for the blood and destruction of all the Japanese and German peoples, and certainly we should not have to agree. Nor should burning the Lindbergh portrait in the mechanical engineering lobby be accepted as a solution to any problem. It is not enough to be indifferently aware of such dangerous attitudes any more than it is to ignore the hostile forces in the outer world seeking to crush us. The same hysteria which developed whole books devoted to the belittlement of Wagnerian opera during World War I is developing here, and it marks the smallness of men.

G-E Campus News

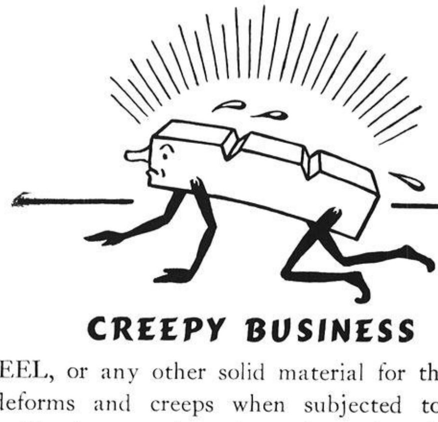


STEP ON THE GAS!

STEPPING on the gas to produce a speed increase of six feet per day along a highway wouldn't break any speed laws. But six feet extra per day makes engineers hang on their hats when the traveling is through solid rock. And that's the added progress being made by the company excavating the eastern portal of the new 13-mile Continental Divide tunnel by the installation of a new ventilating system utilizing G-E motors and control.

The system saves 20 minutes in the time between shooting each blast in the tunnel and getting back to drilling again. Fans spaced along the tunnel start up immediately after the blast, suck out the gas and smoke, and then reverse and blow fresh air into the tunnel. The fans start in sequence, with an interval of 20 seconds between each, so as to prevent building up large differences of pressure.

The tunnel is being excavated by the S. S. Magoffin Company, under the direction of the U. S. Bureau of Reclamation, to bring water for irrigation and power from Grand Lake, on the western slope of the Continental Divide, to the eastern slope.



CREEPY BUSINESS

STEEL, or any other solid material for that matter, deforms and creeps when subjected to heat and stress. But how much a given piece of steel in, say, a steam turbine, is going to creep during its life of 10 or 20 years is something a designing engineer can't wait 10 or 20 years to find out.

That's why all sorts of accelerated creep tests have been tried—ways to get a hurry-up prediction of the behavior of metal in service. Dr. Saul Dushman (U. of Toronto '04), assistant director of the G-E Research Laboratory, has thrown some new light on this problem by devising a method that produces extensions in length of as much as half a per cent an hour. By it he can get information in a day or two that would have required months by older methods.

The method consists of loading a thin wire of the metal with a weight, heating it with an electric current to a bright red heat in an atmosphere of nitrogen, and measuring the extension. The results seem also to suggest that creep does not occur atom by atom along the length, but rather in the movement of groups of atoms numbering from 50 to 1000.

95% PERFECT

MILADY will find her reflected charms brighter if her mirror is coated with silver, but that reflection will wear better if the coating is aluminum. That's what Frank Benford (U. of Michigan '10) and W. A. Ruggles, of the G-E Research Laboratory, found when they tested 37 kinds of mirror surfaces.

Silver evaporated onto the front surface of the mirror from an electric filament reflected 95 per cent of the incident light. The initial score for aluminum was only 88 per cent. But six months later the aluminum mirror was just as good as ever, while the silver one had deteriorated considerably.

Gold, incidentally, scored third among the pure metals, reflecting 82 per cent of the light. But while all the other metals gave their best results when evaporated on the front surface of the mirror, gold worked best when deposited on the back, as is the practice with ordinary looking glasses.

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