MINNESOTA TECHNOLOG

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SUMMER • 1943

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INSTITUTE OF TECHNOLOGY UNIVERSITY OF MINNESOTA

This Month...

CURT LARSON doesn't sleep all the time even though this picture may make it look that way; he wrote the article "Wartime Farm Power" that appears in this issue of the TECHNOLOG. Curt received his degree in ag engineering last March, but he is now working as an engineer testing hydraulic turbines and ship propellers on the hydraulic test floor at the Allis-Chalmers plant in Milwaukee. He likes Milwaukee but has a very nice reason for liking Minneapolis better.

WALZER

Previous to his graduation, Curt was active in campus affairs. The field day program with its obstacle race for queen candidates during the 1943 Engineers' Day owes its success to his hard work. Some of his favorite pastimes are softball, bowling, eating, and dancing; his favorite is waltzing to Viennese melodies.

Looking toward the future he says, "My ambition is to be able to give the farmer something to make his life easier and happier."

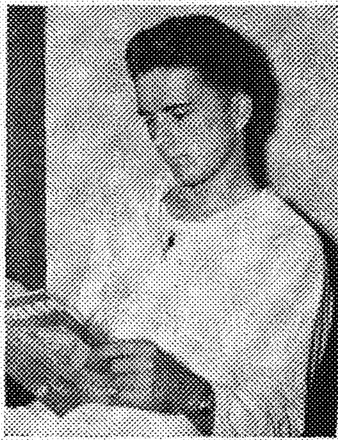
GRANT BUTTERWORTH is the man who wrote the article on Buna S synthetic rubber which appears on page 6 of this month's TECHNOLOG. Grant is a sophomore in Aero and intends to do aeronautical design upon graduation. He started out in chem engineering, but decided that eventually the odoriferous laboratories would be fatal; therefore, he transferred to his present course.

ONE-TRACK MIND

Duluth Central is Grant's old alma mater. He graduated from there in June, 1942, after having been in the "average number of clubs." It seems that he has more fun out of school than in, but he does not enlarge upon that statement. When asked about his interests outside of school, he claimed that he remains faithful to a certain girl in his old home town. Upon being told that such an attitude was indicative of a one-track mind, he immediately stated that it was a very good track.

Grant draws, designs, and builds model airplanes. His father and brothers are all engineers, too, and this proves to be just another phase of his excellent one-track mind.

DEAN BABCOCK, the boy with the soulful look, joined the Navy to see the world, but saw Pioneer hall instead—he'd never seen it before in spite of his wide acquaintance with the University, so a whole day's guard duty wasn't a total loss. Because there is an article in this magazine concerning V-12, and because Dean is a V-12 sailor, the reader should get the connection between author and article.



HOBBY SQUELCHED

Dean graduated from Patrick Henry high school in June, 1941. At Henry he was president of a Hi-Y group, editor of the Patrick Henry *Patriot,* and a hurdler on the track team.

Before he became subject to naval discipline, Mr. Babcock was a junior in electrical engineering. Dean is (or was) treasurer of the Board of Publications and is a member of Phi Gamma Delta fraternity. After having been out for freshman track, Dean decided that schoolwork and more interesting outside activities took a lot of time, so he turned in his spikes and sweat clothes. He claims, strangely enough, that his hobby of staying out late has been sadly curtailed since he went aboard at Pioneer hall.

MILES B. OLSON appears in the picture to be out on the knoll reading the *Daily* and smoking the devil out of his pipe. Of course, Olson says that is just the way it appears, and actually he is studying current events and is trying to figure out how to get rid of the devil.

Miles likes to play golf, but he didn't know where he was going to get the gold to buy balls this year; informed that he had inherited a gold mine, he couldn't find any balls. Before July 1, another of his hobbies was his diet; that was because he was in V-7, and a gob's uniform requires a sylph-like figure.

SAILOR NOW

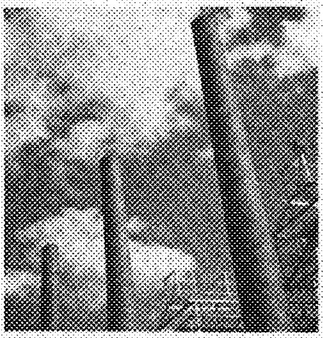
Miles was the chairman of Engineers' Day this year, is president of both Theta Tau fraternity and the Technical Commission, and belongs to the All-U Council, A.S.M.E., American Foundrymen's Association, the TECHNOLOG staff, and the A.S.M.

The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNOLOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNOLOG is two-fold: first, to put in the hand of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

MINNESOTA TECHNOLOG



THE COVER picture shows the stacks behind the guns. Courtesy Westinghouse Electric & Mfg. Co.

FRONTISPIECE. This 35-ton transformer, a product of Westinghouse, is aiding in the distribution of electricity for war power. Note the men on top dwarfed by the size of the machine. Courtesy Westinghouse Electric & Mfg. Co.

STAFF

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SUMMER, 1943

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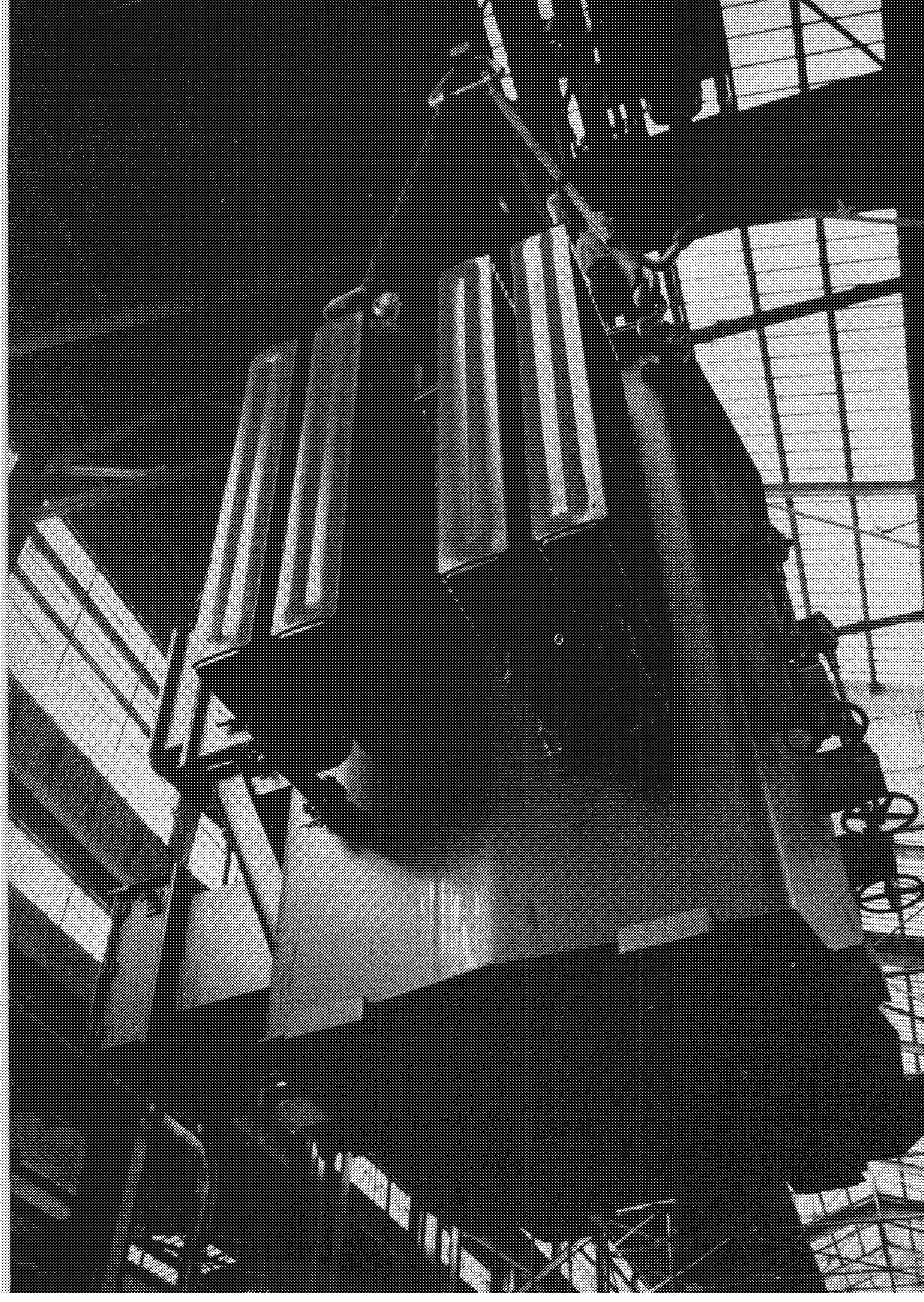


Getting Along On

WARTIME FARM POWER

By CURTIS L. LARSON, B. AG. E.
TEST ENGINEER ALLIS-CHALMERS COMPANY

IN spite of an acute shortage of farm manpower and limited production of farm machinery, our government is asking for an increase in agricultural production. We not only have to feed ourselves and our armed forces, but we also must send aid to our allies and have enough in reserve to help the people of the conquered countries.

There is only one way to meet this demand—more new tractors, longer operating days, more repairs for used tractors, and more scientific farming.

Food has become more than a commodity. In this war food is a factor just as important as ammunition or guns. Every farm is proportionally as important as a defense plant, and every tractor is as vital as a jeep.

Tractors have played an important part in the development of agriculture as a science, and now they will be instrumental in winning the war. Since 1913 the number of man-hours required to produce an acre of wheat has been cut from 12.7 to 6.1 by the use of tractors and power machinery, and other production figures are in the same ratio. The average tractor, by replacing five horses, saves about 25 ten-hour days spent each year caring for the horses. The one-and-one-half million tractors on American farms are doing the work swiftly, when it is needed, and without delay.

The outstanding feature of the modern farm tractor is its all-purpose design. It can be used for almost any farm operation involving field, road, or belt work. Machines mounted on it include row-crop cultivators, hay mowers, corn pickers, manure loaders, and post-hole diggers. Some of the rigs drawn behind tractors are seeders, harrows, plows, combines, binders, and manure spreaders.

To make possible these varied operations, most of the tractors are the row-crop type, having a tricycle chassis with high clearance and rear wheels which may be adjusted from fifty to ninety inches apart. The two small front wheels are mounted as a unit which can be turned at nearly right angles when either rear wheel brake is applied. This arrangement facilitates a complete turn in a very confined area. With drawn implements short turns are made possible by a drawbar which may be locked or left free to swing. The length and position of the drawbar can be adjusted to fit any machine.

Machines which have rotating parts are driven directly by the tractor by a splined shaft called the power take-off. Formerly machines of this type were driven by the traction of their wheels, but this method was undependable, especially on a soft or slippery ground. The power take-off runs at a standard speed for all makes of tractors. It is connected to the machine by a long shaft with a universal joint. It is also used for power lifts and hoists the mounted machine at the touch of a foot pedal.

The tractor evolved from the old-time straw-burner of 25 per cent drawbar efficiency through the coal-burning steam engine and the early gasoline models with an efficiency of 50 per cent to the kerosene tractor of 1925. Finally it became the machine it is today and has drawbar efficiency of 85 per cent.

The modern tractor is light in weight so that it handles easily and does not pack the soil excessively. Its weight per horsepower has been cut in half in the past thirty years; this leaves only enough weight to secure proper traction. It usually has four forward speeds—three field speeds varying from two to seven miles per hour and a road speed of about sixteen miles per hour. Streamlined radiator grilles and bright-colored paints give the tractor eye appeal. The farmer now takes as much pride in his tractor and its performance as he once did in his horses.

Improvements are being made in tractor design at the testing grounds of the manufacturers and at agricultural engineering colleges.

Most tractor engines are medium speed and operate at from 950 to 1,500 revolutions per minute. They are divided into three classes according to the fuel they burn; they are those which burn heavy tractor fuel, those that use high grade gas, and those that burn either low grade gas or regular tractor fuel. Heavy fuel tractors have low compression ratios and high operating temperatures, that is, around 200° F. Gasoline tractors have higher compression ratios and operating temperatures as low as 160° F. Tractor-fuel engines are started on gasoline and then switched to tractor fuel.

Farm tractors are rated according to the power they deliver to the drawbar or belt. They vary in size from the recent "baby" tractor used on orchards and truck farms, which pulls one plow, to tractors of forty horsepower which are used for heavy field and belt jobs. They are also rated as one, two, or three plow tractors. The most popular models are the thirteen and seventeen horsepower, which pull two fourteen- or sixteen-inch plow bottoms. These will run at full load for a ten-hour day on as little as ten gallons of fuel.

Thanks to rubber tires, the farm tractor no longer rides as roughly as the proverbial lumber wagon, but rolls smoothly and steers as easily as an automobile. These low-pressure tires cushion the bumps and eliminate the constant shaking, thereby providing riding comfort, increasing the life of the tractor, and decreasing repair costs. A still more important advantage of rubber tires over steel wheels is the increased power made available at the drawbar. As shown by a large number of tests, a tractor can deliver from 15 to 20 per cent more power to the drawbar with rubber tires than with steel wheels under ordinary conditions. This increased power is obtained from a decrease in slippage and a lessening of rolling resistance because of soil disturbance. These factors easily pay the extra cost of the tires, which usually last the lifetime of the tractor. Although rubber tires for farm tractors were first used about 10 years ago, almost all of the new tractors sold in 1940 were equipped with them. Though rubber is now rationed, rubber tires have been officially designated as an essential part of the farm tractors used in our wartime food production.

PHOTO COURTESY OF MINNEAPOLIS MOLINE

Government Synthetic Program

ROLLING TO VICTORY

On Buna S

By GRANT BUTTERWORTH, AERO. E., '45

WHEN the Japs made their plans of Far East conquest they reasoned that America's hamstrings would be severed. Without her supply of natural rubber Tojo thought that Japan's strongest enemy would be practically helpless. In spite of the fact that our normal source of supply of natural rubber was almost completely cut off we are getting rubber—actually, we are making rubber.

Significant Name

The compound known as Buna S (GS-R, standing for Government Synthetic Rubber, is another designation) is an emulsion copolymer of butadiene and styrene. This latex, once obtained, is processed and compounded in much the same manner as natural rubber. Therefore, it is the actual combining of the chemicals to form the latex which is the synthetic process. Buna S rubber obtains its name from the combination of the first two letters of butadiene, one of the basic compounds used, and the chemical symbol for sodium, Na, which was originally used in the unimproved process; the S stands for styrene which is the other copolymer used. The manufacturing consists of: (1) preparation of the basic constituents, (2) polymerization, which is the changing by union of two or more molecules of the same kind into another compound having the same elements in the same proportions, but having a higher molecular weight and different physical properties, and (3) compounding of the synthetic rubber latex to form the final product.

To prepare the synthetic rubber latex the basic compounds are mixed in soapy water; the small droplets of latex that are formed are separated from the solution by coagulation and decantation, and the resulting curds are dried and pressed into sheets.

The chemicals now used in the manufacture of Buna S rubber are butadiene and styrene, both hydrocarbons. So that the reader may understand more clearly the combining process actual preparation of the chemicals is discussed first.

Butadiene Processes

Butadiene, which has the chemical formula of $CH_2:CH \cdot CH:CH_2$, is produced mainly from petroleum. This chemical is the actual bottleneck for the production of Buna S rubber, for it has been necessary to construct special plants for its manufacture. Butadiene is obtained from other sources, including potatoes, grains, sugar and coal, and is manufactured by the following process.

1. Pyrolisis, or cracking of petroleum. In this process a high temperature and low pressure are maintained and the yield varies from 1 to 23 per cent.

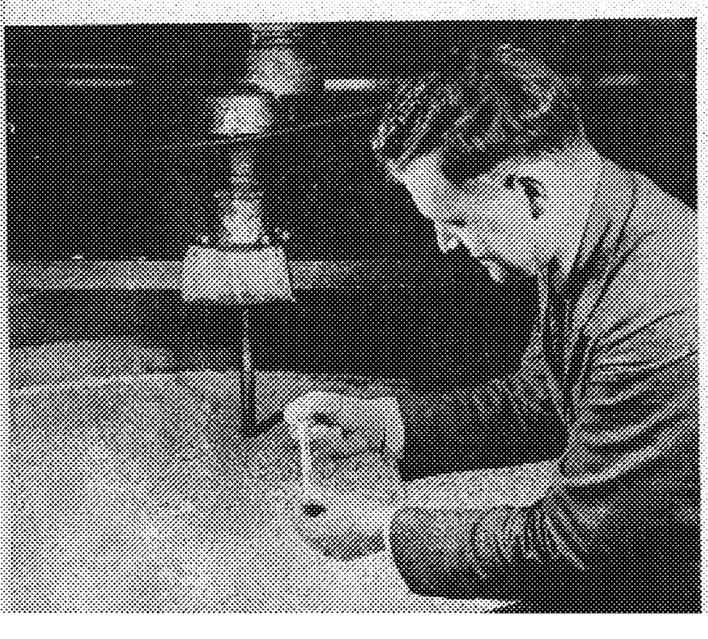
2. Catalytic dehydrogenation, or the Houdry process. Butane, a simple hydro-carbon whose formula is C_4H_{10}, is changed to butadiene by dehydrogenation.

3. Alcohol process. This will produce about one-third of the country's equipments. It yields about 20 per cent of butadiene.

4. Aldol process. Acetylene is used to produce acetaldehyde which is polymerized to aldol. This aldol is very easily converted to butadiene. In Germany this process is used extensively but in a slightly different form.

THE RAW MATERIAL. Curds of latex formed by polymerization are coagulated with dilute acids and washed in large vats.

PHOTOS BY B. F. GOODRICH



Styrene, having the formula $C_6H_5 \cdot CH:CH_2$, is produced from benzol, a coal tar derivative, and ethylene, a gas obtained from coal gas or alcohol. This compound, which is built up from the familiar benzene ring, forms a series of polymerides, the highest molecular weight being over 100,000. By definition polymeride means "of the same elements in the same proportion by weight, having different molecular weights." Examples of this are cyanic acid (CNOH), fulminic acid ($C_2N_2O_2H_2$), and cyanuric acid ($C_3N_3O_3H_3$).

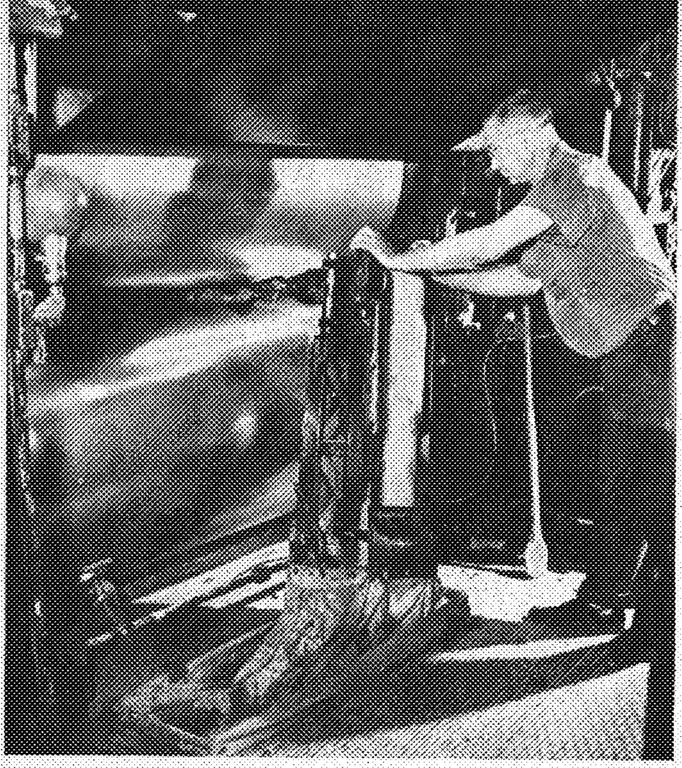
As polymerization proceeds, long thread-like molecules form. These molecules are soluble and crack upon heating; therefore, they can combine easily with butadiene.

The two chemicals, butadiene and styrene, are combined by polymerization to form the liquid rubber latex. They are mixed with an emulsifier, originally sodium oleate, but now diolefine. These materials are placed in soapy water, which acts as the solvent, and then a catalyst is added. The entire mixture is kept in the container at room temperature for forty hours. During this time the butadiene and styrene polymerize and the product obtained is synthetic rubber latex which is in the colloidal form suspended in the solution. Because iron slows the polymerizing action of butadiene, glass and enamel containers are the only ones used in this process.

When the polymerization has been completed, a coagulant (dilute acetic acid or salt solution) is added to the emulsion and the rubber precipitates. The process proves difficult, for the latex particles are smaller than those of natural rubber, and so special equipment is needed. The coagulated latex may now be decanted from the solution which contains part of the butadiene and styrene not yet polymerized. This remaining solution is added to a new batch. Phenyl-beta-naphthylamine is added to the coagulated latex to stop the reaction, otherwise the rubber would continue polymerizing.

Sunlight Detrimental

Buna S curds cannot be exposed to oxygen or sunlight, lest they polymerize further; therefore, the latex is kept in dark, airtight containers. The coagulated emul-



PRODUCTION PROCESS. *An operation in which fabric is impregnated with synthetic rubber in preparation for making tires.*

sion more completely disperses upon the addition of a peptizing agent. Once this compound is added, all tendency to polymerize ceases, and the latex can be handled in the open air. The workers now spread the buna into long, shallow trays, which are placed in an autoclave, or pressure cooker. Here the latex remains for four hours at a temperature of 250° F. and a pressure of 85 pounds per square inch. During this time the latex softens and forms long sheets, which can be handled easily. However, these sheets are not the final product but merely the basic latex, and they are changed completely before the actual synthetic rubber is obtained.

As just stated, the rubber latex is not the final product. The latex would be of little use as rubber, for it is absolutely lacking in rubber-like properties. In order to give the latex these properties, various substances are added to it during the milling process.

Pigment Important

The most important of those substances added is black pigment, which causes the particles of the latex to stick together, *i.e.*, gives it tensile strength. These pigments are usually carbon products; channel black is the one most extensively used. Others are furnace black and zinc oxide, but of these three, channel black gives the rubber latex the greatest tensile strength and the best resistance to abrasion and tear.

Another important material needed in the rubber is the softener, which makes the rubber plastic but resilient. Saturated compounds are used, the most common being stearic acid.

Sulfur, also added to the rubber latex, acts as a curing agent in the vulcanizing process. This substance may be omitted, however, and tetramethyl thiuram disulfide substituted. An accelerator, which may be thiazole, sulfamine, dithiocarbamate, or aldehydeamine, acts as a catalyst during the curing process, and shortens the time.

The milling, or mixing, of the rubber latex with these various materials is an interesting procedure. The machine used is a rolling mill, composed of rollers which are arranged in a circle with a 60-inch radius. The mixture, when placed on the mill, must pass through series of adjacent rolls which are not over 3/64 in. apart. In this way the latex is mixed thoroughly with the other substances, and an emulsion is produced. Because Buna S compounds generate heat upon mixing, becoming short and brittle, the mill must be kept as cold as possible. Therefore ice water is kept flowing through the interior of the rolls, and the temperature is never allowed to rise above 120° F. The various ingredients are added at exact intervals for the best results.

At the end of the milling process the rubber is forced through an extruder, consisting of a 3-foot disk with many small holes punched in it, and is placed in long narrow pans. The uncured rubber now has a black shiny appearance and can be cut very easily with a knife. Although it looks somewhat like cured rubber, it is lacking in the necessary properties, for the uncured emulsion has little strength or elasticity, but rather is like an extremely soft plastic. Curing, however, changes this.

The compounding or vulcanizing of the rubber is accomplished by heating the emulsion, producing a rubber whose physical properties are greatly improved.

Strangely enough, little is known about the process of vulcanization. Men know what it does but have only theories as to what actually takes place. Because of this fact, the theory of vulcanization will be discussed briefly. Vulcanizing changes rubber from the plastic to the elastic form. Upon this all agree. However, the old theory as to how this reaction occurs is now outmoded. This obsolete theory stated that vulcanization takes place in two steps as follows. Sulfur below its melting point adsorbs to the rubber's surface. Above the melting point of sulfur, it combines chemically with rubber.

If this theory were true, there would be a critical temperature at the melting point of sulfur. However, there is no critical temperature in this process. Therefore, that theory is no longer considered true, and the following one is now accepted. Vulcanization occurs at every temperature and proceeds continuously. The process is additive; the sulfur connects chemically with the double rubber bonds.

This theory is borne out by the fact that once vulcanization starts, sulfur cannot be separated from the rubber, even though the test is made at a low temperature.

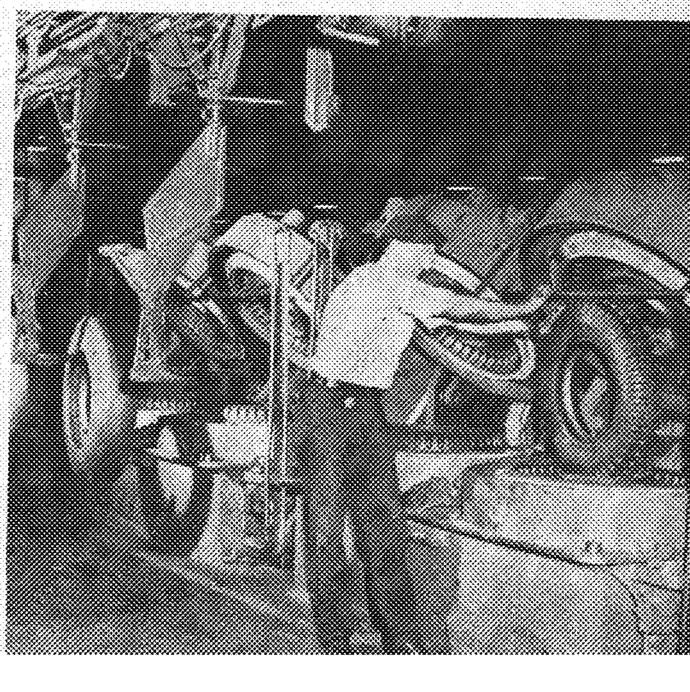
In the heaters used for the rubber vulcanizing steam jets are present which furnish the heat and pressure needed to cure the rubber. Once the cooker is securely closed, the steam valves are opened, and, if sulfur is used, the rubber is heated for 60 minutes under 60 pounds of pressure and at a temperature of 227° F. to 239° F. However, if thiuram disulfide is used instead of sulfur, the temperature is increased to 292° F., and the time is decreased to 30 minutes.

As the curing proceeds, the tensile strength increases until a maximum is reached. From then on, the strength remains the same, but the elasticity decreases. For this reason the curing time is 60 or 30 minutes. The accelerators, which were added during the milling process, act as a catalyst and decrease the time necessary to produce the cure. Because Buna S compounds do not scorch easily, this acceleration can be very rapid.

Characteristics

When the proper cure has been obtained, the rubber is withdrawn from the pressure chamber. The rubber in them is far different from that which was placed in the heater, for it has a greater tensile strength and has changed from a plastic mass to a non-sticky, elastic rubber. Compared with natural rubber, Buna S synthetic rubber has a lower tensile strength, is not as elastic, tears more easily (especially at high temperatures), and is softer. One might think from this that Buna S rubbers have little value, but this is not the case, for they make excellent tire treads, since they withstand abrasion as well as natural rubber. Buna S synthetic rubber is also used for shock absorbers and wire insulation, and other uses for it are being found all the time.

THE FINISHED PRODUCT. *A workman is removing a tire made of synthetic rubber from a watchcase heater after curing.*



AFTER THE AIRPLANE

Then What?

By MILES B. OLSON

MAN has attained practically all the goals that he has set for himself. Automobiles, telephones, the wireless, airplanes, telescopes, and television have all been invented by man; and the sentence, "It cannot be done," is no longer applicable to science.

The upper atmosphere and beyond is one of the greatest goals, however, for man yet to attack. Balloons and airplanes have taken a step in this direction, but these means are limited to heights at which there is air.

There is but one vehicle remaining to man by which the stratosphere can be attacked, and this is the rocket, which is independent of air. "The Future of the Rocket," an article by David Lasser in *Scientific American*, says:

"In the simplest terms, the rocket consists of a tube of which there is a chamber open at one end to the outside. In this chamber fuel, such as smokeless powder, is burned. The gases of combustion thus formed exert a high pressure in every direction. Their pressures on the side walls of the chamber balance each other, but the pressure parallel to the chamber causes two things to happen. The gases press upon the end wall of the chamber, and, conversely, they tend to rush out of the chamber through a nozzle into the open. Due to these pressures, caused by the tendency of the gases to expand, a force is exerted on the end wall, which pushes the rocket ahead. This action does not depend on the medium, such as air, outside the rocket. In fact, the operation of the rocket is helped rather than hindered in a vacuum. Although the power obtained at the tail of the rocket may not be so great in a vacuum as in air because in a vacuum the gases tend to expand and escape more quickly and thus lose their energy more rapidly, the reduction in the head resistance, due to the absence of air, more than outweighs this factor. The air resistance against any moving body increases directly as the square of the speed. Thus the rocket is peculiarly fitted for operation at high altitudes or in open space where presumably there is almost a complete vacuum."

Most people have never given any serious consideration to the rocket, and thus they declare experimentation in its field is ridiculous. However, this lack of knowledge that most people have regarding rockets is the reason why the field has not advanced more than it has. Nevertheless, despite its slowness in getting started, the new science of rockets is well on its way. Societies for the promotion of rocket study have been started in several different countries.

Professor R. H. Goddard, who started experimental work in 1909, was the first really practical experimenter in the United States. While directing physics at Clark university from 1922 to 1930, Goddard made many experiments with rockets, and he aroused much attention in 1929 and 1930. Colonel Charles A. Lindbergh became very much interested in the work and suggested it to the late Daniel Guggenheim. A grant was given Goddard to carry on further research under the ideal conditions of New Mexico climate, and at the same time a leave of absence was granted him from Clark university. Additional grants have been given Goddard, and he has been experimenting in Roswell, New Mexico, for many years. He is now America's number one rocket man.

Up to 1931 the German scientists were the most advanced in rocket investigation. Among some of the great rocket men in that country were Professor Oberth, Max Valier, Dr. Paul Heylandt, Reinhold Tiling, and Pietsch.

Through modern research much work has been done in recent years to encourage the progress of rockets. Colonel Lindbergh once said, "The rocket is now in that most interesting period of discovery where the shore lines are unplotted and the future is limited only by the imagination. We cannot state what speeds or ranges the rocket may attain, but it is not restricted by the rotation of an engine or by dependence on the atmosphere. As the airplane gave man freedom from the earth, the rocket offers him freedom from the air."

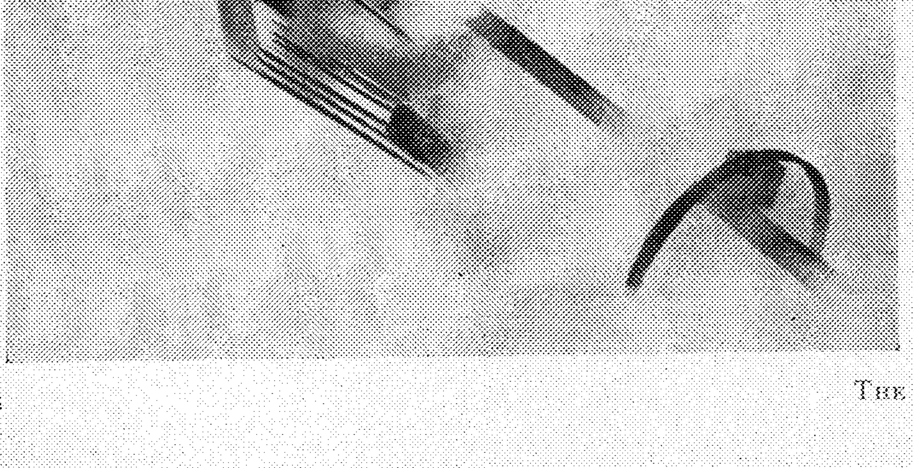
It cannot be said that a rocket develops so many horse power as is true in motor cars. A rocket is meant solely for use in the stratosphere where there is little or no air resistance and where a gasoline engine could not run for want of oxygen. It is at these high altitudes that a rocket performs with maximum efficiency. A charge that on the ground would propel the rocket but a short distance at a low speed, would propel the same rocket in the stratosphere a great distance at a high speed. Therefore, the builders of rockets measure the force created in pounds.

The stumbling blocks which are holding back the speeds of rockets are problems of

(Continued on Page 17)

Small size rocket at take-off

COURTESY SCIENCE SERVICE



Navy College Program

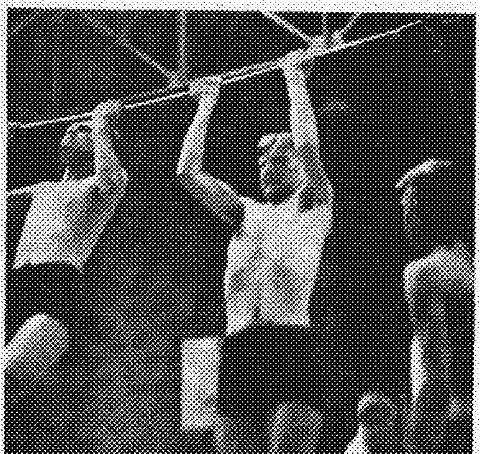
TRAINING TARS-TO-BE

BY DEAN BABCOCK

The latest and one of the largest groups of servicemen on the campus is a unit of the Navy's college training program. Dry-land sailors though they be, they are rapidly shaking down to become real Navy men. Already they have mastered the intricacies of infantry drill and Navy lingo. Daily they can be seen marching smartly up Church street as they go to their first hour classes.

With new ships sliding down the ways daily, and a more active construction plan in formation, a new source of officer material was needed. The Navy College Training Program was set up to fulfill this need. While the V-12 program does not turn out officers, it prepares men for the officers training which is to come. The program superseded the former V-1 and V-7 college reserve plans. Most of the men in the program have been on inactive duty from several months to a year. The orders to active duty were sent during June and the students reported July 1. For several days the Armory had the appearance of a receiving ship as the men acquired the various elements of their nautical garb.

The V-12 program is set up like any college. The men are classified as freshmen, sophomores, juniors, or seniors according to their previous college experience. The men that are now in the program as freshmen were enlisted recently after taking a qualifying examination. The sophomores and juniors are mostly men who were previously in the V-1 program. The V-1 qualifying examination was given in May to those who finished their sophomore year in June. The seniors are practically all men who were previously enlisted under the V-7 program. Some men in specialist fields have come in through the SV-7 program. The men were all originally enlisted as apprentice seamen but received no pay while on inactive duty. On active duty, the men are still apprentice seamen and draw the pay as apprentice seamen.



PHYSICAL PROGRAM

Members of V-12 are shown as they go through Navy strength tests.

Varied Branches

The unit at Minnesota is divided into engineers, pre-meds, pre-dents, and some business students. The length of time that these students will stay in school depends primarily on the type of commission that they are working towards. Specialists, such as certain types of engineers, and medical and dental students, in general, will be allowed to remain to finish the work for their degree. Students working towards commissions as deck officers will in general be allowed to complete two or three years of their work.

The program is divided into 16-week semesters, two semesters to be equivalent to a year of college work. The courses are primarily the same as those offered to civilian students with some modifications to adapt them to the schedule and purpose of the program. Only a small part of the time is spent on Navy courses. Courses in Naval Organization and Navigation are offered, but are not required except of those starting college after June, 1943. Physical education is required five hours a week. The first 16 weeks of this program is spent in a conditioning course. Students who satisfactorily complete this program then enter a maintenance program of competitive sports. According to Navy and University rulings, students above first-term freshman level in the V-12 program are eligible for competition in varsity sports.

The unit is also organized in the military sense. The unit is classed as a battalion and has at its head a battalion staff. The battalion is divided into four companies of two platoons each. Each company has a commissioned officer as its commanding officer and a Chief Petty Officer, together with a student staff of officers. Each platoon also has its staff of student officers.

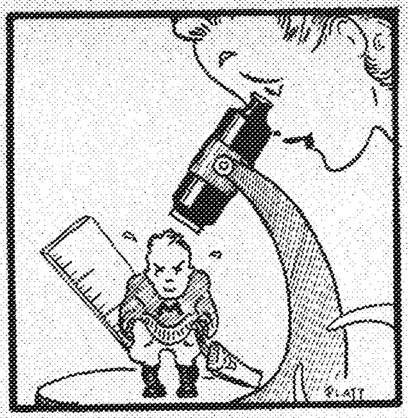
The students also maintain the watch at the barracks at Pioneer Hall. The watch is set up with commissioned officers as Officer of Day and Chief Petty Officers as Officer of the Watch. A senior student stands the watch as Junior Officer of the Watch.

The students' day is a busy one from reveille to taps. Reveille sounds at 0610 and formation for calisthenics is ten minutes later. After a brief but brisk twenty-minute period of loosening and stretching exercises the men return to their barracks to prepare themselves and their quarters for the day. Breakfast is a 0700. With shoes shined, faces cleanly shaven, and uniforms neat and clean, the students march to their classes at 0815. Classes last until 1120 for first mess and 1220 for the second mess. After an hour for noon "chow" the students return for their afternoon classes. The time after a student's last class and before evening meal formation is classed as campus liberty and the student is free within the limits that have been set up. Evening meal formation is 1800 and the time after the evening meal until 1930 is also campus liberty. From 1930 until 2130 the students observe study hours when they are restricted to their rooms or other places of study. Taps sound at 2200 except for students who have extra studies to finish.

Weekend Leave

On weekends the V-12 students have a limited amount of city liberty. On Saturdays liberty starts at 1500, after inspection by the commanding officer. Liberty expires at 0100 Sunday for seniors, 2400 for juniors, 2300 for sophomores, and 2200 for freshmen.

Students who successfully complete their work in V-12 will be assigned to reserve midshipmen's schools. These schools have been set up at various places around the country. The first was set up aboard the U.S.S. Prairie State in 1940. Here the men enter as apprentice seamen and are shortly made midshipmen. After an intensive period of three months the men graduate and are commissioned ensigns in the Naval Reserve. These officers are then assigned to the fleet for active duty or to shore stations for further training.



Two Curves With THE WRIGHT ANGLE

By OPAL BELLAMY AND BARBARA FRANKLIN

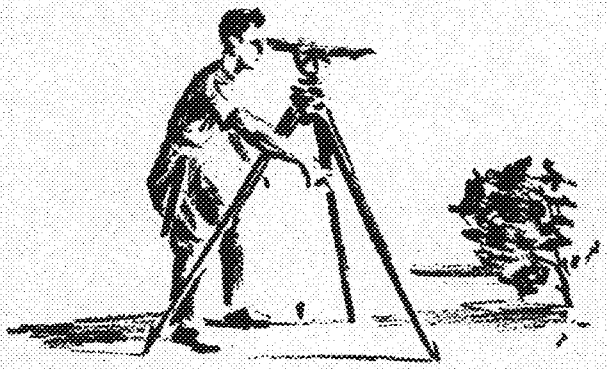
Before the dear reader sets himself down with his favorite magazine, we would hereby like to issue a warning that it takes a man both brave and bold to delve into the innards of this column.

Not only is the following material as corny as the pure hybred stuff they grow back in dear old Iowa, but it is also as putrid as the Chicago stockyards on a warm summer day.

Read on, dear soul — but don't say you weren't warned!!

It's noon and the spaces between our respective ears are as blank and as empty as the display cases at the butcher's shop. We can think of nothing to account for this unusual phenomenon unless it's this meatless Tuesday situation. It's not the fact that it's noon that's bothering us particularly — but the fact that our right-honorable editor says that 1:30 is the deadline, and we're afraid if we don't slow down a bit, we may actually make it. We just can't afford to spoil the reputation that we so laboriously built up with our own magazine back home before we arrived in this forsaken corner of the U. S. A.

Let's stop and think a moment. . . . We're sure there must be innumerable subjects of interest to the engineering element on campus. There's always the presumption that engineers are men—



and then where does that get us. We're the conscientious type of people who hibernate and study all the time, and can we help it if we've never seen a man?

If worse comes to worse, we can try out poetry on you poor dopes. Poetry being the sort of stuff that Webster defines as "the form of literature that embodies beautiful thought in rhythmical language." — he says! Since this is more or less a man's magazine — and since man's favorite subject is "man," our theme shall be **MEN**.

Short ones, fat ones,
Tall ones and dark;
The world is overrun with men,
And how they love to spark.

Little ones and big ones,
Funny ones and sad;
The world is just crammed full of men,
Of that I am so glad.

Neat ones, pale ones,
Joey ones and slicks;
Oh, yes there's lots of men around,
But I know all their tricks.

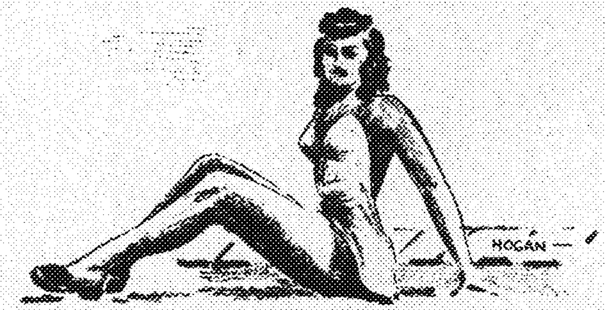
Fast ones (HUM), slow ones,
Dumb ones, and some
Are even drips, and droops and goons,
But I can't snag a one.

We were horrified beyond all words when we met an engineer trundling down the path toward us the other day carrying upon his bowed shoulder some gruesome object that we could not identify. After numerous inquiries around the campus we learned to our amazement that it is merely a transit (the spelling of which we are still in the dark about), that noted instrument of mechanical genius used for surveying distances. We also learned from a reliable source that among other numerous uses, it serves beautifully as a spy glass for scanning the roofs for semi-clothed worshipers of the sun god, Ra. For shame, you mighty engineers!

Then again there is always the subject of Shevlin hall. We realize that the majority of the engineers are allergic to said subject, but for the benefit of the limited few who enjoy reading anything, the following tidbits may prove interesting.

It has been rumored that Shevlin has been bothered lately by an uncouth number of (we mean a number of uncouth) insects which have merited cheesecloth draperies. We hope this doesn't tread upon the toes of any of the faithful readers of the Greater Minnesota TECHNOLOG. (Note: Plug.)

Oh, yes, and there's another small matter of a bathing beauty contest for the engineers. Each school of the College of Engi-



neering is asked to submit four of their C.K.'s (Campus Kings to to you uninformed) to compete for the title of The All-Campus Answer to a Maiden's Prayer. All contestants are to appear in suitable apparel the first rainy day after release of The Greater Minnesota TECHNOLOG. (Note: Another plug!) All entries will automatically become the property of the sponsors.

We really think it's only fair to remind all of us of the fact that Hitler is serious. With this in mind we hope the following will be called to the attention of our readers in the Naval Reserve. The question of the hour is—just what is the use of those wooden guns? We realize that Hitler has an allergy to wood, the softie; but we're worried about Goering whose head has a Brinell hardness of around 477. If one of our brave followers could think of a scheme whereby these weapons could hurl projectiles, they would undoubtedly make a small mint due to small cost, lightness, and quantity of material available. This is excellent subject material for extensive research toward your Masters.

And we can't ignore the A-1 clad Army either. We want them, each and every one, to know how much we appreciate their songs, but why in HELL can't they give out to *Back Home Again in Indiana* or *We're Loyal to You, Illinois*. We're homesick enough without listening to *California Here I Come* and *That's Where the Tall Corn Grows*. No slam to you Iowans! Believe us!

Time is valuable to us all, and we think we've strained our poor brains long enough. Be good. And if you can't be good . . .

THE ? MARK

SLIPSTICK PHILOSOPHY BY MELVIN MARK, M.E., '44

In summer school we don't go to work in the morning—we are surrounded with it when we get up. But what can one expect of a day that begins with getting up in the morning.

• • •

Art Engstrom must have a sixth sense—I couldn't find any sign of the other five.

• • •

Wayne Brock, Chem. E., saw his first burlesque show! Here is his reaction: "I don't like them. What have you when you get done?"

• • •

Asked to write an essay on the life of Benjamin Franklin, a little girl wrote this gem of a paragraph:

"He was born in Boston, traveled to Philadelphia, met a lady on the street, she laughed at him, he married her and discovered electricity."

• • •

Dames are pushovers for gay caballeros. Caballeros are athletes in Spain. Athletes in Spain throw the bull for diversion. Therefore, dames are pushovers for bull-throwers.

• • •

"Beauty is only skin deep."
That's bosh,
It's thinner than that,
It comes off when you wash.

• • •

She: Are you a member of a crew?
Bob Linsmayer: No.
She: Then stop stroking me.

• • •

"What do you mean by bringing my daughter in at this hour of the morning?
Bob Zesbaugh—"Have to be at work by seven."

• • •

A bachelor is one who never Mrs. anything.

• • •

He: Only a mother could love a face like that.
She: I'm about to inherit a fortune.
He: I'm about to become a mother.

• • •

From the mail bag:

Dear Don,
I just read in the paper that students who don't smoke make better grades than those who do.

Dad

Dear Dad,
I have heard about it, too, but truthfully I would rather make a B and have the enjoyment of smoking; in fact I would rather smoke and drink and make a C. Moreover I would rather smoke and drink and neck and make a D.

Don

Dear Don,
I'll break your neck if you flunk anything.

Dad

THE NEW INCOME TAX FORM
a. How much did you make last year?
b. How much do you have left?
c. Send b.

• • •

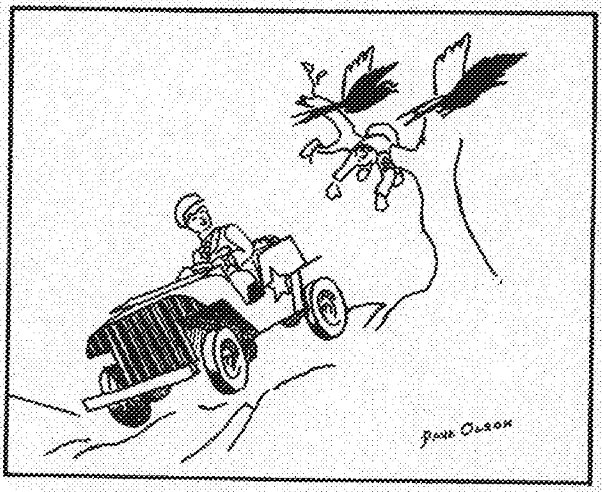
Englishman: I say, what are they doing?
American: Dancing.
Englishman: They get married later, don't they?

• • •

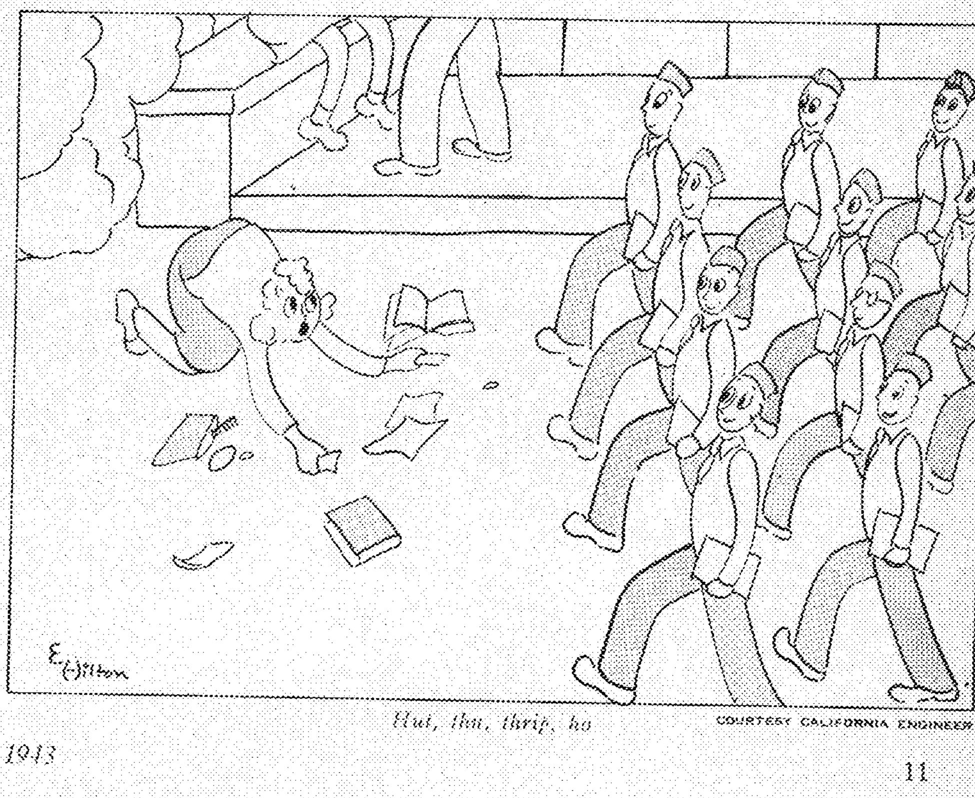
Little Jack Horner
Sat in the corner—
B.O.

• • •

Dedicated to THE ARMY



What say, Sarge?



Hut, tho, thrip, ho

COURTESY CALIFORNIA ENGINEER

Editorial Comment

AS WE SEE IT

Sane Dollars

Most of the words we have read or heard concerning War Bonds had an emotional appeal. However, there is a definite bedrock stratum of realism behind the "why" in the purchase of War Bonds.

First and most important, War Bond dollars go to work producing bullets, guns, planes, tanks, and ships. Also they buy food and medical supplies for our fighting men.

The second job of the War Bond dollar is that of an absentee. Dollars can be dangerous if they are allowed to circulate unchecked through financial channels. But when invested in War Bonds these dollars can no longer work towards inflation by buying scarce materials, driving prices upwards, and creating a condition almost as dangerous as war itself. They have become sane dollars.

Also the War Bond dollars get down to business and produce for you. They use their overtime to earn interest for you, and they become cushions upon which you can rest your financial problems when the war is won. They will wait patiently for the day when they can buy a new car for you, their master.

So, lying quietly beneath the emotional appeal, there is a good solid common sense foundation of logic behind your purchase of War Bonds. Do the logical thing and put all the dollars you possibly can into War Bonds so that they can work for Uncle Sam and you.

War Finance Committee

Why Were You Deferred?

This country's direct participation in the war is approaching the two-year mark, and as it does a greater number are being called to take an active part. Many former students are serving with the armed forces all over the world, others are preparing for useful service in Army and Navy training programs, and still others are doing their utmost in industry. We who remain as civilians in the University must realize that ours is an important job. We have been granted deferments because the War Manpower Commission has found that our chosen vocations are vitally important, primarily in the war effort, and also in the peace effort to follow. It is our obligation to proceed under the accelerated program with the proper spirit and not to make excuses because of the abnormal conditions with which we must contend. We must suppress the urge to throw our books aside for a gun. Our duty is to study, a duty that probably is harder to perform than one of more violent nature that permits physical action against the enemy.

At a time like this it would be well to recall the ideals and purpose of the University. Perhaps the last part of the inscription on the façade of Northrop Auditorium fits the present situation best. For those of you who do not recall the inscription it reads as follows: The University of Minnesota—Founded in the faith that men are enobled by understanding—Dedicated to the advancement of knowledge and the search for truth—Devoted to the instruction of youth and the welfare of the state. This last phrase "devoted to the welfare of the state" could just as well mean to the welfare of the nation for the University is attended by many non-residents of Minnesota. Application of this aim to the Institute of Technology is particularly apt because engineering is devoted to the betterment of man. We know that during this war the engineer has played a tremendous part by developing and producing the needs of our fighting men. If it were not for these men behind the men behind the guns the cause for freedom would not have progressed to where it is today. Ours is the responsibility to continue with this work when we graduate. When we go into industry we will be aiding not only in the war effort, but will be receiving valuable experience for the postwar period. We cannot overlook this so we must continue to pursue our education diligently.

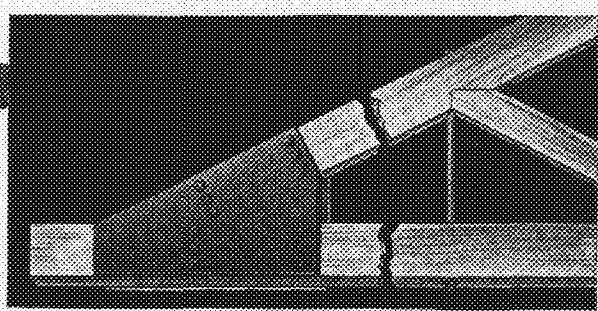
Turn Off That Light

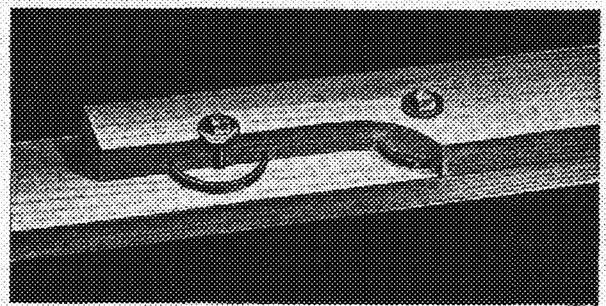
Just a flick of the wrist and it's out, the light I mean. That's all it takes—a flick of the wrist—to control one of man's most useful servants. So flick a wrist, and turn off that light!!

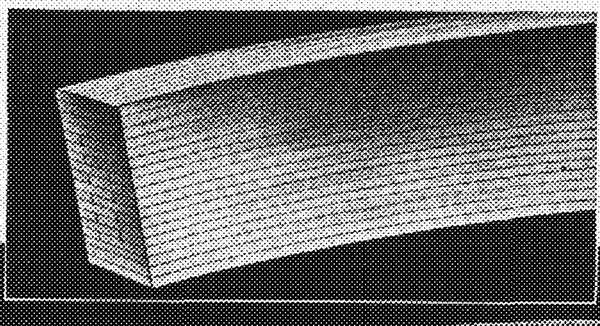
War taxes a country to the utmost. In this connection, we have all heard that it is important—vital that we save and conserve all of our resources. On the whole, we have been doing a wonderful job. But it is the little things on which we have slipped. People don't realize it, but electricity is as vital a war commodity as are iron, lead, coal, tungsten or any of our other natural resources. We must help save and conserve our electricity too!

We take it for granted the light goes on when we snap the switch. And we still take it for granted that the light burns when we don't need it. But we don't take it for granted that we should turn off that light when we're through with it. If everyone would turn off their lights when they were through using them, we would really help by saving this much needed extra electricity. Besides, it would cut down the electric bill.

So how about turning off that light after it has served its purpose? It won't make us or break us, but it will help.







TECH NEWS

SUMMER, 1943

Senior Engineers Utilize Student Placement Service

Seniors who will graduate by March, 1944, have been notified that they are eligible to use the service of the present course of interviews of the Student Placement service.

The function of this department is to fit senior engineers into positions for which they are best fitted. Through the placement service, representatives of various companies employing engineers may make arrangements to interview prospective employes. Personnel sheets are supplied to a student upon request, and he is notified to report to office 114 in the Main Engineering building before an interview is arranged.

Last year 85 companies sent representatives to the office, and jobs were found for very nearly all students who used the service.

Aero Honor Society Formed

During the spring quarter the Minnesota chapter of Tau Omega, national honorary aeronautical engineering fraternity, was installed in a ceremony at Coffman Memorial union.

The Institute of Aeronautical Sciences received the invitation to form the chapter during the winter quarter, and after a group of senior aeros discussed the proposition and voted to form the organization, departmental approval was obtained, and the charter was granted.

The new organization will help to unite the aeronautical department, enable the students to become more completely acquainted with their instructors, promote a spirit of fellowship, and give the underclassman an aim in his college career as an aero engineer.

REGISTRATION IN I. T. DROPS

Although the number of civilian students registered in the Institute of Technology is slightly larger than last summer, attendance, in spite of compulsory accelerated programs, is small when compared to that of an ordinary quarter. Calling to active duty by the Navy of V-12 reserves accounts for the large decrease in civilian enrollment.

There are 323 seniors in all departments of the Institute—engineering, architecture, chemistry, mines, and physics. The freshman class is second in size with 236 members, and the sophomores follow with 195. Smallest is the junior class, which has 189 members. The largest department is chemical engineering with its total enrollment of 237.

Besides regular students there are 11 Pratt-Whitney coeds registered in engineering. Even though civilian representation has been whittled down, the Institute is taxed to capacity with the soldiers in the A.S.T.P. and the Air corps, the sailors in V-12, N.R.O.T.C., and electrician's and machinist's mates' schools, and the students in night school defense courses.

R. E. Summers Is Coordinator

Professor R. E. Summers of the Mechanical Engineering department is coördinator for the Navy V-12 program. His duties are coördinating class schedules and helping with the budget and academic matters for the Navy program.

Even though the V-12 program includes students in the Arts college (pre-dentists and doctors), in Dentistry, Medicine, and Business, almost 90 per cent of the Minnesota group is taking engineering courses. Therefore, Professor Summers' office is in the Main Engineering building where it will be easily accessible to the greatest number of V-12 men.

MECHANICAL ENGINEERS HAVE PICNIC AT MINNETONKA

Faculty members and employes of the Mechanical Engineering department held their annual picnic July 10 at Lake Minnetonka. Activities included a ball game between unidentified teams, swimming, and an impromptu debate concerning faculty members by Professors Frank Rowley, B. J. Robertson, Clarence Lund, Robert Summers, and James Ryan, and Machinist Erick Rosendahl. Robert English recited "I Love Thee, Agnes!" A dancing exhibition by Myrl Lindeman and Louise Beaucamp was followed by general dancing to music from a juke box.

Committee members in charge of the picnic were Marion Edwards, Myrl Lindeman, Thomas Murphy, and Millard Lajoy.

Life-Saver for Men and Materials

A SIGNIFICANT development to come out of the first World War was a black, granular substance known as activated carbon.

Particles of this material are so highly porous and have such tremendous active surface area, that they can pick up and hold surprising amounts of toxic gases, volatile vapors, and odors. Developed by NATIONAL CARBON COMPANY, INC., a Unit of UCC, to meet the specific menace of gas warfare, activated carbon saved many lives during the last war as an important ingredient in gas mask canisters.

After the Armistice, this amazing material was further developed by CARBIDE AND CARBON CHEMICALS CORPORATION, another Unit of UCC, for numerous industrial uses. As a result of this work, one type of activated carbon is now saving millions of gallons of such essential solvents as alcohol, ethyl acetate, ether, and acetone, previously lost through evaporation in manufacturing processes. This is accomplished by passing vapor-laden air from solvent-using processes through tanks containing COLUMBIA activated carbon, and then steaming the solvents out of the carbon.

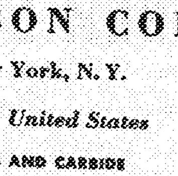
This year, in smokeless powder plants, plants making plastics, and in other plants engaged in war work, it is estimated that savings will amount to over 100 million gallons of solvents.

And the work of activated carbon is just beginning. Through the constant research that typifies all UCC Units, CARBIDE AND CARBON CHEMICALS CORPORATION has developed still newer uses which are contributing to the nation's health and welfare.

BUY UNITED STATES WAR BONDS AND STAMPS

FRESH AIR! War workers are kept supplied with odor-free, healthful air by means of activated carbon purifiers used in conjunction with air conditioning installations.

SAVINGS FOR INDUSTRY! Recovery of alcohol and other solvents by activated carbon is releasing transportation and production facilities for other vital war uses.



SAVINGS FOR YOU! In making plastics, artificial leather, one type of rayon, and many other products, the recovery of solvents with activated carbon results in savings to consumers.

MERCY MASK! Men of the armed forces, Civilian Defense volunteers, and workers exposed to the dangers of toxic atmospheres are protected by activated carbon in masks.

UNION CARBIDE AND CARBON CORPORATION

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

Principal Products and Units in the United States

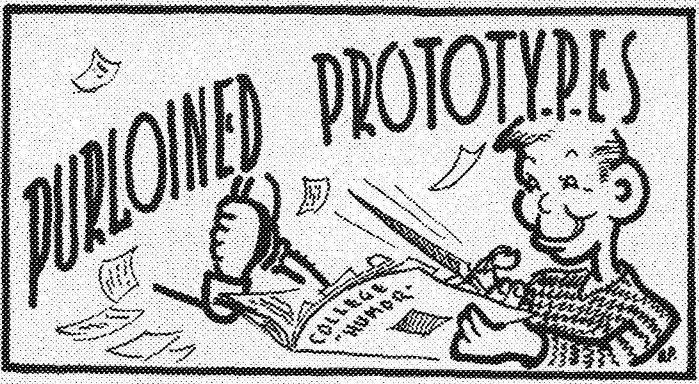
ALLOYS AND METALS
Electro Metallurgical Company
Haynes Stellite Company
United States Vanadium Corporation

CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS AND BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation



BY BILL SANFORD, M.E., '44, AND HERB ROCHEN, A.E. '44

An unobtrusive gentleman in the museum was gazing rapturously at a huge oil painting of a shapely girl dressed in only a few strategically arranged leaves. The title of the picture was "Spring." Suddenly, the voice of his wife snapped: "Well, what are you waiting for?—Autumn?"

• • •

"Where does this shady lane lead to?" asked the motorist. "Well, stranger," drawled the farmer thoughtfully, "it's led mor'n half the young folks around these parts into a right smart heap of trouble."

• • •

"Mary, where have you been until 3:00 A.M.?"
"Walking, Mother."
"For goodness sake!"
"Yes, Mother.

• • •

Passenger: "Porter, get me another glass of ice water."
Porter: "Sorry, suh, but if I takes any more ice, dat corpse in the baggage car ain't going to keep."

• • •

"So, your husband is one of the big guns of industry."
"Yeah, he's been fired seven times!"

• • •

A citizen, who prided himself on being something of a good Samaritan, was passing an apartment house in the small hours of the morning when he noticed a man leaning limply against a doorway.
"What's the matter?" he asked, "drunk?"
"Yup."
"Do you live in this house?"
"Yup."
"Do you want me to help you upstairs?"
"Yup."
With much difficulty he half dragged, half carried the drooping figure up the stairway to the second floor.
"What floor do you live on?" he asked. "Is this it?"
"Yup."
Rather than face an irate wife who might, perhaps, take him for a companion more at fault than her spouse, he opened the first door he came to and pushed the limp figure in.
The good Samaritan groped his way downstairs again. As he was passing through the vestibule he was able to make out the dim outlines of another man, apparently in worse condition than the first one.
"What's the matter?" he asked, "Are you drunk, too?"
"Yup," was the full reply.
"Do you live in this house, too?"
"Yep."
The good Samaritan pushed, pulled, and carried him to the second floor, where this second man also said he lived. He opened the same door and pushed the second man in.
As he reached the front door he discovered the shadow of a third man, evidently worse off than either of the other two. He was about to approach him when the object of his solicitude lurched out into the street and threw himself into the arms of a passing policeman.
"Off'shur! Fer Heav'n sake, Off'shur," he gasped, "protec' me from that man. He's done nothing all night but carry me upstairs and throw me down the elevator shaf."

A bathing suit—like a barbed wire fence—is designed to protect the property without obstructing the view.

• • •

A bee was sitting on a clover taking a nap. Along came a cow who ate the clover and the bee. When the bee awakened, he was inside the cow's stomach. The bee was very "unhappy" and stung and stung the cow. Finally it became tired and fell asleep. When the bee woke up, the cow was gone!

• • •

DIARY

Monday: "Was flattered to be placed at captain's table."
Tuesday: "Spent morning on bridge. Captain seems to like me."
Wednesday: "Captain's proposals unbecoming to an officer or gentleman."
Thursday: "Captain threatens to sink ship if I do not agree to his proposal."
Friday: "I have just saved 600 lives."

• • •

A robin returning to his nest one day was very much chagrined to discover that his would-be mate was resting on a bevy of eggs that in no way resembled the conventional blue-green of his species.
"Well, my dear, what's the meaning of this?" he hastily inquired, pointing to the eggs in question.
"Oh, them," answered his spouse, "don't worry, my dear, I just did it for a lark!"

• • •

Many a girl thinks she shows distinction in her clothes, when the proper word is "distinctly."

• • •

Bad men want their women to be like cigarettes—slender and trim and all in a row to be selected at will, set aflame, and when the flame has subsided, discarded, only to select another. The fastidious men want their women to be like cigars. They are more expensive, and they make a better appearance, they last longer, and, after all if the brand is good, they are seldom discarded, but used to the end. The good man wants his woman to be like his pipe—something he becomes attached to, knocks gently but lovingly, takes great care of always. A man will give you a cigarette, offer you a cigar, but will never share his pipe.

• • •

A very beautiful and lovely young maid in a very wealthy household was suspected by the mistress of excessive attractions to her husband.
Upon being told her services were no longer needed, a small argument ensued between maid and mistress.
Said the maid, "But at least you know, Madam, that I am much more beautiful and attractive than you, yourself."
Replied the mistress: "Indeed! And who told you that?"
"The master. And, furthermore, Madam, I have been told that I wear my clothes very much more smartly then you do and make a better appearance."
"Indeed! And who told you that?"
Replied the maid again: "The master; and furthermore, Madam, I have also been told I am a very much better companion in the more intimate ways and moments."
"Well," retorted the mistress, "and I suppose the master told you that, too?"
"No, Madam," replied the maid, "not the master—the chauffeur."

• • •

Morning After

In the dog house, half dead,
Throat so dry and throbbing head,
Bloodshot eyes and body sore,
The morning after the night before.
Can't eat nothing, got no pep,
Lost my money, lost my rep,
Can't get up, I feel so bad,
Boy, what a wonderful time I had.
Never felt so bad before,
Even my darn old tongue is sore;
And when I breathe, I still taste gin;
Gee, what a party it must have been.
Can't remember where I went;
Don't know where the time was spent;
But, gosh what a time it musta been;
Look at the helluva shape I'm in.

(Continued from Page 8)

attaining high enough speeds, obtaining powerful enough fuels, and building long-life combustion chambers.

Physicists say that if speed of about 25,000 miles an hour more exactly 6.664 miles a second, can be obtained, power may be shut off. If it is outside the earth's atmosphere, the rocket will thereafter coast to its objective on its momentum, forever outflying the steadily weakening attraction of the earth.

At the present time a pursuit plane weighing 4,000 pounds can attain a height of 20,000 feet in one and one-half minutes. Professor Goddard shot a rocket in December, 1930, which attained a height of 2,000 feet and a speed of 50 miles per hour. Later one of his rockets reached a height of 7,500 feet with a maximum speed of 700 miles per hour. The rockets used were eleven feet long and weighed 33.5 pounds.

Heat up to 5,000 degrees Fahrenheit has been developed in the rockets, and gas velocities of 3,600 miles per hour and over have been recorded. Goddard has found from his experiments that rockets operate at their greatest efficiency when the gases of combustion flow from the exhaust nozzles at the greatest speeds. When the speed of gas expulsion was 1,000 feet per second, the efficiency of the fuels was only about two per cent, but when the speed of expulsion was stepped up to 7,000 and 8,000 feet per second, the efficiency was between 55 and 65 per cent. Thus it is seen that the rocket is a means of transportation at high speeds.

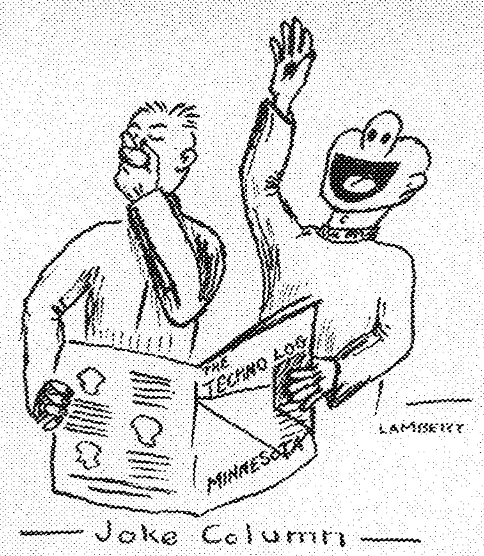
Many different types of fuels have been tried in rockets since the new science was discovered. Many claims are made about different fuels but science is still trying to find more powerful propellants. In 1935 the American Rocket society learned from tests that alcohol proved to be a more efficient fuel than gasoline because the alcohol burned more smoothly. They also claimed that gunpowder was too violent, dangerous, and hard to control to be used in rockets. Tanks of nitrogen were used very successfully to provide the necessary pressure needed to force the fuel into the combustion chamber during flight tests. The California Institute of Technology has found that in flight, liquid fuels are best, but for experimental purposes gaseous fuels are sufficient in a mixture of ethylene and liquid oxygen fired by electricity has proven to be a very good propellant for rockets. It has been found that gasoline and liquid oxygen are ten times as powerful as trinitrotuene.

About 1930 the American Rocket society quit using powder and turned to liquid fuels. They could then separate the main fuel supply from the combustion chamber, thus isolating this dangerously heated part of the rocket. It was then a simple matter for them to govern the flow of the fuel. The Germans used liquid fuels with great success and also designed a water-jacket for cooling the combustion chamber.

The combustion chamber is in the heart of the rocket, and its requirements are the most exacting of all. In the chamber the fuel is burned, and the resulting gases create the reactive force that propels the rocket. The chamber then, is a precise element of the rocket which must be constructed to permit the proper introduction of the fuels to provide as complete a combustion as possible and to force an ejection of gases with the greatest possible speed. Engineers discovered that it was best to introduce the fuels near the throat of the nozzle instead of in the head of the chamber as had been done previously. It was decided that the egg-shaped combustion chamber could not be bettered. The materials in the chamber must be of great strength and must be able to withstand intensive heat as well as the corrosive effect of the rapid flow of the compressed gases. Research in light metals with high melting points has shown that an alloy of aluminum, beryllium, and molybdenum should prove successful. It has been proven that for greater efficiency larger combustion chambers must be used.

It is seen today that the rocket has more promising possibilities than has the airplane because the airplane is dependent on the atmosphere. It is also known definitely that if the velocity of an object through the earth's atmosphere exceeds certain speeds, the heat due to the resistance of the air rapidly rises. Thus, the speed of the airplane is limited greatly.

Rocketry is now in its infancy, but is fast coming of age. Most investors started from the fantastic stage and rose to the practical stage just as the rocket is trying so hard to do today. In decades to come space travel will become an accepted fact, and historians delving into dusty records of the twentieth century will find that rocket travel was due to stumblings by a few men upon curious things that turned out to be vital factors in the progress of the rocket.



MORE PURLOINED PROTOTYPES

FOR ENGINEERS ONLY, OTHERS PLEASE DON'T READ

Kid Brother: Give me a nickel, or I'll tell Dad that you held hands with my sister.

Elmer: Here you are.

K. B.: Give me a quarter, or I'll tell him you kissed her.

Elmer: Here, pest!

K. B.: Now give me five dollars!

* * *

"Good morning, Brown, I hear you have a son and heir."

"Yes, sir. Our household now represents the British Isles."

"How is that?"

"I am English; my wife is Scottish; the nurse is Irish; and the baby wails."

* * *

Customer (at cigar counter, pointing): "I always smoke that brand in the can."

Mamie, the clerk: "I'm sure there's no better place to smoke 'em, sir!"

* * *

Legal Entanglement

If "A," "B," and "P" bought a keg of beer together and "A" and "B" drank it all, would "A" and "B" be liable to "P?"

* * *

Young Brown got a job at an airplane factory. The first morning the foreman gave him a two-foot rule and told him to go measure a large aluminum plate. Brown returned in twenty minutes. "Well," inquired the foreman, "what's the size?"

The M.E. (Note) displayed a satisfied grin. "It's just the length of this rule," he said, "and two thumbs over, with this brick, and my arm from here to here, bar the finger-nails."

* * *

Engineer Pel: "Busy"?

Ditto Falkenstrom: "No, you busy?"

First Ditto: "No."

Second Ditto: "Let's go to class, then."

* * *

If brevity is the soul of wit, then my girl's dress is funny as hell, and I can see through the joke.

* * *

"I hear the Board of Regents is trying to stop necking."

"Is that so? The next thing you know, they'll be trying to get the students to stop, too."

* * *

"Don't you pity a girl in the dark?"

"Yes, I can't help feeling for her."

* * *

He: "I'll be tickled if we find a filling station soon. We're practically out of gasoline."

She: "I'll too be tickled if we don't, I suppose."

The members of an exclusive hunt club decided to hold a fox hunt, and instructed the members to bring only male dogs. However, one influential member owned a female, and she was allowed to run with the pack.

The morning of the hunt they followed the dogs for an hour, then lost them completely. One of the hunters saw a farmer in a field and questioned him:

"Have you seen anything of a pack of dogs and a fox?"

"Sure, just a minute ago. They were going that way."

"What were they doing?"

"Wal," said the farmer, "the last I saw of them, the fox was running fifth."

* * *

Agnes: "What's your father's occupation, Bill?"

Bill: "My father's a cop, but I'm no flop."

Agnes: "Well, my father's a baker, but I'm no Quaker!"

Robert: "Huh, my father's a chauffeur, but I'm no loafer!"

Romona: "Er-ah, my father's a surgeon."

* * *

"We want a girl to sell kisses at the bazaar. Have you had any experience?"

"Well, I'm a Comstock Coed from 'West'."

"I'm sorry, miss, but we were looking for amateurs."

* * *

DEDICATED TO ALPHA TAU DELTA

Two very cute Powell nurses slipping in after hours met two young grad nurses.

"Shhh, we're coming in after hours."

Two Grads: "That's okay, we're going out after ours."

* * *

"Does your gambler husband ever leave you alone nights?"

"Yeah. He plays out about once a week."

* * *

Guest (to host in new house): "Hello, Bud, how do you find it here?"

Host: "Just walk upstairs, and then two doors to the left."

* * *

He: "What well developed arms you have!"

She: "Yes, I play tennis."

He: "You ride horseback, too, don't you?"

Have You Got Measles Too?


IT WAS Ever THUS
1775 — In the Revolutionary War when "the embattled farmers stood, and fired the shot heard 'round the world" and until the victorious close of the war for independence, our farmers' small sons, daughters, wives and grandfolks backed them up on the farm front.
1917 — From the beginning of our participation in World War No. 1 until its close, farm women, young boys and girls, and the old folks willingly stepped into the shoes of the hundreds of thousands of young men who were in the armed services of our country.
1861 — In the war between the states the women and children as well as the older men of both the North and the South backed up their loved ones on the fighting fronts by working on the farm fronts.
Again . . . SHOULDER TO SHOULDER
AMERICAN FARM WOMEN, girls, boys and older men have backed up the men on the fighting fronts in every crisis. Their co-operation makes America the happiest place on earth to live in, to work in and to farm in.
About 100 years ago over 80% of our people had to be on farms to feed all. Today, less than 20% are on farms, yet feed and clothe the best fed, best clad nation on earth. Farm machinery, too, helped make America what it is today — this grainery of the United Nations forms the ARSENAL OF DEMOCRACY because American farmers are always ready to use new labor saving machines. Modern machinery has allowed the large percentage of our men and women to go into industry, and so together we have established the highest standard of living in all history.
Minneapolis-Moline and our industry are building all the farm machinery allowed under Government limitation orders. In addition, all are building quality products for our armed forces so that Victory and normal living will be ours sooner. What good if we could supply all the machinery our dealers might want and we lost the war? So urge your customers to Buy War Savings Bonds and Stamps Now — then when machinery is once more available, they will have the money to buy it.
Get your customers' machinery repaired now. Keep putting all your scrap into the big scrap.
THE JEEP originated by Minneapolis-Moline in 1938 as a prime mover . . so named by army men in 1940 . . three models are now made by MM. Below is the latest model. LATER the name Jeep was applied to many other small army vehicles.
FOR VICTORY
BUY
MINNEAPOLIS-MOLINE
TRACTORS & FARM MACHINERY
MODERN MACHINERY
CARE FOR YOUR TRACTOR FOR YOUR COUNTRY
MINNEAPOLIS-MOLINE
POWER IMPLEMENT COMPANY
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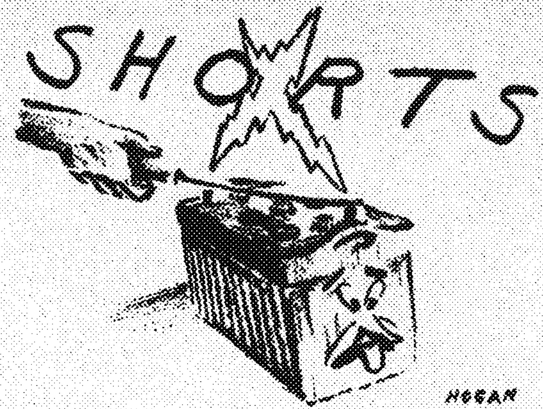


Those of you who don't know it are about to find out that the greater Minnesota TECHNOLOG has never before been published in the summer. It has been our privilege to undertake this task so we hope you long suffering readers appreciate our efforts.

● ● ●

Past editor, Jack Rockwell, and one of our last month's authors really have something to be proud of. It seems that Rock happened to run across an article by a fellow whose name is John Linsley. This article ran under the title "Esperanto" in the May issue, and now we come to the good part. *Science Digest* after seeing the article in the LOG liked it well enough to buy it from Linsley for their August issue. All of this just goes to show you that the articles we print might be worth reading after all.

● ● ●

This month in the Stray Scraps box in the hall of the Main Engineering building we were very much pleased to find such interesting tidbits as an old glove, the torn wrappings from a stick of gum, one telephone number that proved to be disconnected, and no humor. From this we have gathered that the inhabitants of the Engineering building have become very clean both in mind and habits. We are willing to bet as a result that the number of jokes and telephone numbers known by the present class of engineers is well below average. Anyone interested in proving that such is not the case can do so by filling the box up as it should be.

● ● ●

It seems that one of our staff members has the idea that a column given over to problems of the engineers and anybody else on campus who has a difficult decision to make would be welcome. We agreed and decided that as long as this is one of the first pages turned to after the jokes, we hope, we would devote this space to letting you know about it. Anytime that anything bothers you (if you are a beautiful female we can't help it but you could give us your phone number), drop us a note, or come into the office.

If there are enough problems we will publish the material, but if not we will not write the column ourselves because we are a happy lot as a general rule. The only gripe we have is that we don't have enough pretty girls to do our typing for us.

● ● ●

There are still a few vacancies on the TECHNOLOG staff so that any of you who have not dropped in because you thought the organization was complete are welcome. There is always a place for anyone who is interested in coming around and working. Drop into the office anytime or see one of the assistant editors.

● ● ●

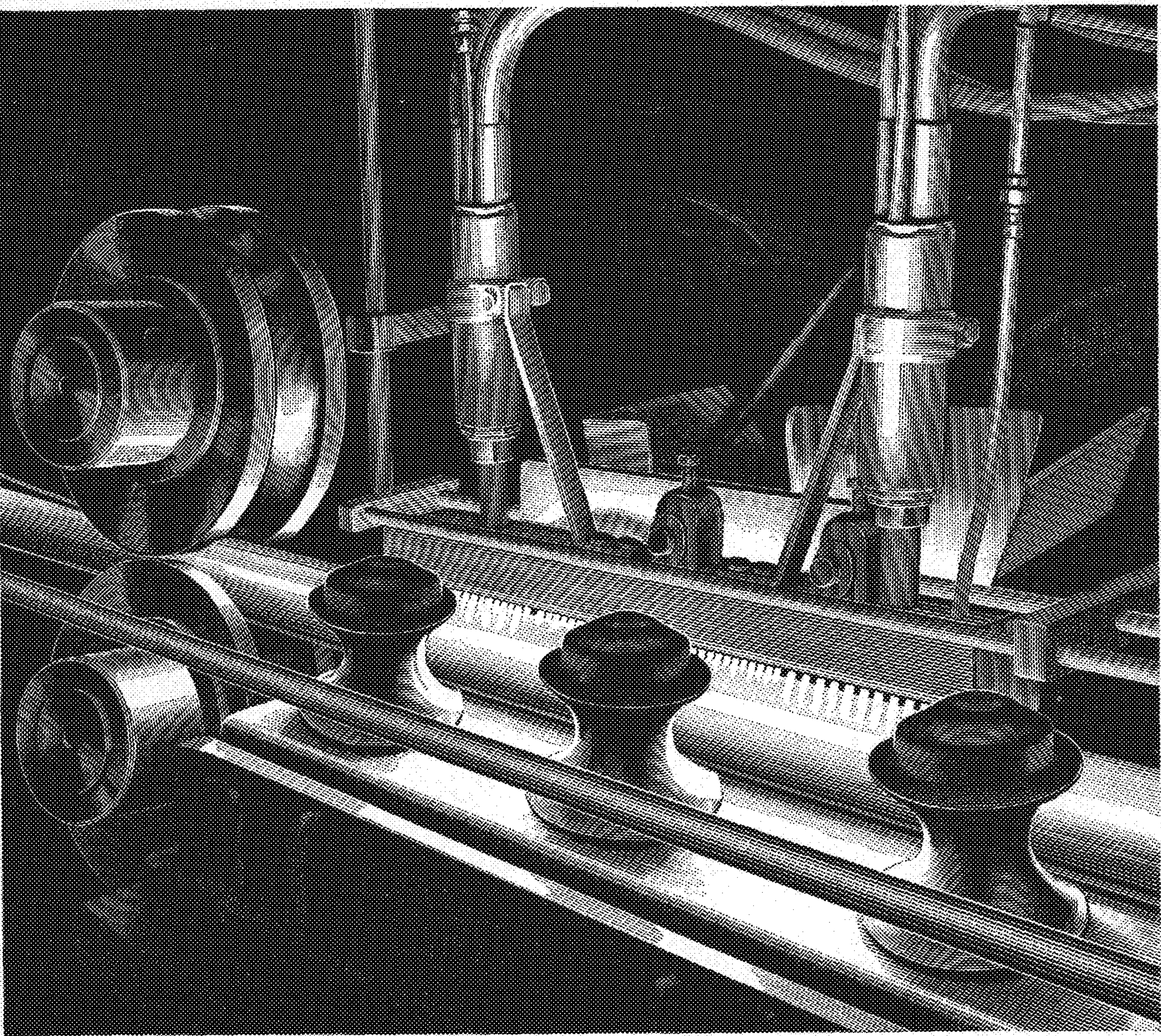
The time is ripe to print a list of the engineers who have not spent an evening on the river bank. The list is as follows:

—— —— —— ——

● ● ●

We heard a story just the other day that we think you might enjoy. It seems that several soldiers were over in the Union talking to someone when one of them asked where the educational magazines were. The person proceeded to tell him and he occupied himself for several minutes looking over the selection. At last he came back with what he had been looking for. It turned out to be a copy of *Esquire*.

G.V.



MACHINE-WELDING ARTERIES FOR INDUSTRY

RACING under a shower of white-hot oxyacetylene flames at speeds up to 200 feet per minute, formed metal strip is quickly converted into welded tubing.

Tubing produced by this Airco automatic welding method is characterized by strength, shock-resistance, and uniform wall thickness—and especially by its speedy manufacture and low cost.

Because of these advantages, tubing welded by the Airco automatic method has found a wide range of uses in industry . . . from drive shafts in trucks and tanks to its more common role in distributing gas, oil and water in machinery of production and war.

This use of the oxyacetylene flame is another example of how Airco research is extending the benefits of flame and arc processes to many manufacturing operations. By constantly increasing the efficient application of these processes, Airco research has broadened their usefulness to industry.

If you want to keep posted on flame and arc developments, write for a free copy of "Airco in the News." Address Air Reduction, Room 1656, 60 East 42nd Street, New York.

AIR AIRCO REDUCTION

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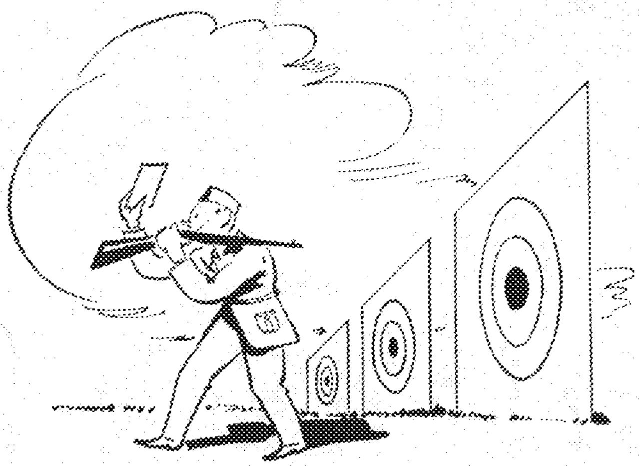
IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!

G-E Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD



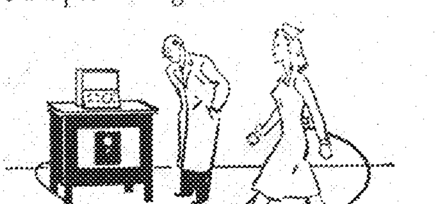
NOW THEY DO IT WITH MIRRORS

BECAUSE light is faster and cheaper than bullets, Garand automatic rifles placed in a new General Electric gage are precision-sighted in one-third the time used previously. Up to 13 rounds of ammunition are saved in setting the sights on each gun.

A "master" rifle, which has been correctly sighted by firing, is first placed in the gage, and the equipment is adjusted to conform to the bore directions and sight positions of this rifle.

When others are placed in the gage, the target optical system aligns them with the master by the use of mirrors.

Though built specifically for the Garand rifle, the gage can be adapted to sight other rifles.

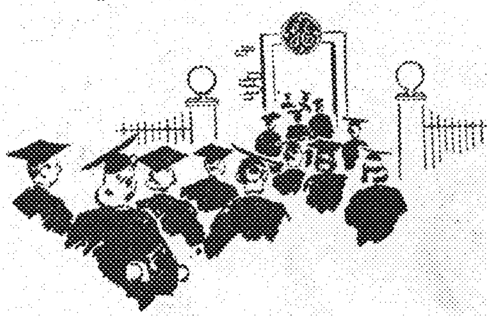


WIRED FOR WALKING

HARNESSING infantile-paralysis patients to a 12-element oscillograph is a new way of determining the presence of spasms in muscles—and in muscles formerly believed to be unaffected by the disease.

The oscillograph was developed at the University of Rochester School of Medicine. To obtain a record of the spasms, dime-sized resistance disks are applied to six points on the bottom of each foot, each disk connected to one of the 12 highly sensitive G-E galvanometer elements.

As the patient walks, the pressure he places upon each disk varies the current passed by each, and a tiny mirror in each galvanometer reflects a pin-point light beam. These beams strike a strip of photographic paper, producing 12 curves that reveal the function of six areas on each foot. The curves show the variation of the simultaneous pressure changes with 95 per cent accuracy and can easily be compared with records of normal walking.



MARCH OF MINDS

SEEKING new worlds to conquer, college graduates have flocked to General Electric and its associated companies until now their number totals 9222, comprising approximately five per cent of all men and women employees.

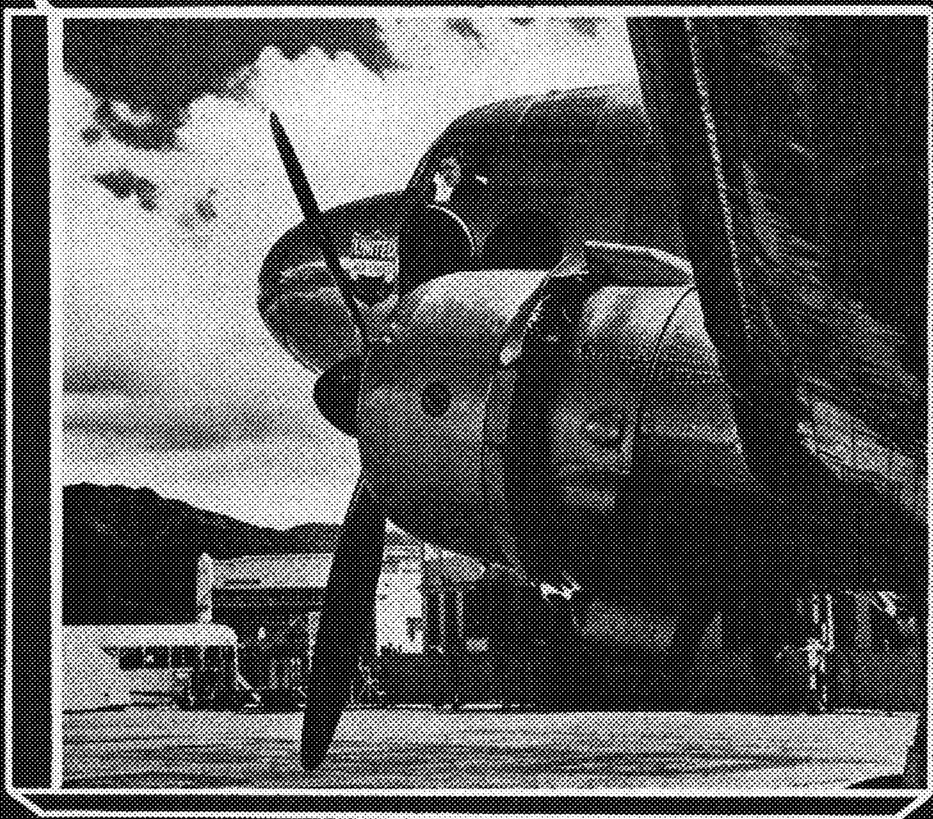
The opportunities to be found in industry have brought graduates from 325 American colleges and 34 foreign colleges, with 6000 degrees in electrical, mechanical, and civil engineering; 500 degrees in physics, chemistry, and other sciences; nearly 800 liberal arts degrees; and more than 1000 degrees in business administration. Law, medicine, agriculture, forestry, education, journalism, music, theology, and secretarial schools are all represented.

At the present time, 23 colleges and universities each have more than 100 graduates at G. E. *General Electric Company, Schenectady, N. Y.*

You are invited to listen to the "Hour of Charm" at 10:00 p.m. EWT Sundays on NBC and "The World Today" at 6:45 p.m. Monday through Saturday on CBS.

GENERAL ELECTRIC

TECHNOLOG



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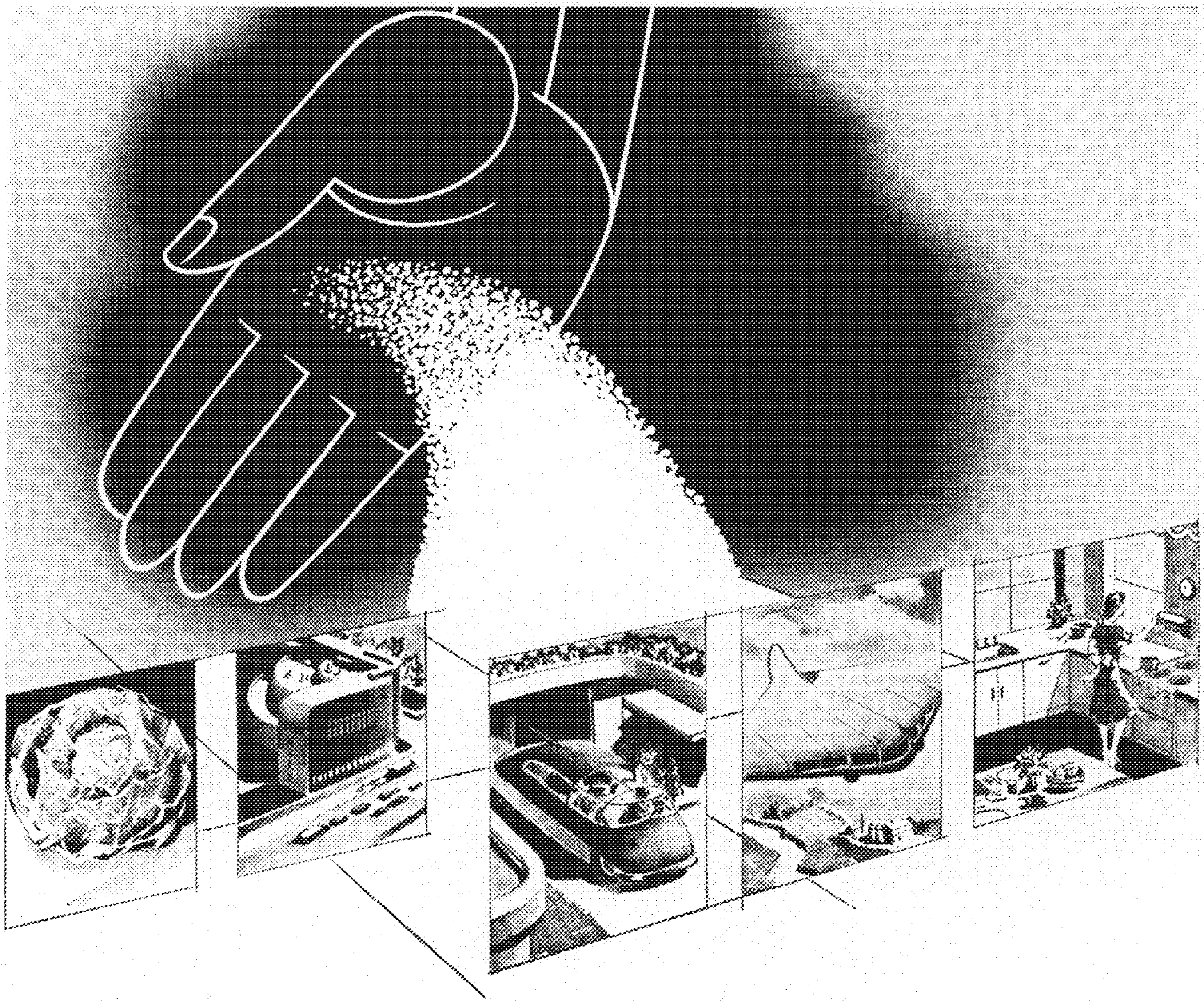
MINNESOTA



PLASTICS—*products of industrial initiative*

Plastics are a stimulating source of inspiration for architects and industrial designers in search of new ideas. When these intriguing materials are released from their military commitments, innumerable applications for the home fron will arise. No products offer a better example of how progress can be accomplished when industry is given free rein to its initiative.

As a producer of basic chemicals needed for the manufacture of plastics, Dow is in a particularly fortunate position to promote their development. Three major Dow plastics—Styron, Ethocel and Saran—have already been produced. They possess distinctive properties that permit a bewildering array of uses in almost every field of human activity. There are also varieties of Dow plastic materials for coatings, finishes and other purposes in the electrical, textile and many other industries.

These plastic products do more than supplant other materials. They are veritable points of departure that lead to fresh fields. When normal conditions return, self-reliant industry, expanding on its own resources, will develop and apply them for the greater well-being of all America.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

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DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND VICTORY

Here's <u>one</u> Nazi broadcast that's the Gospel Truth!

U. S. TANK IS BEST, SAY NAZI EXPERTS

Germany Will Doubtless Copy Gyroscopic Feature of General Sherman Tank, Berlin Radio Declares

By The Associated Press

A special new German institute for testing captured tanks has adjudged the American "General Sherman" the best type the Allies have turned out, the Berlin radio said yesterday, adding that the Nazis "doubtless" would copy its construction—particularly the gyroscopic gun-mount, which they consider its outstanding feature.

"Doubtless" Best Type

"According to the findings of the Institute," said the broadcast, recorded by the Associated Press, "the 'General Sherman' tank is doubtless the best type the allied armament industry has yet produced.

"A special innovation on this type tank, which by a gyroscopic system prevents the gun from being affected by the jolting of the tank when traveling on rough grounds, greatly interested the German experts. They believe this to be the first attempt at borrowing from the construction of warships for the construction of arms for warfare on land, and doubtless it will be copied soon."

When the German radio paid glowing tribute to the General Sherman tank—for once it was telling the truth.

You see, tank battles used to be stop-and-go affairs, because a tank's heavy cannon could be aimed accurately *only when the tank was at a complete standstill.*

That was bad—because every stop naturally made the tank a juicy target for the enemy.

Then the Army Ordnance Department called on American industry for the solution of this problem. So the men of Westinghouse went into a huddle. And out of it came what has been called one of the greatest military developments of this War—a tank gun stabilizer that permits *incredibly accurate fire while the tank is charging ahead at full speed over rough ground!*

And then, to button up the job, Westinghouse went into production on these gun stabilizers so fast and so thoroughly that almost before you could say "El Alamein," they were being produced in sufficient quantity to equip every American tank!

No wonder the Germans thought well of the General Sherman. And no wonder they considered its gun stabilizer its outstanding feature. For this one device has revolutionized the whole combat technique of tank fighting!

For us, tank battles are no longer stop-and-go affairs, with every stop offering the enemy a "sitting pigeon." American tanks are now more than 500% deadlier than ever before.

And the Westinghouse Research Laboratories, which developed the device—the Westinghouse engineers, who perfected it—and the men and women of Westinghouse who make it in great numbers—are proud as Punch.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Penn.

» » **Westinghouse** « «

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

this month

BY PAT MURPHY

Calling all engineers! Calling all engineers! In case you haven't noticed (but we're sure you *have!*), there are two beautiful secretaries working under your very noses, in the office of Experimental Engineering Building! They are Barbara Flory and Marion Edwards, the two best answers to any boss' prayer! Marion and Barb collaborated on the article on P———, —but we'll get to that in a minute. Barb, whom we interviewed first, was very gracious, and VERY pretty. She is statuesque, has light brown hair, blue eyes, and long legs. Ummmm! Marion is small and dark. She has black hair and brows and deep blue eyes. The peppy vivacious type. Judging from our wide experience with engineers, we knew you'd want all the delicious details! Both he-yoo-hoo-ties. Sigh!

MARION AND BARB

Where were we?—Oh—Marion's been working in there for four years, and "Barb" for one. "Stinky"—pet name bestowed on Marion when she graced Folwell's halls—graduated from our own Alma Mater—she majored in English here at Minnesota. English major serving time in Engineering Building! Incongruous? All her associates give an emphatic answer to this question—it is *No* with a capital N!!

Barb is a graduate of Minneapolis Central. During her school years there she wrote for the paper and the magazine. Marion was at one time a reporter on her home town paper, the *Sault Daily Star*, at Sault Sainte Marie, so as you can see, their article marks no debut. (Though the TECHNOLOG would be proud to sponsor two such femmes!)

Needless to say, the Army and the Navy appreciate Barb and Marion. Besides her secretarial duties Barb has become an advisor to the lovelorn bureau. Soldiers and sailors visit the office frequently to confide their woes to Barb and seek her advice. Which she *gives*.

Mr. William R. Mastenbrook, author of *Lithography,* knows whereof he speaks. He is a lithographer, and has been one for twelve years.

Because photography and lithography are so closely related, you might well expect photography to be another of Mr. Mastenbrook's hobbies. It is. He likes to get unusual shots from unusual angles of unusual poses. Loves to experiment with lighting, filters, meters, etc., etc., ad infinitum. He has excellent facilities for developing his own, too . . . he uses the dark room at the shop!

His other hobbies (he's versatile) are stamp collecting . . . he has a beautiful selection of U. S. stamps . . . mechanics . . . he likes to tear things apart, and put them together again . . . and bowling. Dave gasped in admiration, as he told of brother-in-law's bowling feats. Mr. Mastenbrook bowls every Saturday night without fail, averages 185, and breaks 200 at least every two weeks! He takes his wife with him and she's as enthusiastic about bowling as he is . . . but she seldom wins.

Their family is small . . . they have one daughter, thirteen.

Mr. Mastenbrook has very little leisure. In trying to keep up with lithography, photography, stamps and bowling, he has practically no spare time. The article on lithography is Mr. Mastenbrook's first break into print, and we know he must have sacrificed much of his precious time for us.

PHILATELIST TOO

Harry Brenner, the feature editor of our own TECHNOLOG, is one of the Authors of the Month. (No chosen connection with the Book of the Month Club.) The masterpiece on page 30, entitled *Into the Stratosphere* is Harry's brainchild.

Medicine and its relation to and with the air corps is a subject which has long interested Harry. He is widely read on the topic, and, besides his reading, Harry gets some "inside info" from a source which he refuses to divulge. Military secrets, huh?

All of which may seem slightly incongruous to engineering—but after all, a fella has to have some outside interests. And Harry has 'em. He's an active member of Sigma Alpha fraternity on campus, works on the LOG, is president of his local chapter of Junior B'nai B'rith, and—we thought we'd better lead up to THIS slowly and gently—is a connoisseur of women! (he thinks). He also likes fishing.

BEAUTY JUDGE

When he finishes college, the man wants to be a field engineer in some far-away place like South America, Russia or Alaska. He probably will be just that. He's the sort of person finishing what he starts, gets what he goes after, and, in short, achieves his goal.

The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The MINNESOTA TECHNOLOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

The purpose of the TECHNOLOG is two-fold: first, to put in the hand of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

MINNESOTA TECHNOLOG

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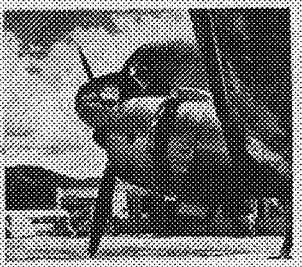

THE COVER. A United Airlines pilot takes a last look before taking off with a load of passengers on essential war business. United Airlines Photo.

FRONTISPIECE. A team of welders encircled by the frame of a 4,500 horsepower motor for a war-busy industrial plant. Courtesy of Westinghouse Electric and Mfg. Co.

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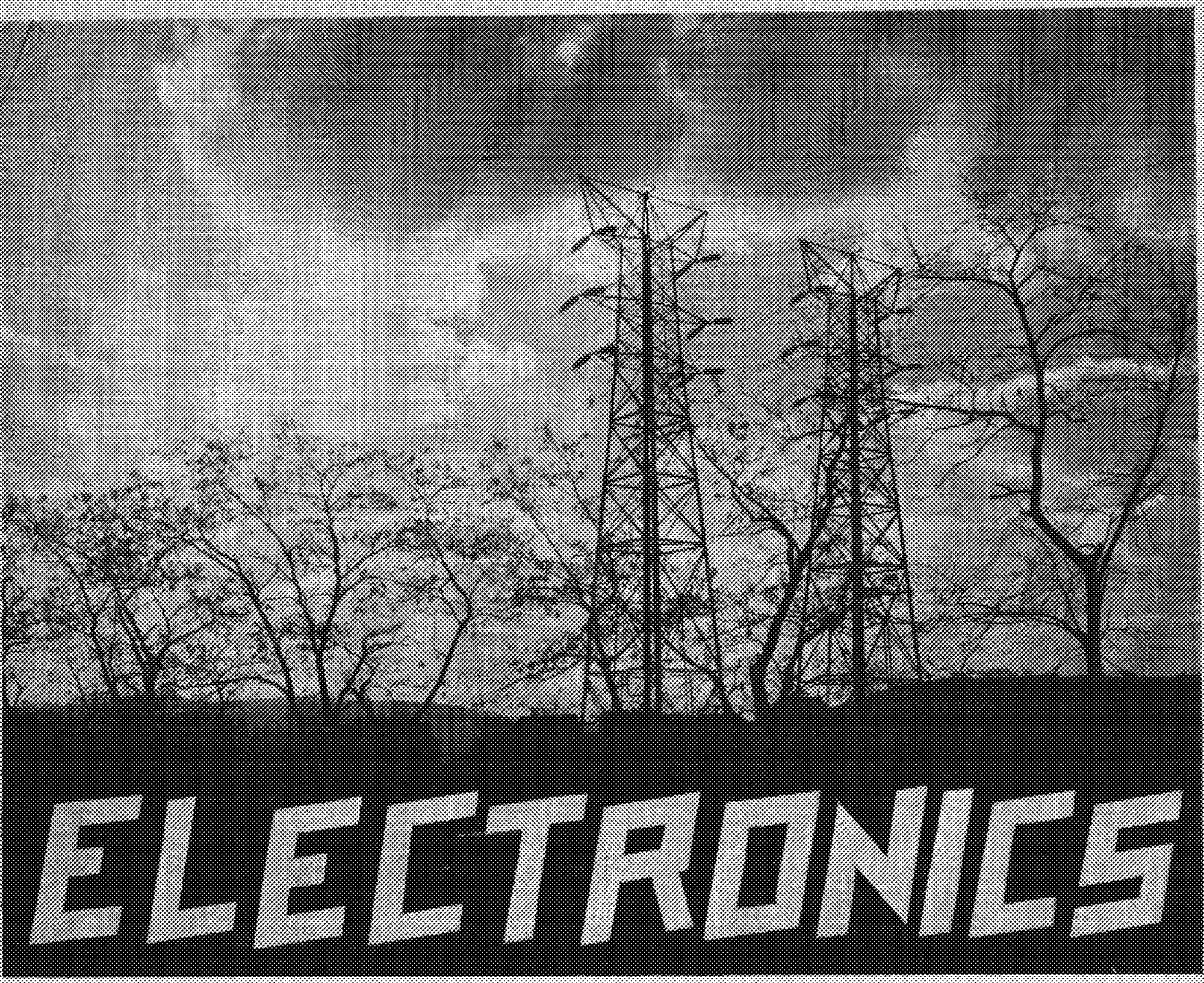


PHOTO COURTESY OF WESTINGHOUSE

BY
CARL J. MADSEN
ELECTRONICS ENGINEER
WESTINGHOUSE

The transmission line shown above is now being used more efficiently through use of carrier current relaying which depends on electronics.

TO many people the word "electronics" still carries with it the atmosphere of strange imaginary worlds, assorted eliptical orbits, weird atomic structures and other mystifying figures. To others, it conveys radio broadcasting and television. However, to those associated with the science of electronics for over a decade, this mirage is replaced by the mental picture of thousands of electronic devices in every-day use in our factories, mills, offices and homes.

There are probably as many definitions of the word electronics as there are individuals associated with its application. One definition is: electronics is the application of devices in which the flow of free electrons are made to perform such numerous functions or duties, as to rectify, amplify, generate, control, convert light into current and current into light. The necessary tubes may take the form of diodes, triodes, ignitrons, pentodes, beam power tubes, thyratrons, phanatrons, kenatrons, photo tubes, cathode ray tubes and so on. A brief study of the application of these hundreds of types of tubes shows that the science of electronics is not new. It also shows that the future possibilities are extremely important in that hardly a week passes without the development of new tube types or new combinations of tubes and circuits to perform new functions.

Early activity with electronic tubes led to the creation of radio station KDKA, the pioneer of our present-day broadcasting. The development by Westinghouse of high-power, air-cooled, radio transmitters, made possible by high-power, air-cooled electronic tubes, undoubtedly aided in the development of high-power tubes for use in Radar equipment. But the activity was not confined alone to the broadcasting field as shown by a number of important Westinghouse contributions such as the Ignitron tube, Weld-O-Trol, Ignitron welding timers and numerous electronic control devices used in many of our industries today.

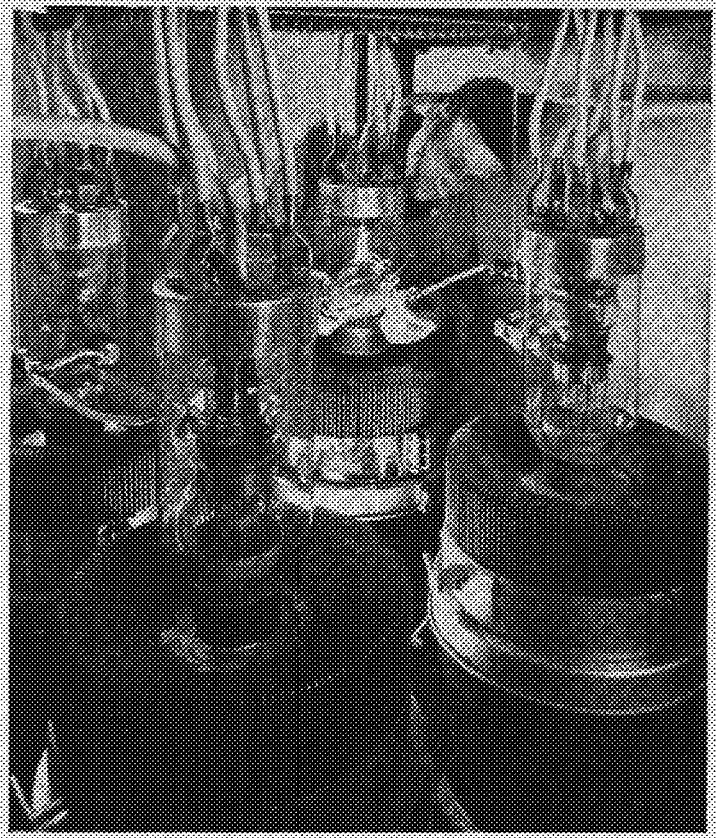
The developments of electronics can best be explained by breaking down the applications into these nine classifications:

Rectification
Inversion
High Frequency Heating
Communications
Measurements
Control
Inspection and Sorting
Precipitation
Radiation

There are two fields which have been important in past years in rectification. The first is power rectification. The second, high voltage rectification, is important in that it is frequently employed as a means to an end in many other types of electronic equipment, such as, power supply for high frequency oscillators, Radar, communication equipment, measuring equipment, and our broadcast receivers and transmitters. Rectification will have an important position in most of the electronic devices which may be developed in the future because of the nature of electronic tubes.

At the present time relatively little work has been done in the use of inversion principles. A few particular applications in the conversion of 25 to 60 cycles and vice versa have been made. However, the use

TUBES FOR NAVY RADIOS. One of the many electronic devices required by a modern war, these high power radio transmitting tubes enable instantaneous ship-to-shore communication.



SPARE TUBE CHANGER. By means of a push-bottom relay, defective 50,000 watt modulator tubes are replaced with spares during transmitting periods. Two of the tubes shown are spares.

of inversion will become increasingly important to a number of industries in the future as a source of variable-frequency, a-c power which provides a means of variable speed control for drives employing a-c motors. It should be extremely useful in the operation of certain high-speed machine tools for variable-speed control.

High frequency heating was the subject of much experimental work more than ten years ago. Experiments were conducted at that time in the heating of various materials such as plastics, bonds, food, metals, cements and for the extermination of bugs and larvi. Excessive cost caused by misapplication or misunderstanding of some of the limiting factors proved some of these applications unpractical. However, a number of these applications have been brought to the fore-front recently and will undoubtedly become increasingly widespread in their application in the future.

Some of the present applications employing dielectric heating are the bonding of plywood and the heating and curing of plastic materials. Dielectric heating has its important application where thick sections of plywood, thermo-plastic or thermo-setting materials are involved. The development of thermo-setting bonding materials now permit fabrication of thick sections of plywood in the matter of three to five minutes. Hours were required with steam or other form of heat. The same is true in the heating and curing of plastics. In addition to speed, the electronic method does a more thorough and uniform job. High frequency heating is bound to have an important position in the future in both the plastic and plywood industries.

To date, induction heating has been limited primarily to those particular applications important to our war program. After the war is over and the limiting restrictions of supply have been removed, hundreds of new high frequency heating applications important to the steel, aluminum, and tool and general manufacturing industries will be found for electronics.

In the field of communication considerable prophecy has already been made by many leading authorities on frequency modulation, television and broadcasting. Important developments in the past year or so will lead to vast expansion in the number of frequency modulation and television sets. Even in our present broadcasting field the trend of ever-increasing power leads us to predict the building of "super-power" broadcasting stations of 750,000 to 1,000,000 watts output.

Carrier current transmission, a less known phase of communication, has found increasingly wide application in the past few years. Its use in connection with protective relaying has permitted the capacity of our present power lines to be increased over 50 per cent, with a comparable saving in vital copper and other critical materials. Telemetering, or the remote indication of circuit and plant loading to a central dispatcher in the power distribution system is another application of carrier current developments. This application facilitates the economic operation of power generating systems. As the power needs of the country grow, this industry will find some of the wartime developments in electronics ready to assist in their problems.

In the field of electronic devices for making measurements, a number of developments have been made in the past few years. These developments include dynetric balancing, the electron mass spectrometer, cathode ray, stroboglow, micrometers and many others. Dynetric balancing is highly important today as it measures and locates the position of off-balance components of all types of rotating parts from the tiny aircraft instrument gyros weighing less than a quarter of a pound, to the massive marine gears weighing over 80 tons. In the conventional sizes, rotors weighing from ½ pound to one hundred pounds are often balanced in less than 15 seconds. Former methods required more than one hour. Off-balance components producing vibrations of as low as three thousandths of an inch can be accurately measured electronically and the position for a balancing weight located within two degrees. This development will be of increasing importance in years to come in helping to build longer life machines with quieter and more dependable operation.

The electron mass spectrometer, developed by Westinghouse, is a device for the rapid analysis of chemical compounds. At the present moment its most useful application appears in the petroleum and synthetic industries where hydro carbons and other compounds associated in the production of synthetic rubber and motor fuels require close control. At the present time samples equivalent to 5 cubic centimeters at atmospheric pressure are qualitatively and quantitatively analyzed with an error in accuracy of less than 1 per cent. More important is that these analyses are often completed in less than 15 minutes where former methods often took at least a day. The mass spectrometer will be adaptable to many other industries in the future as a means of close control in critical processes. It is even possible that the principles of the mass spectrometer may be extended to the actual production of rare elements.

A few other electronic measuring devices made by Westinghouse are cathode ray oscilloscopes, stroboglow, speed indicators and micrometers.

In the field of control apparatus Westinghouse has been active for many years producing electronic lighting controls, photo-electric devices, smoke recorders, resistance welding controls and motor speed controls. In resistance welding Westinghouse is at present producing many welding timer units for use in plants welding vital plane parts. As new technique in welding procedures are established, welding control and sequence timers will play an increasingly important part for these operations.

A rather recent development has been the Mot-O-Trol, an electronic device which permits the operation of d-c motors from an a-c power source. With a wide range of speed control, good speed regulation and current limiting acceleration. The speed is controlled with precision from a remote pushbutton station that permits the operator to maintain instant control at all times. At present, it is built in sizes up to 15-hp, with larger ratings probably soon to come. In machine shops and the machine tool industry this means increased production and superior products. Other devices such as register regulators, voltage regulators and speed regulators will become common practice in the printing, steel and paper mill industries.

Many types of electronic equipment have been developed for use in the inspection and sorting of products in a diversified group of industries. Industrial X-ray, for instance, is at present applied for the inspection of armor plate, welds, airplane parts and other equipment, spotting certain defects which might otherwise escape notice. In peacetime the advantages of this type inspection may result in safer, lighter automobiles, trucks and planes as unnecessary safety factors for unseen defects can be avoided.

Photo-electric devices in applications such as pin hole detectors permit the rapid inspection and automatic sorting of prime and defective sheets. Defects which often escape visual inspection are spotted faster than the combined work of a dozen employes. Simple operations such as high speed counting and the control of conveyor lines are applications which are in operation today, but which undoubtedly will be extended to many other industries in the near future.

The precipitation of dirt and dust particles, fumes and smoke has had an important place in a number of industries, such as film processing laboratories, precision instrument factories and arsenal plants. In the machine shops a Precipitron has removed as much as 4 gallons of oil a day from the air surrounding a high speed lathe, oil which otherwise settles on the light, walls and equipment as well as in the lungs of the workmen. It is quite probable that a Preciptron for the home will soon be available to remove irritating pollens as well as dust and germs from the air which we breathe. Even the smoke from combustion gases may be removed from our chimneys to make our homes and communities cleaner places in which to live.

Light radiation is sometimes questioned as to its position in the electronic field. Fluorescent lights producing more than twice the number of lumens per watt than our filament incandescent lamps are being used in increasing quantities in factories and homes. A slight variation of the same principles of operation may be more important in our daily life than the fluorescent light. This device is the Sterilamp, a source of ultra-violet radiation that has the property of destroying many types of bacteria. The demand has been so great that production has been unable to keep pace. Its applications are so universal that it is not improbable that our homes, refrigerators, laboratories, meat storage and curing vaults, food processing and handling industries, public meeting places and so on will be completely equipped in the future.

Radar, the great development of this war will have many applications to the transportation industry when the demand for military equipment has passed. Our planes will fly in greater safety, our liners dock at their berths without delay even though fog shrouds the course to be covered. The location of every mountain, plane, boat or rock within the danger area will be instantly known to the controlling personnel. It may be used on railroads, reducing the hazard of collisions.

It is not possible to anticipate all the future developments made possible by electronics. The possibilities are beyond imagination. However, many applications exist where electronics can do the work better than other types of equipment, do some things not possible in any other way. But electronics cannot do everything. Many possible applications are not economical or practical. With electronics now on the tip of every tongue it is essential that every experienced electronics engineer weigh carefully every request, every possible application to avoid misapplications which may lead to delay in acceptance on jobs it can do well.

The vast production capacity developed to meet present wartime requirements will place electronics in the position to serve the needs of the postwar world, but our development effort and production facilities must be used wisely. It is important that we "keep our feet on the ground" lest the electronic field again be smothered by adverse publicity caused by misapplication. Westinghouse has and will continue to contribute to the expansion of electronics and its application to the service of man, keeping "Electronics at Work."

TESTING A MERCURY VAPOR LAMP. These lights which are used extensively outdoors, are dependent on the same principles as radio tubes for their operation.

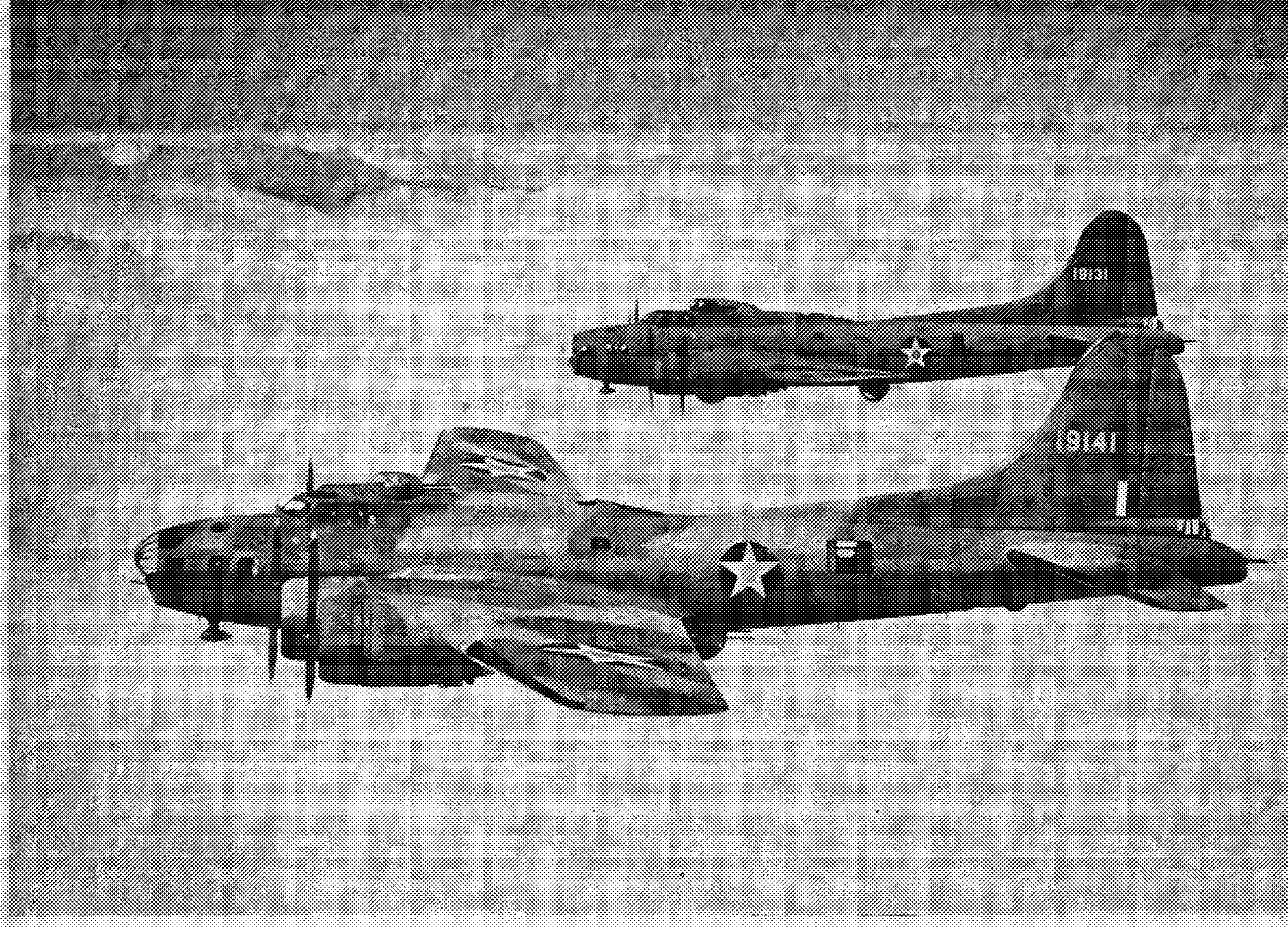


PHOTO COURTESY OF ALUMINUM COMPANY OF AMERICA

INTO THE STRATOSPHERE

For High Altitude Research

BY HARRY BRENNER, AERO. E., '45

The successful daylight bombing raids by the Flying Fortresses are carried out at high altitudes and would not be possible without oxygen units for the crew.

THERE'S another plane off the assembly line and here comes another pilot to man that plane. He's a skilled pilot—he's a healthy pilot. He is confident, and people have confidence in him. He just wasn't chosen at random though—there is a story about how pilots are chosen—the story of aviation medicine.

It was on June 5, 1783, in Annonay, France, that the first balloon rose from the surface of the earth. This balloon was unmanned. It was then that the question arose whether or not man could stand the ascent into the upper reaches of the atmosphere. That is where the history of aviation medicine begins. On September 19, 1783, another balloon rose, with a ram, a cock, and a duck as the pasengers. A few weeks later the first human being went up in a balloon. However, no ill-effects were incurred as the warm air balloon was unable to rise to a very great altitude. It wasn't until the hydrogen balloon was invented that high-altitude flights could be attempted. In 1875, Croce-Spinelli, Sivel, and Tissandier rose to a height of 29,000 feet in a hydrogen balloon. Only Tissandier survived. It was seen that the effects of altitude would have to be overcome if we were to conquer the air. Research was done by doctors who scaled great mountains in answer to their queries. But it wasn't until the advent of heavier-than-aircraft that work on altitude research was speeded up. As a result of this research, new fields dealing with the effects of speed and acceleration were uncovered. By 1913 the plane had already risen to heights that had caused trouble to those in free balloons because of lack of oxygen. Other problems presented themselves. The effects of atmospheric pressure, cold, rays, on sensation and perception, were noted. Work was started almost immediately to see what could be done to overcome these obstacles.

It was evident that only the most perfect human specimens could be trained to be pilots.

Statistics released by the British War Ministry for the years 1914 to 1915 showed that of all the aviators killed, only 2% died by enemy bullets, 8% were lost on account of aircraft failure, and 90% of the losses were attributed to physical or psychological failure. The next year, when only physically fit men were selected for pilot training, did this situation improve.

After the first world war, as the aviation industry grew, research in aviation medicine was further intensified. Remarkable discoveries were made until now we have the answers to many of the problems that annoyed us just a comparatively short time ago.

It was the lack of oxygen at great heights that was the cause of many a physical failure which led to disaster. Oxygen is carried to all parts of the body by the red blood cells. These cells are saturated with oxygen in the lungs to about 95% at normal sea level. With this oxygen saturation, all the senses and reflexes are normal. But with an increase in altitude the oxygen supply cannot keep up with the demand for oxygen, and the first physical effects of altitude are noted. The oxygen saturation decreases and the reflexes become slower. Also with this increase in height and lack of oxygen saturation the pulse rate increases. The heart pumps more blood in order to overcome the oxygen deficiency. The deficiency cannot be overcome and some of the various organs soon feel the lack of oxygen. The brain is the first to be affected. Then the muscular strength decreases starting at about 13,000 feet up until about 25,000 feet when it drops off abruptly. Attentiveness and perception fall off and the senses become numb. An example of this is the unintelligible handwriting of a person at about 20,000 feet. There is a great strain on the heart that sometimes may be fatal.

With the increase in altitude, there is a decrease in atmospheric pressure that affects the body in a "mechanical" fashion. The volume of a gas is proportional to its pressure. With a decrease in pressure the volume will become larger. Thus if there is any gas on the stomach, such as an ulcer, the gas will expand, corresponding to an increase in altitude. The same holds true for the mucous membranes for anyone that has a cold or sinus. If any gas is trapped in a tooth, expansion of the gas will produce pressure on the nerve and cause a severe pain.

Another cause of trouble in the past has been the great amount of pressure or centrifugal force that is exerted on a pilot in a dive. The force is usually enough to push the pilot through an ordinary seat. This tremendous pressure acts on the outside of the body as the normal blood pressure remains the same. The difference in pressure inside and outside the body and the acceleration of the plane affect the blood in such a way that the specific gravity of the blood during the dive is equal to the normal specific gravity of the blood, times the acceleration of gravity. Thus at an acceleration seven times that due to gravity the blood is almost as heavy as iron. The extreme pressure due to centrifugal force in a dive is sometimes enough to collapse the veins and displace blood to the legs. With this fall in blood pressure the vessels leading to the eyes collapse and no blood is pumped into the eye. This results in a blackout until the acceleration ceases. A blackout can be fatal in a dive unless some automatic control is provided to pull the plane out at a specific height.

OFFICIAL PHOTO U. S. AIRFORCE

PORTABLE OXYGEN UNIT. The small walk-around bottle provides a 4 to 8 minute supply of oxygen and enables the user to move around in a plane at high altitude.

All these problems once faced the doctor, but not any more. Medicine, in association with engineering, has conquered the troposphere and has reached the stratosphere. Now, modern oxygen masks give to the pilot the vitally needed life gas that is so conspicuously absent upstairs. Pressurized cabins in passenger planes keep the passenger as comfortable at 15,000 feet as he would be on the ground. The invention of the negative pressure chamber enables us to test prospective pilots to find at what altitudes they can be useful, without the use of an oxygen mask. In the negative pressure chamber, conditions can be stimulated to any desired altitude, by withdrawing the air in the correct amounts and reducing the temperature. Without leaving the ground, it was found that the effects of altitude were first felt at about 13,000 feet and that the limit of endurance was about 25,000 feet. This convenient chamber has given us a method of research that has saved many lives and has advanced the progress of aviation by many years. And in the dive bomber the use of a tilted seat, automatically controlled by the acceleration of the plane pulling out of a dive, has eased the pressure on the body due to centrifugal force, as the force now acts at right angles with the longitudinal axis of the body.

There is no telling what the engineer-doctor team may accomplish. Already they have won the fight against many previously unsurmountable odds. But is is certain to say that the future does look promising for high flying aviation, thanks to those men who are always there, but whom we never see.

HIGH ALTITUDE TRAINING. A Navy doctor is administering oxygen to a cadet who passed out when simulated oxygen and pressure conditions at 18,000 feet were reached in the test chamber.

OFFICIAL U. S. NAVY PHOTOGRAPH

An Air Pirate

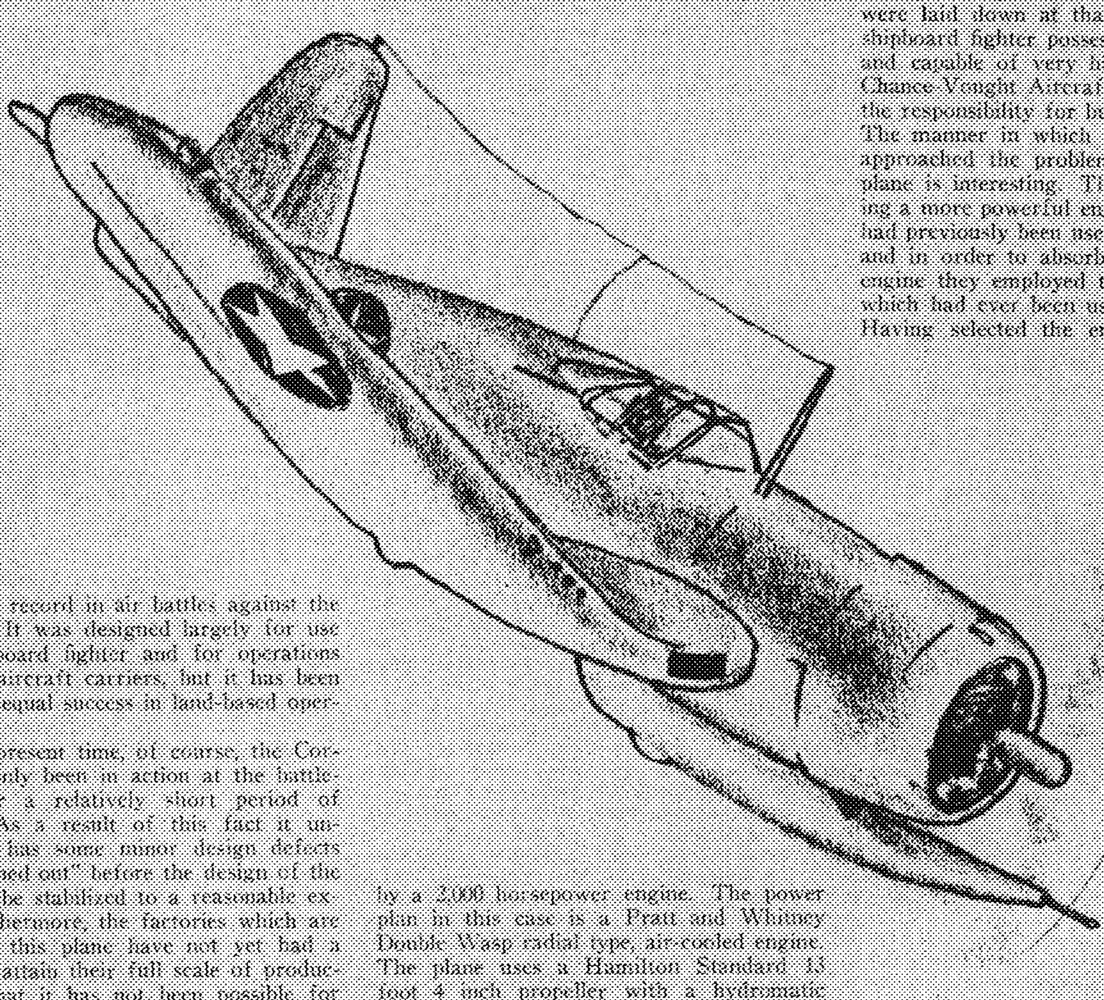
THE CORSAIR

BY DANIEL MOTL, B.M.E.

ONE of the newest and probably the best fighter plane now in action with America's naval air forces is the Chance-Vought "Corsair," designated the F-4-U. This plane was first put into combat service with the Navy in the early part of 1943 and has seen action principally in the Pacific theater of war where it has already begun to roll up an impressive record in air battles against the Japanese. It was designed largely for use as a shipboard fighter and for operations based on aircraft carriers, but it has been used with equal success in land-based operations.

At the present time, of course, the Corsair has only been in action at the battlefronts for a relatively short period of months. As a result of this fact it undoubtedly has some minor design defects to be "ironed out" before the design of the plane can be stabilized to a reasonable extent. Furthermore, the factories which are producing this plane have not yet had a chance to attain their full scale of production, so that it has not been possible for the Navy to use this plane in as large numbers as some of its other fighter planes, such as the Grumman "Wildcat." Nevertheless, the Corsair has already received a large number of enthusiastic compliments from many different sources. Navy pilots who have used the plane themselves are unreserved in their praise of its fighting qualities. Many of these pilots have expressed eager anticipation of the day when they will be able to fly this fighter plane against the Japanese Zero in large numbers. Officials of the Navy and the Army who have witnessed flight tests of the Corsair have expressed the belief that the plane is capable of making history as a fighter and have predicted that it will play a leading role in smashing Axis air strength.

The Corsair was designed and built by the Chance-Vought Aircraft Company of Stratford, Connecticut. It is the American Navy's only fighter—in fact, the only naval fighter plane in the world—to be powered



by a 2,000 horsepower engine. The power plan in this case is a Pratt and Whitney Double Wasp radial type, air-cooled engine. The plane uses a Hamilton Standard 13 foot 4 inch propeller with a hydromatic type of constant speed pitch control. It is capable of flying at speeds well over 400 miles per hour in level flight, although its exact top speed, of course, has not been revealed. Some Navy officials, however, have called it "the fastest fighter plane in the world." It is also a well-known fact that the Corsair is capable of operating efficiently at higher altitudes than any other Navy fighter. Furthermore, it has been built with terrific fire power, although the exact number and size of its guns is another military secret. All of these extraordinary features together give the Corsair a combination of speed, ruggedness, maneuverability, hitting power, climbing ability and altitude performance which are probably not equalled by any other naval fighter which has yet seen service in this war.

This plane was built in response to specifications set up by the United States Navy two years ago. The requirements which were laid down at that time called for a shipboard fighter possessed of great power and capable of very high speeds, and the Chance-Vought Aircraft Company accepted the responsibility for building such a plane. The manner in which their engineers first approached the problem of designing this plane is interesting. They began by selecting a more powerful engine than any which had previously been used in a fighter plane, and in order to absorb the power of this engine they employed the largest propeller which had ever been used on such a plane. Having selected the engine and the propeller, they then proceeded to design the fuselage, and this portion of the plane was made as small and slender as practical considerations would permit in order to contribute as much as possible to the speed of the plane.

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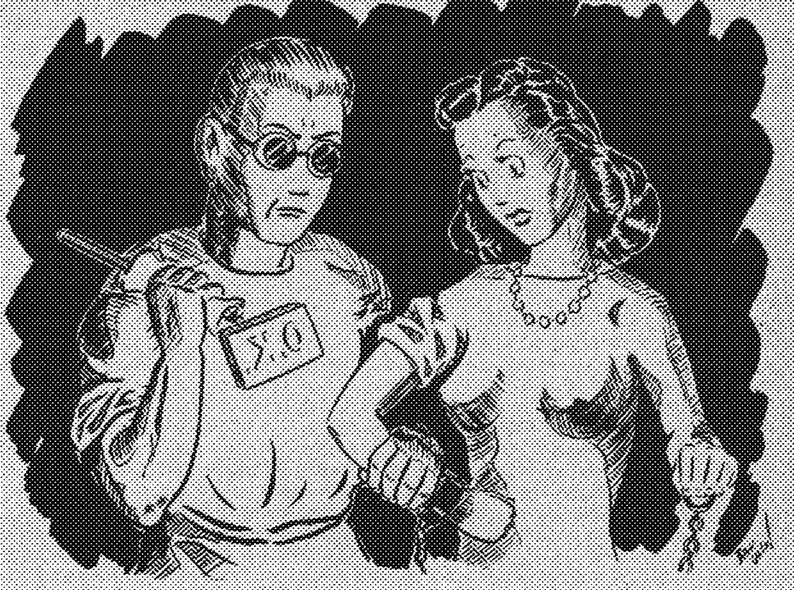
How Green

MY SECRETARY

BY BARBARA FLORY
AND
MARION EDWARDS



Operating in strictest secrecy, the F.B.O. of the Institute of Technology has combined diligence and esthetics in its major task of selection of secretaries. Only because of its belief that this policy is a morale-builder and cannot be kept from the public in time of need of morale-builders has the F.B.O. determined that it should make the following announcement:

"Hello!"

Thus having exposed itself, the society's entire organization must be revealed.

In the belief that they were being hired because of their aptitude and ability in business subjects, girls have unwittingly gone through a battery of tests designed by Reddy Kilowatt and "Snerdie" Sliderule to select secretaries with the greatest adaptability to engineers. From the Employment Bureau the unsuspecting female applicants for office work are directed to take tests measuring their capacities and knowledge. The F.B.O. has long had a guide appointed to snare these applicants as they leave the Bureau.

"I'll show you the way," he whispers, and the applicant, her heart thumping, follows him. She is taken completely unawares, and the question has been raised as to whether the F.B.O. is entirely fair in its policy at this point; for the guide does not carry a sliderule, and thus might be taken for any normal student.

The guide (whom we shall call "Guy" for short) takes the girl's hot little hand in his and says,

"What about a coke first?"

"Are you kiddin'?" says the girl. (Note: Only later does she discover that he is, and that the bill for the cokes is in her hot little hand. Many girls have been eliminated by this test, the purpose of which is to determine whether, as a secretary, she will be willing to keep the students in cokes.)

From the cokes to the Electrical Engineering Building, Guy and the girl walk slowly past a group of Civil Engineers, who survey the set-up in an un-Civil manner and take quick notes in their books. Invisible lines are drawn tightly across the sidewalk so that the girl stumbles and plunges into the trap on the other side. (Note: The F.B.O. is unwilling to state whether the next part of the test was patterned after the Excelsior Fun-House or whether the Fun-House was patterned after the next part of the test. There are both sides to the question, according to "Snerdie" Sliderule.)

Stumbling through the Electrical Engineering laboratories, the girl is shocked frequently. If she is not swept away by the current of events, she is finally placed under the Kiss-O-Meter while the Senior Class practices for Engineer's Day next spring. Substitutes are made for "X" in the formula which the F.B.O. has evolved, and a curve is plotted. Everything being equal, the girl is permitted to pass from the portals of the Electrical Engineering Building.

The girl is rushed from the Electrical Engineering Building to Chemistry, where thousands of students are making H_2S. Common reactions to this for the girls are:

1. To press a vein in their wrists and disappear;
2. To express a preference for Electrical Engineering;
3. To ask, "What's cookin'?"

Those who disappear are crossed off the list; those who express a preference for Electrical Engineering are crossed off the Chemical Engineer's list; and those who ask, "What's cookin'?" are shoved into the next part of the test.

From the back door of the Chemistry building, she is pushed along by Mining Engineers with little picks and small horns on their heads into Appleby Hall. (Note: The resemblance of these students to what you're thinking is purely intentional.) She walks over beds of hot anthracite (coals, to you) while the students, swinging their lanterns and various other things, prance about her, shouting, "Let's dig it!" When she is done to a turn, the boys watch her warily. If the turn is in the right direction—namely, bringing her to their feet—they bare their soles to her and point with their toes to the next test.

This section of the test has been arranged to take place between classes in the corridors of the Main Engineering Building. The students have a curious custom which has been practiced for centuries.

(Continued on Page 42)

LITHOGRAPHY

Chemistry's Art

BY WILLIAM R. MASTENBROOK

YOU'VE probably never heard of him, but you are subject to his influence every day—through the medium of most of the colored prints and calendars you look at. His name was Alois Senefelder. While George Washington was paddling around on the Potomac and deservedly earning the title Father of His Country, young Alois was fiddling with experiments which paved the way to a modern process of reproduction to which no end of progress is in sight—and meriting a similar title: father of modern lithography.

Senefelder was an ambitious playwright. His trouble lay in the lack of a suitable method to reproduce his works in printed form, for in those days printing was accomplished by means of an expensive process involving type cut from wooden blocks—a situation not amenable to the pocketbook of a struggling writer. In casting about for a cheaper means of publishing his plays, Senefelder hit upon a new idea. He found that by polishing the surface of a limestone found in Bavaria near Munich, where he lived, he was able to draw a clean image on the stone. His medium was a liquid similar to modern opaque and is known today as lithographic tusche. To this first lithographic plate of Bavarian stone Senefelder applied *aqua fortir* (nitric acid). This preparatory coating reacted so that when he rubbed ink over the stone it adhered only to the surface where he had placed the image and was repelled from the remainder of the stone. Pressing paper against the stone, Senefelder was able to transfer the image in a clean reproduction. By repeating the process, he obtained as many copies as he needed.

Thus, lithography was born; but it was a commercial failure owing to the necessity for repeated polishing of the stones. Too, their great weight made them unwieldy to handle. Since Senefelder's time, the theory of the process has remained unchanged, but chemical research laboratories and industry have made lithography the practical and inexpensive medium of reproduction that it is today.

Two innovations are largely responsible for the current success of lithography: metal plates and photography. Metal plates have led to the development of high speed offset presses, since such plates may be curved to fit in place on a press cylinder. Zinc and aluminum are chiefly used for plates, although experiments with monel metal and stainless steel promise great advances in the future. Zinc plates, most commonly used, contain copper, silver, arsenic, bismuth and magnesium. Rolled in sheets from .0011 to .0015 of an inch and given a mechanical graining to make their thickness and cut to press size, they are surfaces receptive to the printing image. Surface grain is provided by a vibrating machine in which the plate is covered with an abrasive mixture of fine silicon carbide or quartz sand. Steel, glass or wooden marbles travel over the metal as the machine vibrates, pushing the abrasives about the plate and developing a perfect, evenly-grained surface. After graining, the plate is ready for use, and pains are taken to prevent unnecessary oxidation which might make the surface unsuitable.

Senefelder's tedious method of creating the image on the surface of the plate has been supplanted by a simple process—photo-lithography. Almost any type of copy, whether in one or several colors, can be photographed by means of lens filters. The negative obtained is used in making an albumen plate. For the deep etch plate, a positive of the negative is required.

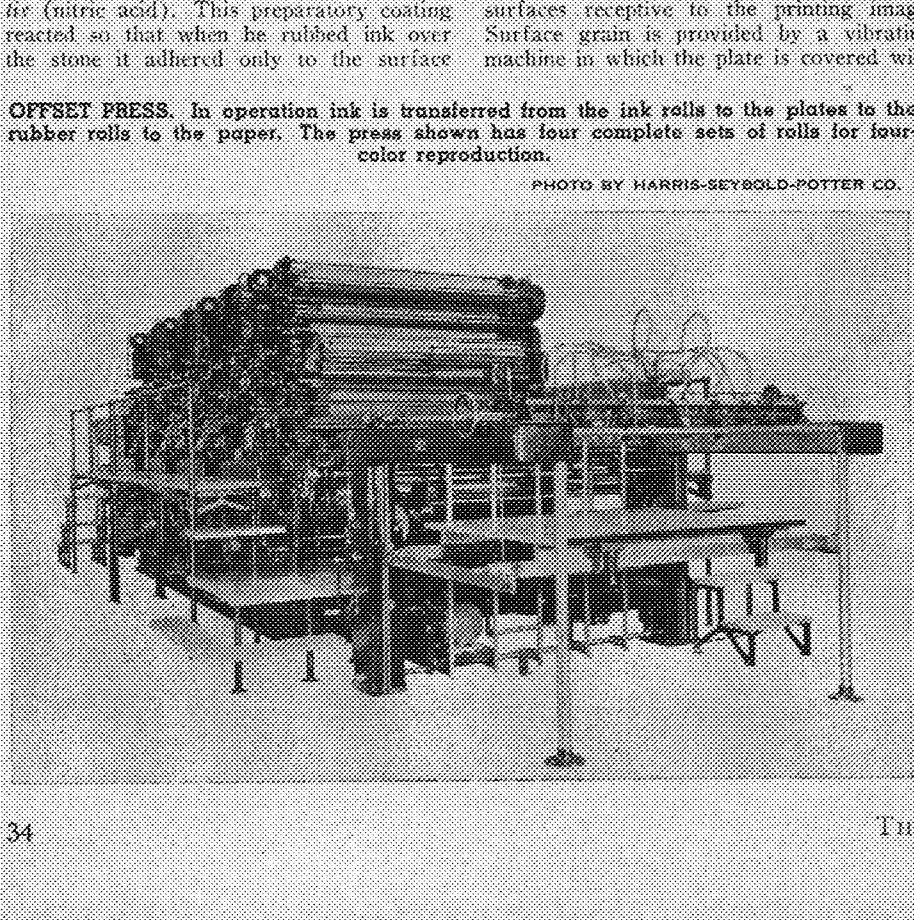
The albumen plate is commonly used, quick to make, but is generally weaker than the deep etch, and is consequently used on shorter runs. It is given a counter etch with solutions of alum, and acetic and nitric acids to sensitize the zinc. A coating of chromated albumen follows, consisting of ammonium bichromate and water to which is added egg albumen or a synthetic made from milk or soy bean casein or a petroleum residue. Egg albumen is subject to fluctuations in temperature and humidity and must be kept under refrigeration or mixed fresh daily. Use of synthetic albumens has aided materially in overcoming this problem and has the added advantage of being slightly more resistant to acid etches employed to keep the plate in printing condition during the actual press run.

These albumen coatings render the plate, when dry, highly sensitive to light. The emulsion side of the negative is now placed against the coated surface of the plate and kept in perfect contact by means of a vacuum printing frame while the plate is exposed to carbon arc lamps or mercury vapor bulbs. Proper exposure hardens the coating on the plate wherever light has passed through the negative. Areas of the plate protected by the opaque parts of the negative are not affected. After exposure, the plate receives a thin rubbing of developing ink to give the hardened image an ink-attractive surface. A water wash dissolves and removes all albumen not exposed to the light, leaving the hardened image alone on the plate. Desensitizing etch applied to the surface leaves the non-printing areas resistant to ink. The etch is composed of tannic acid, technical phosphoric acid, potassium chrome alum, water and gum arabic. It is followed by a coating of gum arabic, sparingly applied and fanned dry

(Continued on Page 40)

OFFSET PRESS. In operation ink is transferred from the ink rolls to the plates to the rubber rolls to the paper. The press shown has four complete sets of rolls for four-color reproduction.

PHOTO BY HARRIS-SEYBOLD-POTTER CO.



THE UNCIVIL CIVILS

BONG! Bong! The old saw gong again shattered the gray, early morning stillness of Cass Lake this year and slowly—very slowly—penetrated its sound into the ears of thirty-two hard-sleeping civil engineers.

—Hmmmm! Sounds romantic, doesn't it? Well, it wasn't. It merely meant that these said engineers had to forsake the comfort and bliss of their warm, cozy cots for the torture and shivering of their cold, damp clothes to prepare to herald the yet undawned day with roll-call.

However, spirits and body temperatures rose as these engineers ate a hearty breakfast. (Even the sun rose at breakfast time.) By the time everyone had stowed away his cereal, coffee, bacon, and four or five flap-jacks, the atmosphere was as congenial as that of a cocktail party.

Immediately after breakfast they all gathered around the bulletin board to see what were the orders of the day. You see, each engineer, in the four weeks of camp, does 7 or 8 jobs which are done by groups. In these groups, his position is rotated daily so that he never has the same job two days. After finding out what the job was, he checked up on the fine points in a confab with either Prof. Zelner or Prof. Boon.

It should be here said that Prof. Zelner and Prof. Boon did a swell job in handling the camp by themselves. Usually, there are one or two more much-needed instructors. But this year, due to the fact that all the eligible instructors either had Navy classes or were otherwise tied down to the campus, these two men had to do the work of three.

Once in the field, the engineers did such jobs as making a traverse and profile of the two railroads which run through Cass Lake, running a triangulation from point to point on the lake, running precise or differential levels, stadia, or topographics, and laying out a spur line between the two railroad tracks. But these jobs weren't so bad. It was the job of "shooting" Polaris that bothered the engineers. This job had to be done after sundown!

"After sundown" meant that the camp really came to life. It was at this period that the best work of the day was done in typical engineer's style. Making a traverse from the "Bee Hive" to the "Red Rooster" was a job that took many of the engineers all their free nights of the camp period to run. But the results of this traverse were highly favorable.

Others in the camp showed their culture and refinement by vying with Rembrandt and DaVinci in the art of painting. They painted the water tower so well that by the time the camp ended the townspeople began to ask when the tower would be painted!?!

Bob Kimball and Jim Haining were the only overnight guests at Star Island this year. They still maintain that the wind was too high and the lake was too rough for them to return to camp. But rumor has it that there were two girls from the "U" living on the island. Anyhow, we can't say. We don't know. Besides, we can prove nothing.

No camp in the North Woods is complete without a few Paul Bunyans. This year there were seven in camp—seven magnificent growths of beard! A healthy growth on any one of these seven furnished him with 24-hour meal service, because any splashed morsels of honey or syrup readily collected in the matted balls of fur. The fur-lined teacup (first prize) went to Ed Gilkey for his lush growth including a variety of colors and an excessive quantity of Tom's best custard pie.

Tom and Carl's eatery, frequented each morning and evening, increased the avoirdupois of the entire camp by some 300 odd pounds. Aside from the fact that there was so much pork that eventually everyone punctuated the ends of his sentences with an "Ughnn," no one would have ever guessed that food rationing was in effect. The meals were superb. It has been tough on the boys to get back to civilization—they can't get enough to eat at home!

"Eeek! There's Church! Let me at him!" It was such a cry that greeted poor, woman-hating, quiet Dave each time the girls at the "Crimson Fowl" saw him come through the door.

Lest the reader be misled and think that the camp was all play and no work, we would like to inform him to the contrary. There was plenty of work done. When it was time to work, we worked hard; and when it was time to play, we played hard. The camp was highly successful. And we hope that the next camp will be as good!

Bigger Round-ups

A-C equipment helps speed meat through packing plants—helps dehydrate foods so each ship can carry 10 times more.

How Allis-Chalmers, one of U. S. A.'s most unusual companies, produ
Tractors and Farm Machinery . . . Generators, Turbines, Drives for W
Plants . . . 1600 products to help Feed the World and Lick the Axis.

FEW OF OUR WORKERS have seen a Texas or an "Axis" round-up . . . yet they *are* helping to put beef on soldiers' plates, prisoners in Allied stockades.

They make the world's largest variety of *farm* and *war-industry* equipment . . .

—Tractors, corn pickers, harvesters . . . equipment for dehydrating and processing foods . . . crushers for min switchgear for steel mills; motors war plants . . . even hull sections for sh

And A-C engineers—in factories over America—are helping to incre production, not just with new machi —*but with machines already on hand.*

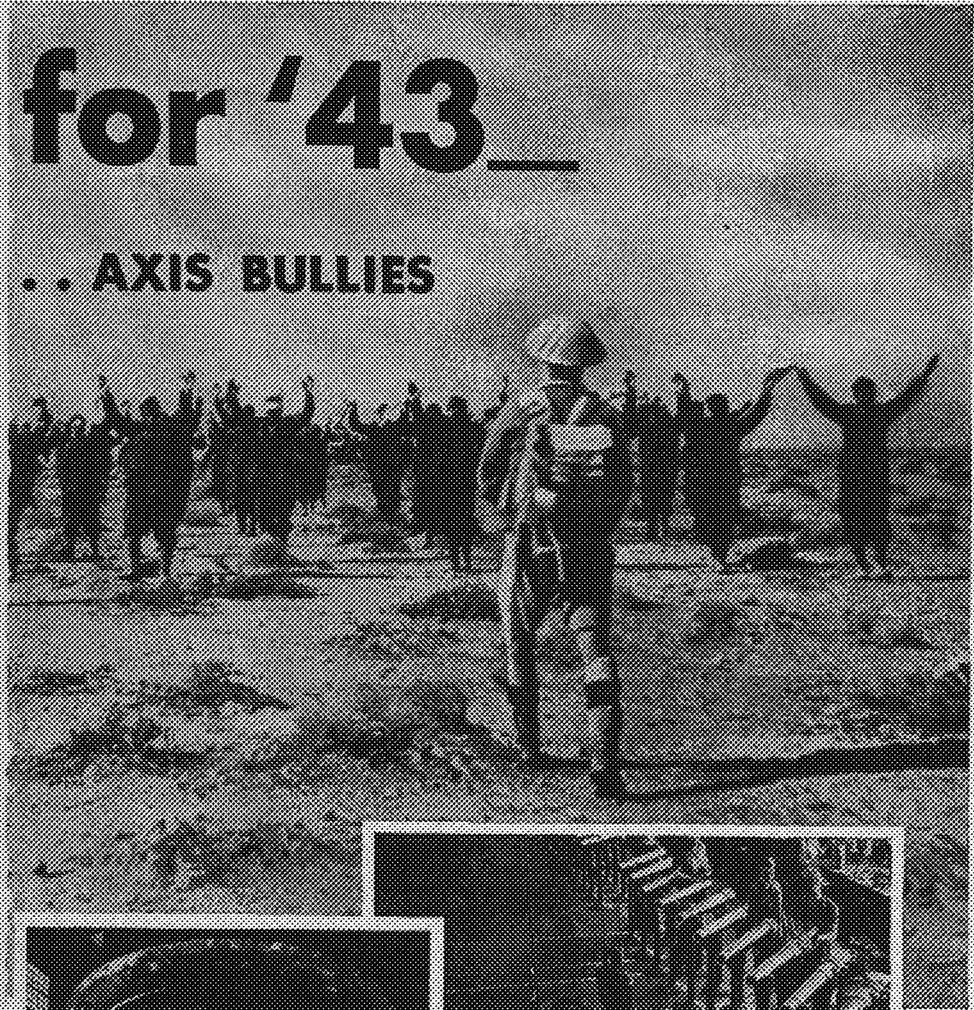
ALLIS-CHALMERS MFG. CO., MILWAUKEE, W

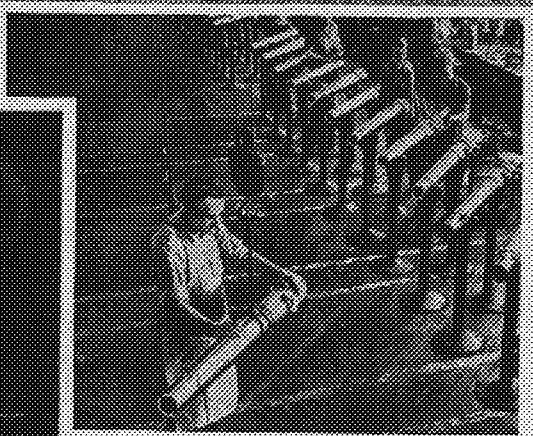
ALLIS-CH

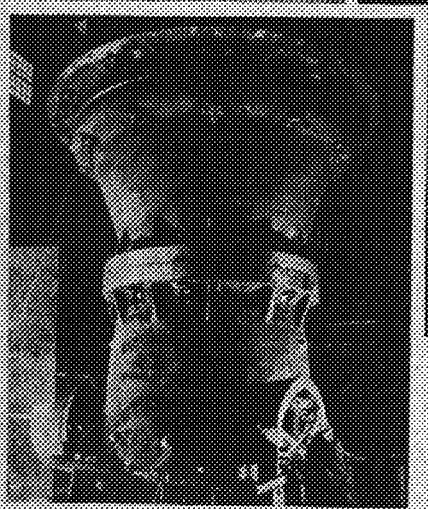
SUPPLYING THE WORLD'S LARGEST LI

for '43_

. . AXIS BULLIES







(*above*) **A-C equipment** — motors, belts, drives—keeps all types of guns moving along U. S. production lines.

(*left*) **Huge A-C crushers** like this one munch iron ore, and other A-C equipment helps turn it into steel.

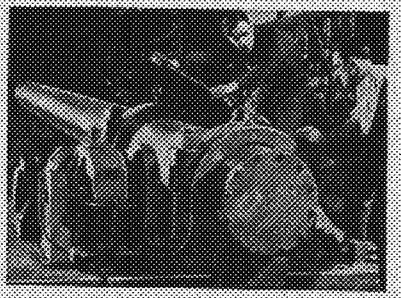
VICTORY NEWS

A-C Launches Farm Commando Plan: A large share of America's farm equipment will soon be brought to peak efficiency through Allis-Chalmers' new "Farm Commando" program.

Two-day mechanic schools are being conducted by Allis-Chalmers men in many agricultural sections.

Designed to give untrained men basic maintenance "know-how," they also serve as "brush-up" schools for skilled mechanics.

Following this, the farmer receives detailed, specialized instruction on his own equipment. Special red-white-and-blue emblems are provided for his machines to announce that each of them is a "Farm Commando, Ready to Roll . . ."

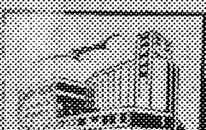


Not A Gun, but an Axis buster nevertheless! This huge tool is used in A-C shops to bore out the inside of kilns. It helps increase production of manganese.

British Ask For A-C Booklet: A sign that British industry currently cocks an eye at vital maintenance, comes in the form of a request from a representative of the Electrical Advisory Panel. To "tell all" about motor care in wartime, our Allies will pattern their information after Allis-Chalmers' "Guide to Wartime Care of Electric Motors." This booklet has already been widely distributed in the U.S.A. *Write for your free copy today.*

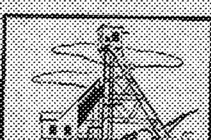
FOR VICTORY

Buy United States War Bonds



FLOUR AND SAW MILL EQUIPMENT

CHEMICAL PROCESS EQUIPMENT



CRUSHING, CEMENT & MINING MACHINERY

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INDUSTRIAL TRACTORS & ROAD MACHINERY

ALMERS

OF MAJOR INDUSTRIAL EQUIPMENT

WE WORK FOR VICTORY · WE PLAN FOR PEACE

(Continued from Page 32)

At this point, however, they encountered a problem which arose as a result of the large size of the propeller. It was necessary, of course, to provide a sufficient amount of ground clearance for the propeller, so that it could rotate freely without being in danger of striking objects on the ground. At the same time, however, it was necessary to keep in mind the fact that the plane was to be designed primarily for use as a shipboard fighter and that, for this reason, compactness of design was an important factor to consider. Under actual service conditions the fighter plane would certainly have to be stored in a very small space when it was transported on an aircraft carrier. Also, it would be difficult to maneuver the plane in the small space of the carrier's decks unless it had a sufficiently compact design.

Thus it was necessary to provide ground clearance for the propeller without sacrificing the compactness of the plane, and this problem was met by using a special type of wing known as the "inverted gull" wing. With this type of design there is a short section of the wing extending outward from the fuselage at an angle of about thirty degrees below the horizontal, and the remainder of the wing, extending outward to the tip, is inclined at a slight angle above the horizontal. Thus the wing is not in a single section extending horizontally outward from the fuselage in a straight line. Rather it is in the form of a broken line extending downward at an angle from the fuselage, then horizontally outward. This type of design gives a very distinctive appearance to the Corsair, especially when it is viewed from the front, and it makes the plane very easy to identify after it has been seen for the first time.

The landing gear were mounted on the underside of the wings, and the design of the latter made it possible to provide an adequate amount of propeller clearance and yet use landing gear which were light in weight and occupied only a small space. It was this advantage which had given the engineers their original reason for using the "inverted gull" wing design, but it was soon realized that this type of wing had other advantages which were probably equally important. It provided the pilot with greater visibility than was found in conventional planes, because he was situated farther above the wings and they therefore formed a lesser obstruction in his field of vision. Also the wing possessed certain aerodynamic characteristics which reduced its "drag" in moving through the air and thus provided a valuable means of increasing the speed of the plane still more. Finally the amount of space required for storing the plane on an aircraft carrier was less than with a conventional wing design because the "inverted gull" design caused the over-all height of the wings to be decreased when they were folded for storage.

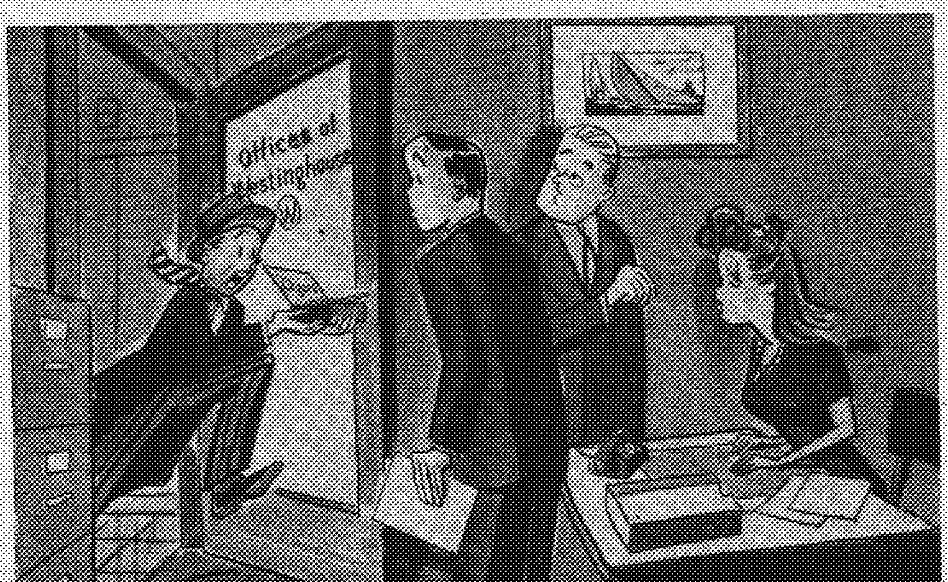
As a result of the Corsair's unique design there were many problems involved in the manufacture of the plane on a mass production basis. The Chance-Vought company undertook to produce the fighter in its plant at Stratford, Connecticut, and succeeded in developing a system of manufacture and assembly which today is proving its effectiveness by turning out Corsairs for the U. S. Navy at an ever-increasing rate. This company had had many years of experience in the manufacture of aircraft, and when the production of Corsairs was begun the company took an important step in the direction of quantity production by vigorously extending their long successful policy of subcontracting. Agreements were made whereby a number of outside companies would manufacture certain important parts of the plane and ship them to the Stratford plant to be included in its final assembly. As a result of these subcontracting agreements several complete subassemblies, such as the outer wing panels, are delivered to the plant already painted and ready for final assembly. Subassemblies such as the cowl, engine mounts, instrument panel, pilot's seat and landing gear, as well as all fins, rudders, stabilizers and elevators, are likewise supplied by outside companies. Moreover, the Chance-Vought company plans a further extension of this system of subcontracting so that in the near future the center wing section and the mid-fuselage section will be built in this manner.

One of the greatest problems in the laying out of the Stratford plant was that of simplifying the manufacture of the Corsair to the greatest possible extent. This was made necessary by the acute shortage of skilled labor and the consequent need for employing inexperienced workers to perform the various operations. For assembly purposes the entire plane was broken down into eight main assemblies, namely: power plant, forward, center and rear fuselage sections, tail surfaces, center and outer wing sections, and landing gear. Each main assembly, as well as all subassemblies, is built up in special jigs, fabricated of welded steel pipe. This construction provides lightness in weight, complete rigidity during assembly, and extreme ease of mobility. All subassemblies are designed to be complete units in themselves, drilled and equipped with brackets and other auxiliaries necessary for their later junction with mating units. Complicated fixtures were eliminated in every case possible in order to simplify operations.

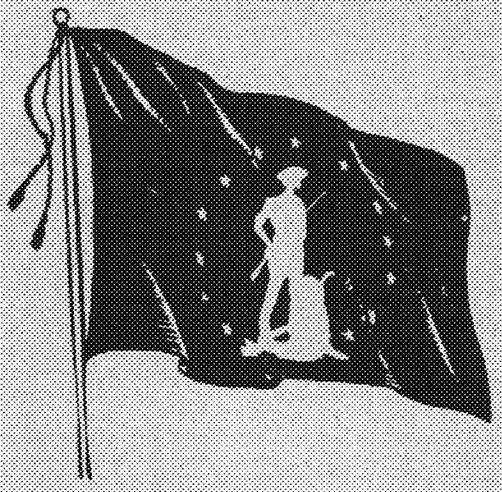
Lofting, a practice commonly used in the aircraft industry, is employed extensively in the construction of the Corsair. Briefly this consists of making accurate full-sized drawings of the various airplane parts, and making galvanized iron templates direct from these drawings. These templates locate all points of drilling and cutting, serve as gauges when the completed parts are inspected, and make possible the establishment of production tolerances in the shop.

The main assembly line extends from one end of the long factory building to the other. Each department is laid out so that its subassemblies, when completed, will join those built in other departments in logical order to form finished assemblies. These assemblies, in turn, progress toward the final assembly line for joining. Thus each main assembly is built up as a complete unit itself before arriving at the final assembly line. Meanwhile the main body of the plane takes form on two "loop" assembly lines which are separate from the main assembly line. These "loop" assembly lines operate concentrically—the inner one caring for the building up and joining of the mid and aft fuselage sections, and the outer loop being responsible for the fabrication and joining of the center wing and front fuselage sections. The final assembly line begins at the point where the center wing and front fuselage sections are joined. Both "loop" and final assembly lines consist of a series of assembly stations, with a definite series of operations performed at each station. There are 71 assembly stations in all.

Included in the manufacture of the Corsair are a rigid series of inspection operations designed to insure the plane's conformity with Navy specifications. The final over-all inspection, complete in every detail, takes place just before the plane leaves the assembly line. The completed ship is then taken to the airport at Bridgeport, where it is thoroughly flight tested and then flown away by a U. S. Navy pilot.



Have a wife, my cigar just had a baby



(Continued from Page 34)

as rapidly as possible. The plate is then ready for the press, although, if desired, it may be washed with turpentine and asphaltum to prevent oxidation or hardening of the developing ink.

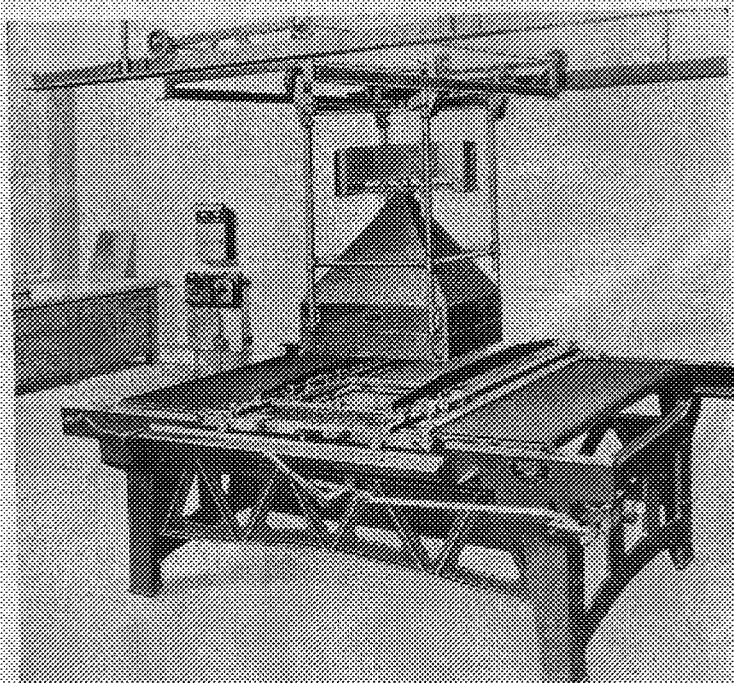
In recent years the deep etch process of plate-making has been preferable where higher quality and longer plate life on large runs are necessary. A film positive, rather than a negative, is required here. The plate is counter-etched as in the albumen process. A sensitizing coating of methyl cellulose, dextrin or soluble starches is then applied. Exposure to light in a printing frame is accomplished in the same manner as described for albumen plates, although the length of exposure may vary and its result will be reversed owing to the use of the positive. The *non*-printing areas of the plate are now hardened. Saturated magnesium chloride or calcium chloride containing some acids are applied now to remove all coating from the printing area. The bare metal, now left exposed wherever the plate is intended to print, is etched down slightly with a solution of magnesium chloride and acid. All traces of the developing and deep etching solutions must then be carefully removed with anhydrous alcohol. Ink-receptive lacquer is applied, followed by coatings of asphaltum and a heavy ink-receptive developing ink, covering the entire surface of the plate. These materials are immediately removed in a water bath, sometimes aided by a mild citric acid solution. The plate may then be desensitized as in the case of the albumen method and covered with a coating of gum arabic, fanned dry.

Today's high speed offset presses are made possible by the metal plate, which clamps securely to the cylinder provided for it. Ink is supplied by a series of rollers which take the ink from the fountain and distribute it thoroughly and evenly to cover the printing surface of the plate. Another series of rollers, covered with a cotton fabric called molleton, supplies moisture— a solution of chromic acid, phosphoric acid, gum arabic and water—to the plate. An alternate solution is composed of magnesium nitrate, dichromate, phosphoric acid, gum arabic and water. Purpose of this moisture is to repel the ink from the non-printing areas of the plate. Modern pH (acid and/or base concentration) control enables the pressman to keep the solution at a strength where it is most effective as an ink repellant yet not strong enough to attack hardened albumen or undermine the lacquer coating on deep etch plates. The actual printing operation differs in offset printing from letterpress work. Ink and dampening rollers con-

(Continued on Page 42)

PHOTO-COMPOSING MACHINE. This machine is a precision instrument for placement of images on offset and lithographic press plates, and is used for multi-color reproduction as well as black-and-white work.

PHOTO BY LANSTON MONOTYPE MACHINE COMPANY



Lithography

(Continued from Page 40)

tact the plate, working together so that ink adheres only to the printing image on the plate.

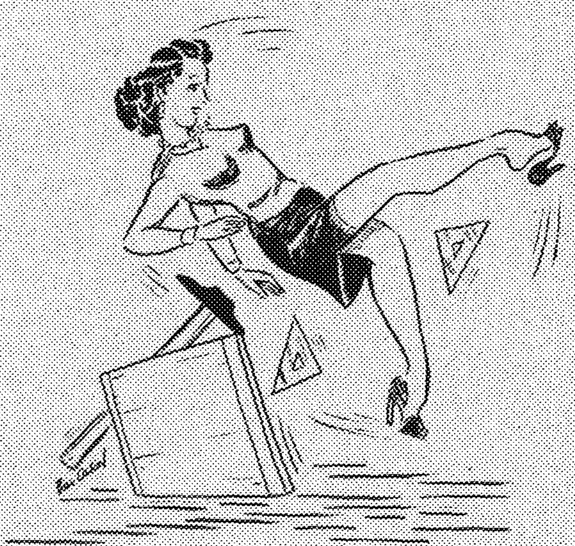
The plate does not contact the paper stock at any time. Instead, it revolves and contacts a sheet of rubber called a blanket, which is mounted on a cylinder immediately adjacent to the plate. The inked image is thus transferred to the rubber blanket. A third cylinder, known as the impression cylinder, in turn contacts the blanket cylinder, and the paper stock is fed automatically between the two, picking up the inked image from the rubber blanket as it travels through.

High speed suction type feeders make possible a pace of five to six thousand impressions an hour on sheet-fed presses. On web-fed or paper roll presses, fifteen to eighteen thousand impressions an hour are possible. Single press units, built so that they may be connected in a line and synchronized, enable modern lithographers to print four colors on each side of the paper in one operation.

Calendars and posters are by no means the bulk of offset work. Such printed matter as books, mailing pieces, magazines, school annuals, outdoor advertising displays, maps, stationery, colored prints, not to mention countless other types of work, make up the field for present-day lithography. Mechanical improvements and chemical research hold the answer for the offset process in the future—a future which promises no limits on increased quantity and quality.

My Secretary

(Continued from Page 33)



As the girl walks down the hall, all those students going forward turn backward and those going backward turn forward. Thus the girl is bounded on the north, south, east, and west by pupils—large, staring ones, two to an engineer. In the confusion which inevitably results, she rushes blindly into a drawing room. Tripped by a drawing board cleverly placed across the doorstep, she is told by a kindly instructor that she will only have to pose for a minute. "The attitude of the students is purely professional," he reassures her, when she appears frightened by the dripping fangs. Some fangs have been known to drip more loudly than the rest, and this is why many students are fondly called "Drizzlepusses."

Guy reappears if the girl lives through this test, which is considered one of the most critical, since if allowed by the F.B.O. to take a position in an engineering office, the girl will constantly be required to deliver notes to classrooms and go through similar procedures. Taking her hot little hand in his, Guy leads her out the back door of Main Engineering and into the Experimental Engineering Laboratories. Nine thousand, two hundred and eighty-seven students are running water and engines and yelling merrily to each other across the laboratory, and Guy pushes the girl gently toward a group who are about to go wading in the rushing water. This group has compasses attached to their ankles, in order to find the direction of flow of the water. "Ask them if this is Mr. Schnaeglegruber's class," he whispers. If the girl can make herself heard and if the class invites her to go wading with them, she is given a high score and sent to Mechanical Engineering.

Having survived the first part of the quiz on adaptability, the girl is considered worthy of working among the engineers. In the forge at Mechanical Engineering, a large "O.K." is branded on her arm and she is started through the final impressive ceremony. An anvil chorus thuds softly in the background, the lights are dim, and the girl gropes her way to the light. In the distance, the chorus rises to a thundering swell as the entire student engineering body (including the alums from '09 on) sings "St. Patrick was an Engineer." Coming out of the maze into the light at last, the new initiatee is met by a group of shouting and laughing engineers who pepper her with salty questions.

"What shall I get my girl friend for her birthday?"

"Do you think engineers are cultured?"

"Has anybody turned in a slide rule?"

"What's Mr. Goombiddy's schedule?"

"What grade did I get in C.E. 6,254?"

"What shall I get my girl friend for her birthday?"

To all of this the girl, having been orientated to engineers, says simply, "Yes." This is the correct answer to the $64 question, and her telephone number is taken by Guy, as the F.B.O. representative. She is strapped to a chair until an opening occurs in an Institute of Technology office, and then she is officially one of the girls; a typewriter is placed in her hot little hands and she starts to work.

What happens after she is on the staff may be guessed from what has already been told you, but if you want to hear how secretaries get involved in Triangles and what a French curve is, read the next story in our series entitled, "What Happens to Engineers After They Graduate?"

(Author's Note: Out of deference to the wolves, no comparison has been made in the article between Engineers and wolves.)

(Editor's note: Author number one of the pair is known as the coördinator of the V-2 program on campus. Author number two is known as Polly Technique.

And now that you have gotten this far we feel that you should know what the F.B.O. is. According to the authors it stands for Fine Boys 011, pronounced fine boys *all*, an organization founded in 1700 B.C. or Before Comstock.

Johnson, over there, used to be a magician.

AS WE SEE IT

An Ultimatum

This is an ultimatum to you to *give*. In writing it I feel like the professor who says, "This is the last opportunity to take the mid-quarter." The great difference between us is that the professor will usually break down and offer the chance again. But, when I tell you that there are only three days left for you to contribute to the Campus War Chest, I mean that after October 23 you will not have the opportunity to give to essential service institutions again this year.

You have undoubtedly seen the War Chest slogan around the campus this week. That "One for All" means that this is one big drive to take the place of the many former drives for Community Fund and student service groups. That "One for All" means that your single donation helps all the groups that will share the contributions.

Yes, even with enrollment down this year our goal is $1,000 higher than that of last year. The collection of $3,000 last year was three times as much as had ever been collected before on the campus. Yet this year, with all of us eager to do more and give more for the war, it ought to be easy to raise $1,000 extra.

Thirty-seven and a half per cent of the collection goes to the World Student Service Fund. You, then, by your contribution are aiding students all over the world, strengthening the cause for education which will some day mean world salvation.

Twelve per cent of the War Chest collection aids foreign students who are studying here at the University of Minnesota. What better way is there of practicing our Good Neighbor Policy and developing international good will than by letting foreigners take advantage of studying at our universities?

Thirty per cent of your contributions go to the Twin Cities' War Chest. In this way you are giving to the United Nations' War Relief, USO, refugee relief, and the community charitable institutions.

Five per cent of the $4,000 goes to SWECC—the Student War Effort Coordinating Council.

The remaining fifteen per cent is kept as a contingency fund in the Chest for future needs.

And you have only three days left to do your best, not your bit for these organizations. Don't postpone your giving another day, for this is the one chance you will have to give, *this year*. If you have given once, give again. Our minimum is $4,000. But each one of you must give so that all—the whole world—will benefit.

Elizabeth Bricker

Express Yourself

Obviously the engineer must have technical training in his chosen field. In addition he must be able to express himself under varying conditions—for example, in applying for a position, in reporting on an investigation, or in writing a technical article. The majority of engineers do not recognize the importance of a seemingly unimportant course—English—and practice in using it. It is sometimes amusing to hear something like this, "Alternating current is, well—you take a sine wave . . ." But the ability to express himself is of utmost importance to the engineer.

Take the problem of submitting a report on an investigation or survey. If the engineer cannot express himself he is in the same position as a carpenter with no tools. And the engineer's ability is often reflected in his written presentation. A few of these considerations to be given attention in writing or editing a report are mentioned briefly.

Most important is subject matter. Are the statements accurate? Convincing? Interesting or boresome? Do they contribute anything? Are they complete and well organized; or do they ramble? Does the article show a well-laid plan of presentation? And does the introduction arrest and hold the reader's attention?

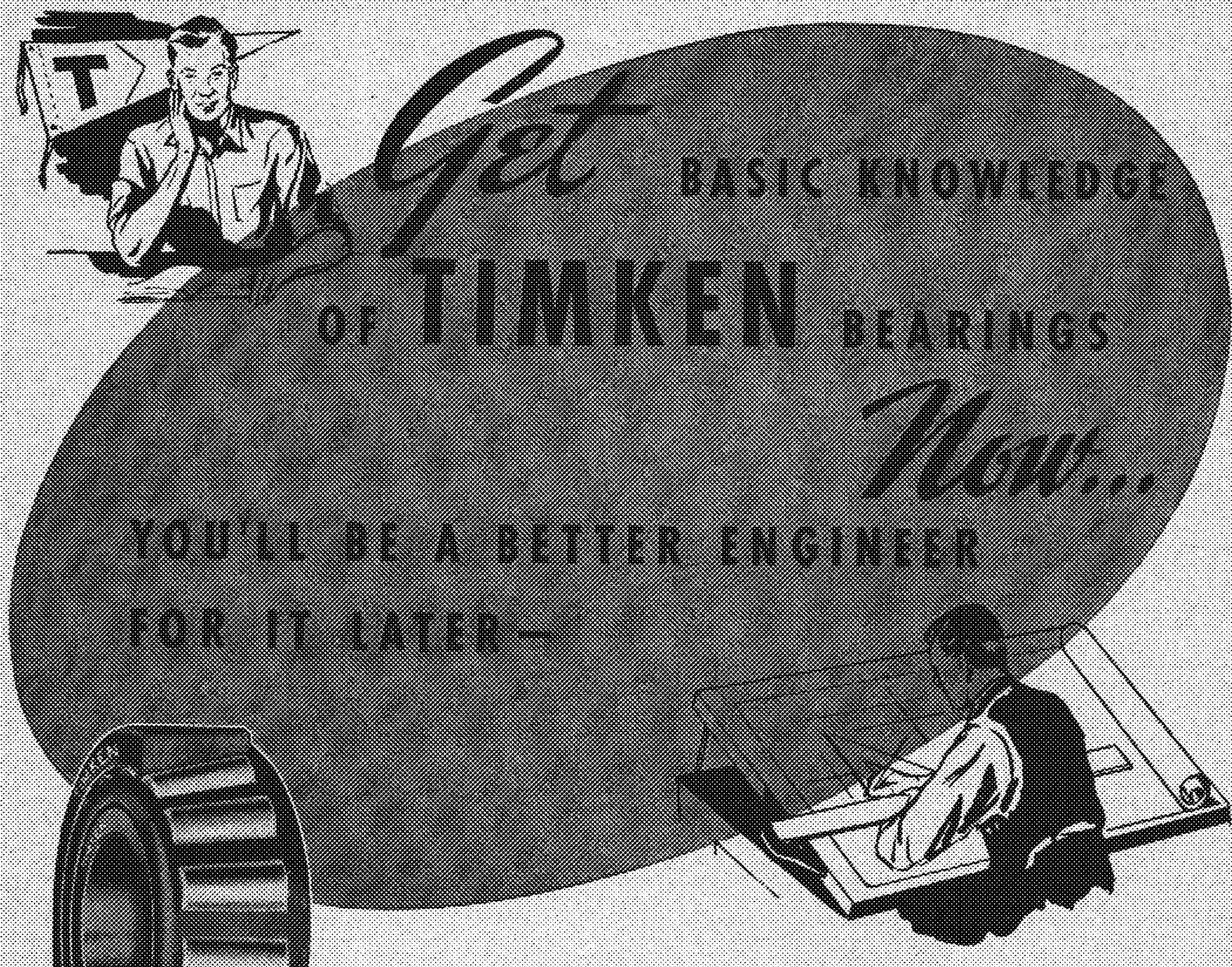
Style is important also. Are the sentences easily read, not too long or too short, but of pleasing variety? Does the language flow smoothly? Or is it labored and patchy?

Lack of attention to any of these details may detract seriously from the value as a whole just as a few inferior castings in a machine decrease its value. The engineer's goal of efficiency should be the same for his written as well as his technical endeavor.

Often the technical writer forgets that when he is addressing laymen, he may be misunderstood or not understood at all because he uses (or misuses) technical terms where others may suffice. Engineers are prone to this fault because they are accustomed to the vernacular of the technical world in which they spend so much of their time. It is a virtue to be meticulous in the choice of words to express a thought, but sometimes language may conceal rather than express that thought.

These paragraphs are presented not as a discourse on the qualities of a good engineer. It is hoped that they may stimulate some thought or steer an undergraduate or two toward appreciation of the value of some of the non-technical courses pursued and slighted.

Incidentally the Technolog office is an excellent laboratory for pursuit of these activities.



Get BASIC KNOWLEDGE
OF TIMKEN BEARINGS
Now...
YOU'LL BE A BETTER ENGINEER
FOR IT LATER—

TECH NEWS

OCTOBER, 1943

CIVILIANS DECREASE

Well, girls, you'll just have to bear it, like all the rest of the horrors of war that civilians have to endure cheerfully. We've racked our brains, trying to find a way to break the news gently—but no matter how we cushion it, the sad truth remains—engineers are now scarcer than new all-rubber tires! Uh huh, we knew you'd feel awful about it. But after all, girls, you have to expect to make SOME sacrifices for your country!

Civilian student enrollment in the Institute of Technology is the smallest it's been since 1920. Of course, there are lots of Army and Navy personnel floating around, who sort of make up the deficit. But who cares about them? They don't count! Our T-shirts are much prettier than their drab old khaki and navy blues!!

Here are the statistics—read 'em and weep! There are 234 freshmen registered in the I.T. this quarter. The aeronautical department drew the largest number of freshmen—61. At the opposite end of the scale, with the smallest enrollment of freshmen, is ag engineering—with a lonely three! Chem engineering has the second largest enrollment of freshmen—53—and has the largest total registration of all the departments in the Institute. There are 35 students in the College of Mines and Metallurgy, four—yes, FOUR—students in ag engineering; 213 in aero, 56 in civil, 140 in electrical, 127 in mechanical, 24 in architecture, 49 in chemistry, 208 in chem. engineering, 12 in physics, 8 in engineering and pr-business, and 16 unclassified freshmen, for a grand total of 857 engineers.

You'll just have to grin and bear it! Unhappy thought; femmes, the species are dwindling. There are fewer and fewer slide rules in view on civilian hips. (There are fewer civilians in view, too!) Not so many of those distinctive figure-hugging T-shirts. Not so many daintily exposed not-so-dainty necks, no more leering and whistling from the third floor windows of the Double E building—ah! (woe)

Ditty composed to commemorate this tragic era—

"No more slide rules, no more books,
No more welfish glances—
Them days is gone for the duration."

AIEE Shows Navy Gun Movies

As ever, under the alert leadership of Wm. "Buck" Carter, present chairman, the AIEE initiated a new year of activity by presenting one of the latest films issued by the Navy on the quadruple, 20 mm. anti-aircraft gun—one of the newest weapons which has aided the sea forces in attaining the excellent record and reputation for deadliness in this war. The film, a three reeler, was shown during the first convocation hour of the quarter, September 30, in 237 EE Bldg.

The new gun consists of a battery of four 20 mm. rifles mounted on a revolving turret, the control of which is accomplished either manually, as in the older types, or automatically by electrical means. With merely a twist of the wrist a single operator is able to level a deadly barrage of whining steel against the opposition in any direction and with precision accuracy. The films were a complete exposition on the technical operating characteristics, maintenance and trouble shooting and were very warmly received.

The audience of about 100 consisted of nearly all the electrical engineers and faculty, several mechanicals and other assorted species.

Unification of Societies Sought

As with all organizations on the campus the professional societies in the Institute have suffered severely from the impact of the war on the enrollment, and the prospects for continuing the operation of some of the units after the graduation of the present seniors look rather pessimistic.

Recognizing the immediate need for a unification of effort on the part of all of the societies, the Tech Commission has initiated an investigation of the possibilities for holding joint meetings including all of the organizations with a pooling of resources, talent, and manpower—in what might be called "convention style." It is believed that with such a coöperative action, programs and speakers of superior quality may be obtained due to the offering of large audiences and financial incentives, as contrasted with the meager type of entertainment that is too often the only thing available to the individual groups. Preliminary discussion has ASME, ASCE and Miners express opinions in mutual agreement with the suggestion and with each other.

Test Pilot Talks

The sophomore and freshman aeros who missed the last meeting of the Institute of Aeronautical Science are all kicking themselves. Not only the common run of seniors were present but also Chief Test Pilot Pfleiderer of Northwest Airlines and a large representation of Curtiss-Wright Cadettes.

After President Alexander Sowydra introduced the members of the areo department faculty indirectly through Professor Ackerman, the guest speaker gave those present an insight to flight testing as it really is. It was strictly off-the-record information.

A special treat was in store for those who stayed for the business meeting. The entire group, including the faculty, were invited over to Shevlin Hall for popcorn and apples.

THE ? MARK

SLIPSTICK PHILOSOPHY

BY

MELVIN MARK, M.E., '44

The wind was blowing very violently on a street corner and a young lady's dress was blown up around her neck. When a man standing near began to laugh, she said irately, "I see you are no gentleman."

"No, and I see you are not either," was the reply.

• • •

He: "If I asked you to become my secretary at $75 per week, would you say, 'Yes'?"

She: "A dozen times a day if necessary."

• • •

Joe: "I want to change my name, your honor."

Judge: "What is your name?"

Joe: "Joe Stinx."

Judge: "I don't blame you. What do you want to change it to."

Joe: "Charlie."

• • •

Jack had money;
Jill had nil.
Jill married Jack,
So Jack had Jill.
Jill went to Reno;
Now she's back.
Jack has nothing,
But Jill has jack.

• • •

Then there was the fan dancer who was arrested for no gauze at all.

• • •

A college professor declares that, contrary to scientific opinion, the interior of the earth is not so hot. In our unscientific opinion, the same thing is true of the exterior.

• • •

We know a girl who went with a writer—and he got some novel ideas.

• • •

Lawyer for the auto accident victim: "Gentlemen of the jury, the driver of the car stated he was going only four miles an hour. Think of it! The long agony of my poor, unfortunate client, the victim of the accident . . . as the car drove so slowly over his body!"

• • •

A girl went out one evening with three brewery salesmen. When she got home she had a Blue Ribbon in her hair, Schlitz in her skirt, and a Budweiser!

• • •

The old narrow trails where two cars could barely pass without colliding are happily being replaced by splendid wide highways on which six or eight cars can collide at one time.

• • •

He: "Darling, I'm groping for words."
She: "Well, you won't find them there."

There once was a maiden from Siam
Who said to her lover, young Kiam,
"If you kiss me, of course,
You will have to use force,
But God knows you are stronger than I am."

• • •

Have you heard about the baby kangaroo? He ran off and left his mother holding the bag.

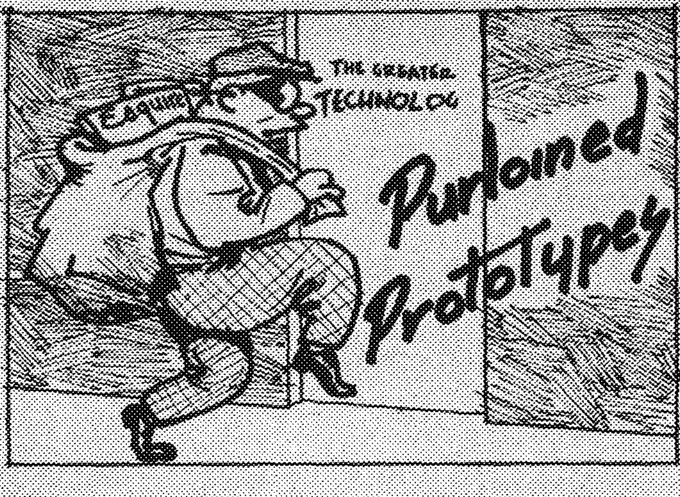
• • •

Judge: "Come now, you really don't think he meant to put your eye out?"

Pat: "No, I don't, but I do believe he tried to put it further in!"

• • •

Have you heard about the two brooms? They had to get married—they swept together.



Bill Sanford, M.E. '44 Herb Rochen, A.E., '44

A traveler who believed himself to be the sole survivor of a shipwreck upon a cannibal island hid for three days in terror of his life. Driven out by hunger, he discovered a thin wisp of smoke rising from a clump of bushes, so he crawled carefully to study the type of savages about it. Just as he reached the clump he heard a voice say: "Why in hell did you play that card?" He dropped on his knees, and devoutly raising his hands, cried: "Thank the Lord, they are Christians."

* * *

There was a little dachshund once,
So long he had no notion
How long it took to notify
His tail of his emotion.
And so it was that while his eyes
Were filled with woe and sadness,
His little tail kept wagging on
Because of previous gladness.

* * *

Freshman: "How about a date tonight?"
Senior Coed: "Sorry, I can't go out with a baby."
Freshman: "Oh, excuse me, I didn't know."

* * *

Southerner: "Honey, would you mind if I kiss yo' all?"
Gal: "Ain't my lips enough?"

* * *

The burglar, finding a lady in her bath, covered her with his revolver.

* * *

"Have you heard how a bustle and a historical romance are alike?"
"No, how?"
"Both are fictitious tales based on stern reality."

* * *

"I wanna come in."
"No, you can't come in."
"Why?"
"Because mama says boys should not see little girls in their nightgowns."
Short silence. "You may come in now. I took it off."

* * *

The Department of Taxation received a typed income tax return from a bachelor who listed one dependent son. This examiner returned the blank with a penciled notation: "This must be a stenographic error."

Presently back came the blank with an added pencil notation: "You're telling me."

* * *

Mrs. Dinocan: "I wonder if you would be so kind as to weigh this package for me?"
Butcher: "Why certainly. It weighs exactly three and a quarter pounds."
Mrs. Dinocan: "Thank you. It contains the bone sent me in the four-pound roast yesterday."

In a primary election a colored girl asked for a ballot. "What party do you affiliate with?" asked the clerk.
"Does I have to answer dat?" she asked.
"You do if you want a ballot."
"Den I don' want no ballot 'cause the party I affiliates wid ain't even divorced yet."

* * *

A boy who wants to make the news
Aspires to fill his father's shoes.
His sister hopes for something better,
She hopes to fill her mother's sweater.

* * *

Caller at hospital: "I'd like to see Mr. Jones."
Nurse: "He's in the sitting room."
Caller: "Oh, well, I'll wait until he's through."

* * *

Honest Hamm N. Rye was returning answers based upon his family history as the medical examiner went through a long list of questions furnished by the Navy Department. His mother died at the age of 42 of tuberculosis. At what age did his father die? A little past 39. Of what? Cancer.

"Bad family record," said the examining officer. "No use of going any further," and he tore up the blank.

Convinced that one shouldn't make the same mistake twice, Hamm applied again for V-12 several weeks later.

"What was your father's age at death?" asked the examining doctor.
"He was 96," Hamm replied.
"And the cause of his death?"
"Father was thrown from a pony in a polo game."
"How old was your mother at death?"
"She was 94."
"Cause of death?"
"Childbirth."

* * *

Papa Stork: "Well, I guess I'll go out and deliver a few baby boys."
Mama Stork: "Believe I'll go and deliver a few baby girls."
Baby Stork: "Well I guess I'll go out and scare hell out of some of these high school kids."

* * *

And then there was the disappointed bride who complained that her husband had never snored until they were married.

* * *

He: "I suppose you dance."
She: "Oh, yes, I love to."
He: "Great, that's better than dancing."

* * *

Toastmaster (introducing the speaker)—I'm sure that Mr. Jones of the Soils and Fertilizer Department will give you a pleasant half-hour. He is just full of his subject.

* * *

A young lady found herself for the week end with a notoriously strait-laced country family in England. Fearing that the pajamas she wore instead of a nightgown might be considered improper, she carefully hid them every morning when she got up. But one morning at breakfast she suddenly realized that she had forgotten them, that they were lying brazenly on her bed. Excusing herself, she rushed to her room. The pajamas had disappeared.

While she was feverishly hunting for them, looking vainly through the closets and drawers, a dour, elderly maid appeared at the door and surveyed. "If it's the pajamas you're looking for, Miss," she said, "I put them back in the young gentleman's room."

* * *

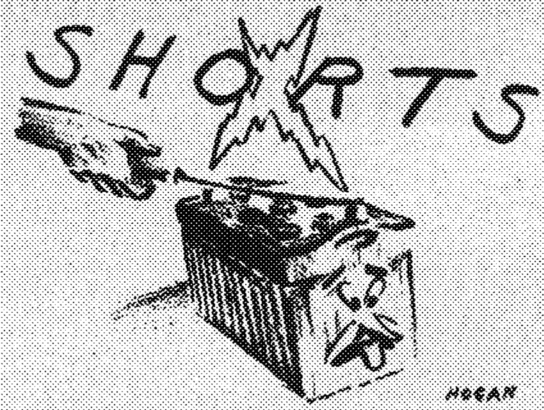
Secretary: "Sorry I'm late, Mr. Smith. I'll be here bright and early tomorrow morning."
Boss: "Don't promise the impossible—just be here early."

* * *

Roger: "I never felt so punk in all my life."
Alvin: "Do any drinking last night?"
Jerk: "Yes, and when I went to bed I felt fine. But when I woke up I felt terrible. It was the sleep that did it."

* * *

"Another combination shot," said the co-ed as she leaned too far over the billiard table.



The final take from the Stray Scraps box in the hall of Main Engineering this month consisted of 2 phone numbers (one good and the other unproductive), 4 candy wrappers, one joke about a polar bear that could not be printed, a pome, and also the name of one engineer that we had missed on our poll of those who had not spent an evening on the river bank last summer. The pome was written by sojer Cpl. Frank Ephraim and here it is.

People who lived 'way back in the Ming Dynasty
Did not have to worry about the f(-t).
People who lived at the same time as Nero
Didn't know that infinity equals one over zero.
People who saw the Norman Invasions
Didn't care about differential equations.
And I'll bet you can't interest an Afghanistannian
The slightest bit in the Gudermannian.

In case you happen to be interested the Gudermannian is a mathematical term for the log ($\tan \theta + \sec \theta$).

• • •

We of the Log have come to the conclusion that the journalists could not get along without the help of the engineers. They borrow our typewriters and our paper cutter, listen to our radio, steal our jokes, ask us to fix things for them, and in general depend on us for a good many things. And now certain females of the journalism school are trying to hypnotize our staff so that they will join up with the other publications and leave us. They stop at nothing.

• • •

On the night of October 14 the publications of the University of Minnesota got together for a pow-wow, picnic, wiener roast, or what have you. They started out for the park on the other side of the river in one car. There were only about 20 people, so you can draw your own conclusions. Since we were not present this information is strictly second-hand but it is from a reliable authority. When they got to the park someone thought of the brilliant idea that a fire might be necessary to cook the wieners so an attempt was made but only smoke and crisp black portions of the *Minnesota Daily* resulted. Our guess is that they could have used a couple of Boy Scouts to help them out.

• • •

Dave Clough, who was managing editor for this issue, really did a bang-up job. While we were down in Milwaukee for the ECMA convention October 8 and 9 and away during the latter part of September, Dave took over without protest. Dave is illustrations editor and has the tough job of writing all the letters requesting photographs and cuts and thanking the ones who reply.

• • •

In case you wonder who did the cover design for the magazine this year it was Maurice Breslaw, a student in architecture who has been doing a lot of the art work. Maury could be depended on to deliver the goods on very short notice and never failed us once. Now that we have tossed the boquet hurry up and draw up another cartoon Maury.

• • •

Next month we are publishing the first of a series of articles on the postwar world. This series will include articles by men in the fields of economics, education, politics, and technology. Writing for the magazine next month is Paul McCracken, an associate of Dr. Uppgren who was formerly a member of the business department faculty.

Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

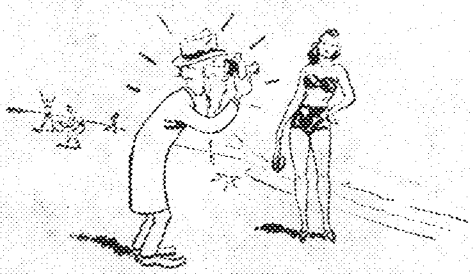
THE "BAZOOKA"

SERENADES by the Army's "bazooka" corps are getting hands in the air on the enemy front and handclapping from the folks back home.

This new anti-tank weapon, dubbed the bazooka from some remote resemblance to Bob Burns' blow-pipe, is small enough to be fired by one man, after a second man loads it. It hurls such a powerful projectile that, after one shot struck a nearby tree, the commander of six enemy tanks surrendered them, believing that he was being shelled by 155-mm. guns.

"It is so simple and yet so powerful," said Major General L. H. Campbell, Jr., Chief of Army Ordnance, "that any foot soldier using it can stand his ground with the certain knowledge that he is the master of any tank which may attack him."

For over a year the bazooka has been in mass production at a General Electric plant that formerly made washing machines and other home appliances.



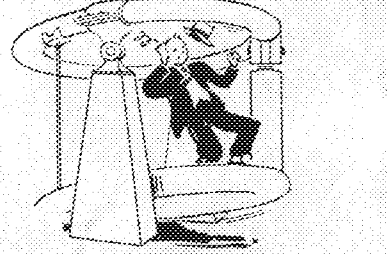
THE LIFE OF ITS LIGHT . . .

. . . is only *one* second, yet so short is each flash that it can be used to take 1,000,000 individual photographs! "It" is the 1000-watt MAZDA mercury lamp in General Electric's new "speed-light" camera.

The device consists of a small box weighing less than 25 pounds. The light source is on the front, like a small head light and can be operated manually with a push-button or automatically by electrical contacts or photo-tube and preamplifier. An ordinary 115-volt a-c household lighting circuit is used to operate the unit.

The lamp itself is about the size and shape of a cigarette and will illuminate 20 square feet of area brightly enough to photo the fastest moving objects. In tests photographs have been taken of a wheel revolving at 70,000 revolutions per minute.

Use of the unit so far has been confined to studying high speed machinery, such as turbines and supercharger parts.



MAL DE MARS

TIME was when the testing of marine equipment had to be done at sea, aboard the type of ship for which the equipment was intended. Now, however, with machines such as the Scorsby tester in G.E.'s Aeronautics and Marine Laboratory the range of detectors and other equipment can be checked right on land, against a fixed horizon.

The device simulates the roll and pitch of a moving ship—and the resulting seasickness. The time of the ship's complete roll can be duplicated—all the way from the nine seconds for a destroyer to the eighteen seconds for aircraft carriers.

The tester is capable of holding 10,000 pounds and is composed of two huge iron doughnuts, the lower one platformed, which are held about four feet apart by two motor-driven arms. *General Electric Co., Schenectady, N.Y.*

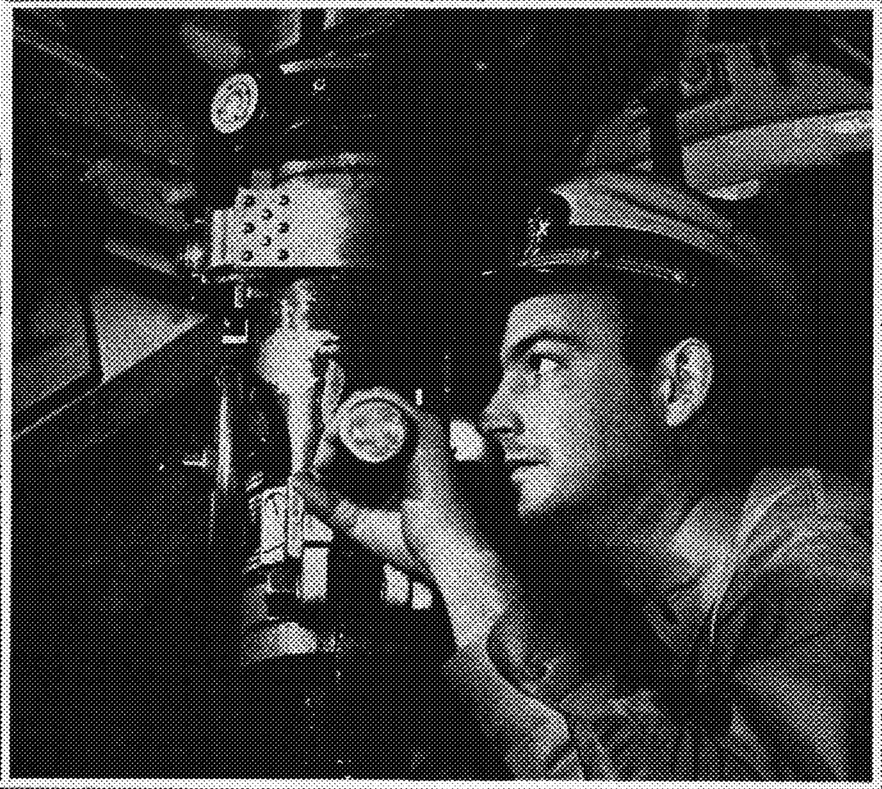
Hear the General Electric radio programs: "The Hour of Charm" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

The best investment in the world is in this country's future—BUY WAR BONDS

GENERAL ELECTRIC

958-N-211

TECHNOLOG



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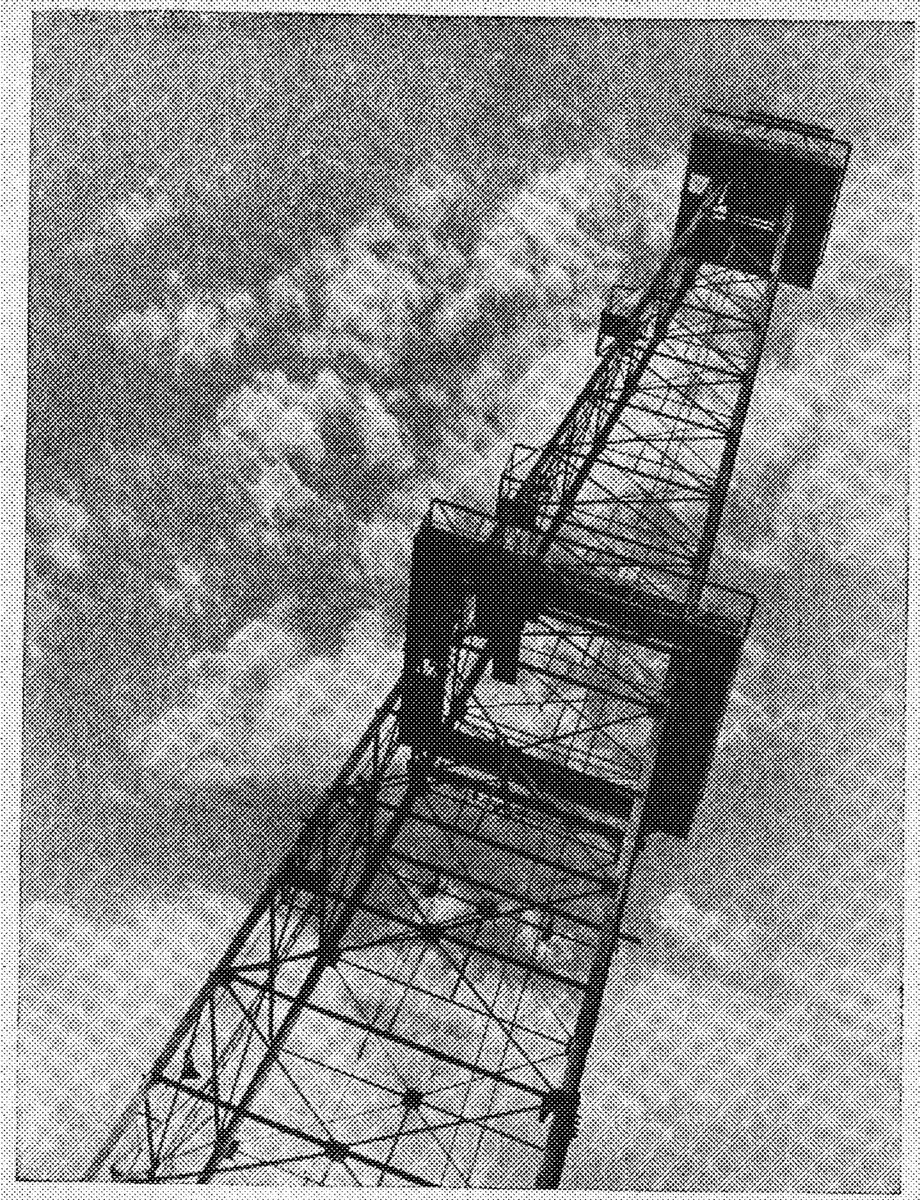
MINNESOTA

The Rubber Plant

with roots two miles deep!



The making of synthetic rubber involves among other things the exact control of gas mixtures of great complexity. Formerly the analysis of some gases required several days of painstaking laboratory work, and in some cases a complete analysis was impossible.

Westinghouse scientists—working in close collaboration with engineers of leading oil and chemical companies—have perfected an electronic "chemist" which is an important addition to the present methods of analysis.

With the improved technique and apparatus now available, the time required for accurately making some of these analyses has been reduced *to an hour or less!*

An amazing electronic device . . . known as the mass spectrometer . . . not only improves the accuracy of the synthetic rubber process, but frees hundreds of skilled chemists from tedious but important production testing in these vital plants.

The mass spectrometer analyzes gases by sorting the molecules—according to their mass—in (roughly) the same way that a cream separator sorts out the cream from whole milk.

Let's say we want to analyze a simple gas mixture containing *one part* of oxygen and 10,000 parts of nitrogen. Here's how the mass spectrometer accomplishes this incredible feat:

First, the gas sample is bombarded with electrons. This *ionizes* the nitrogen and oxygen molecules, giving them electrical charges of their own.

These ions are then drawn by electrical force into a curved vacuum tube. Here, ions of different molecular weights whizz around *different curved paths*—depending upon their reaction to a powerful electromagnet surrounding the tube.

The heavier oxygen ions follow a straighter path than the lighter nitrogen ions and are directed through a tiny exit slit onto a plate where they give up their electrical charge. The amount of this charge, amplified and recorded by sensitive electrical instruments, is an extremely accurate measure of the *quantity of oxygen* in the gas mixture.

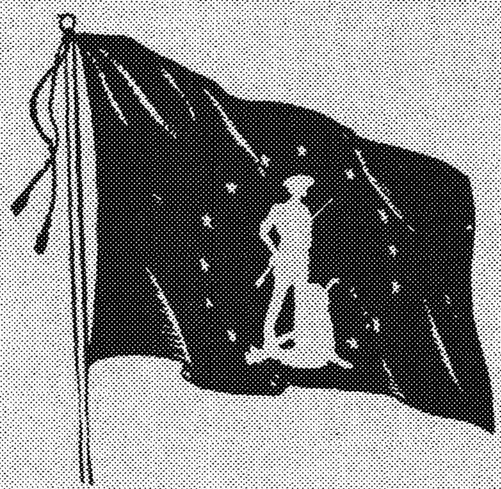
The starting voltage is then changed to allow the nitrogen ions to pass through the same exit slit—thus measuring the *quantity of nitrogen*. This same principle applies to the analysis of complex hydrocarbon mixtures.

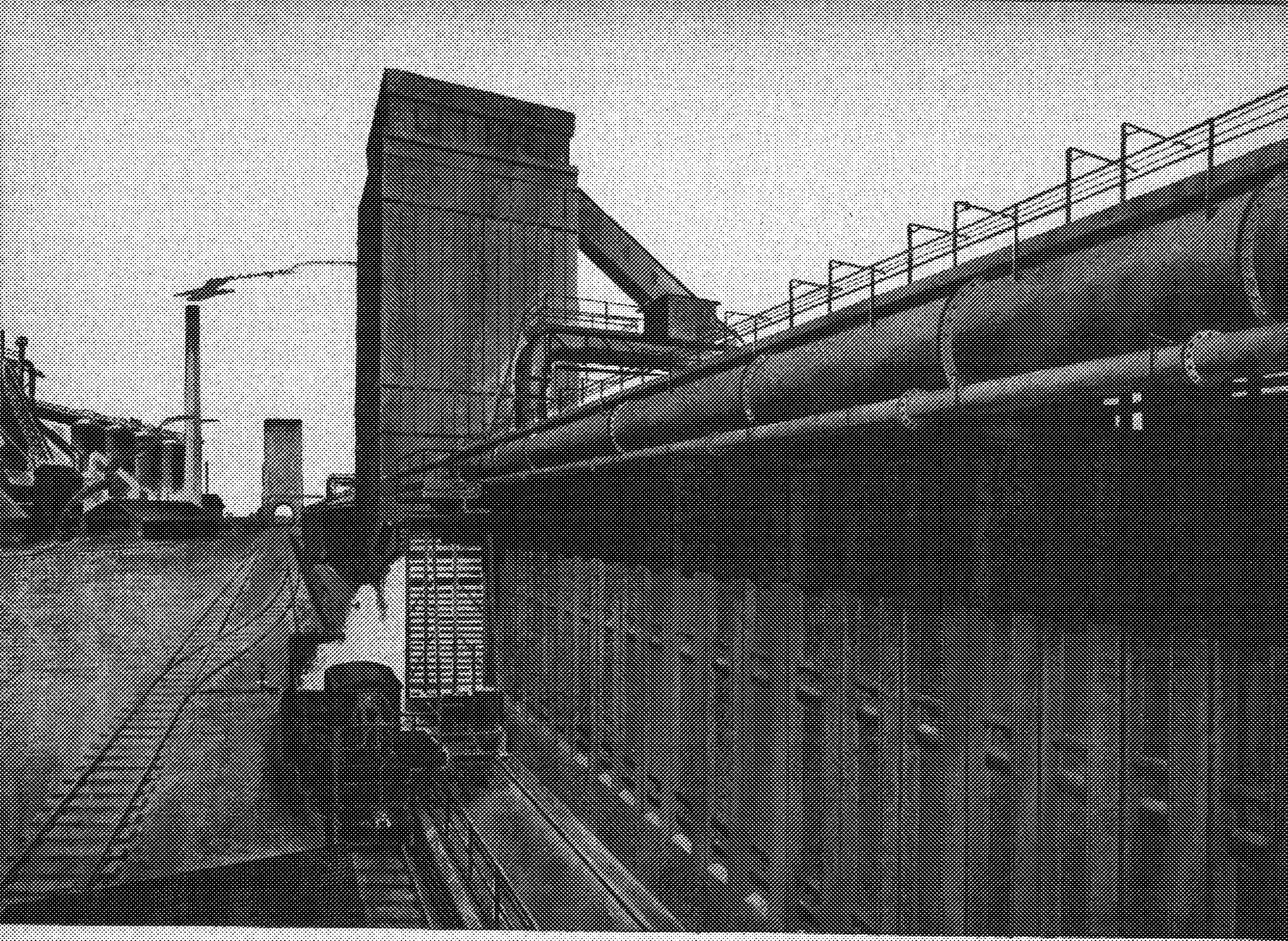
The development of the mass spectrometer . . . for the quick, accurate analysis of butadiene . . . is a typical example of the way Westinghouse "know how" in electronics is tackling the wartime problems of industry in an effort to speed victory.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Westinghouse

PLANTS IN 25 CITIES — OFFICES EVERYWHERE





The Synthetic Age ushers in a **New Era** for the Coke Oven

Nearly half a million new combinations of the molecules have been developed since the synthetic age came in. Millions of new ones are possible. Nearly every time a synthetic material has been developed it has meant a drastic reduction in the price of the material and that has meant an ever-widening market, in the familiar pattern of mass-production.

In the last year for which official figures are available, almost half of the synthetic organic chemicals produced in America came from coal tar sources.

Vast new opportunities stretch away before the modern coke oven and before the people who work with it.

Koppers is the largest builder of coke ovens. It is one of the principal producers and distillers of tar from which many of the chemical wonders stem. It is one of the first designers and builders of recovery plants from which come materials for use in plastics, synthetic rubber, paints, varnishes, dyes, solvents, motor fuel, disinfectants, medicines, flavors, explosives. One of Koppers affiliates is the nation's largest independent producer of bituminous coal. —Koppers Company and Affiliates, Pittsburgh, Pa.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

this month

BY HELEN HELLAND

Paul W. McCracken, the author of "Business as Usual?" has been serving the Minneapolis Federal Reserve Bank in the capacity of Supervisor of Business and Banking Research, since April. At the present time Mr. McCracken is one of a group of three constituting the Ninth District Committee for Economic Development Research.

ECONOMIST

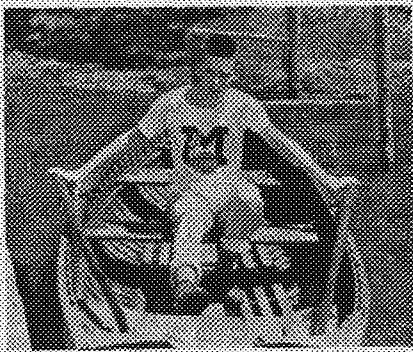
Mr. McCracken was brought up on an Iowa farm. His graduate study in economics was done at Harvard University after graduating from William Penn College, a small Iowa school. Before coming to Minneapolis, he was located in Washington, D. C., as an economist with the U. S. Department of Commerce.

So much for Paul McCracken, the economist. McCracken, the man, loves to canoe during his summer vacation, and to read philosophy by the fire in the winter. He was married only eighteen months ago. Imagine his consternation when he discovered one of his great uncles who served under Sherman in his famous "march to the sea," had been with the company that marauded the beautiful plantation of one of his wife's ancestors!

(Editorial note: Mr. McCracken's article does not necessarily express the views of the Minneapolis Federal Reserve Bank.)

Chuck Amann is the name of the promising author of the article, "Send in a Sub!" This is his first article for the Log. He is majoring in aeronautical engineering and under the present accelerated program, will graduate in June, 1946, if the V-12 doesn't get him first.

Chuck is a recent graduate of St. Paul Central High School. While there, he was a member and treasurer of the pep band. He likes popular music . . . so much in fact



BEATS IT OUT

that he has his own band, and a good one at that. Chuck plays the trumpet and plays at the piano.

Among his other hobbies are swimming and skating. He used to build model airplanes, but he only has a chance to read about planes now.

He hasn't got a steady girl friend, but gives them all a break. Chuck believes that variety is the spice of life.

Chuck also believes in more vacations, or at least one vacation. He thinks that the present schedule is too fast—he hasn't got a chance to catch his breath.

When Chuck graduates, he would like to go into industry and design. He likes to draw and we think he knows some of the angles.

Kal Lifson, future aeronautical engineer, left Washburn High after 12B to enter the accelerated engineering program.

CARD SHARK

"New Fields for Glass" is Kal's first article for the TECHNOLOG, but he has a good bit of practical experience in journalism. He worked on the Washburn *Grist*, and served as treasurer of the Minnesota High School Press Association.

This pledge of Phi Epsilon Pi likes old clothes, Woody Herman, summer, and math; and like most engineers he hates chemistry laboratory and people who study—unlike the great majority of engineers he dislikes most girls!

Kal has worked as a truck driver, salesman of shirts and women's shoes, and as a rodman at the St. Paul Propeller Plant. Now he plans to try a new job working for Uncle Sam in either the V-12 program or flying with the Army Air Corps.

Gerald Johnston stresses the importance of saving waste paper in his current article, "A Substitute for Paper."

Mr. Johnston graduated with a bachelor of science degree from the University of Illinois in 1935. We feel that he is especially well qualified to discuss this topic because in 1940 he was granted a Ph.D. degree by the Institute of Paper Chemistry of Appleton, Wisconsin. And for four years Mr. Johnston has been a chemist for the Waldorf Paper Products Company.

ILLINOISAN

His love of chemistry even carries over to his favorite hobby—semimicro analysis. However, he also enjoys tennis, handball, volleyball, and just "goin' fishin'."

He is married and has two children . . . a boy, two, and a four-month-old girl.

Being a native of Illinois, Mr. Johnston thinks that Minnesota weather is beautiful and enjoyable . . . only when it is just that!

MINNESOTA TECHNOLOG

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Harry Brenner .... Features and Managing Editor
Eugene Andrews .... Makeup
Helen Helland, Maurice Breslaw, Bill Sanford, Herb Rochen, Mel Mark, Kal Lifson, Pat Murphy, Orville Howe, Chuck Amann, Flora Palmstein.

RICHARD ENGDAHL BUSINESS MANAGER

Assistants

Marie Vachon, Ann Bennett, Fern Blumberg, Jo Gordon, Jane Hanft, Irma Davis, Doris Schwanz, Mary Teigen, Dorothy Loritz.

The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is two-fold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

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CONTENTS

THE COVER. The second officer remains at the periscope when the submarine is diving and gives the command to level off. Official U. S. Navy Photograph.

FRONTISPIECE. Men at work on the antenna of station KDKA at Allison Park. Courtesy of Westinghouse Electric and Mfg. Co.

After Victory--

BUSINESS AS USUAL?

BY PAUL W. McCRACKEN

WE WERE pessimistic, somewhat skeptical. Probably we had a right to be in 1940.

The defense program, with the accompanying heavy expenditures, had in 1940 influenced the economy in somewhat the same way as any normal peacetime prosperity. Prices were rising generally but without any immediate tendency of getting out of bounds. Wages and incomes were ascending at an accelerated pace, the relative increase during the first defense-spending year being about three times that of the year ending with the inauguration of the defense program.

Even with all these indicators of business activity pointing toward a comparatively buoyant economic situation, polls of public opinion indicated that we were not too confident about what the future had in store. This was perfectly understandable. The general public intuitively sensed many of the difficulties which the experts and economists derived from their more technical analyses. We could not easily forget the rather disappointing and disillusioning economic performance of the decade of the Thirties which had at that time just closed. The last really satisfactory year of peacetime business activity had been at that time eleven years ago. In that Elysian year of 1929 we produced a total pile or stream of goods and services valued at 99.4 billion dollars, and unemployment was reduced to a practicable minimum.

After the Crash

Then followed years the economics of which are all too familiar to all of us. The stock market crash; prices and incomes tumbling; unemployment skyrocketing; 1930; 1931; 1932.

By 1933 the value of the total pile of goods and services which we were able to produce and sell had nosedived into the cellar and was half that in 1929. A part of this shrinkage obviously arose out of a decline in prices, but no small part of it was a decline in the actual physical volume of goods and services produced and sold. At the same time we found ourselves in the extremely explosive position of having, at the low point in 1933, about 30 per cent of our people in this country wanting jobs, out of work, and unable to find productive employment—well over 13 million men and women.

From this low point in 1933 began a mild and timid expansion in business activity. Each year was slightly better than the one which preceded, with the single exception of 1938's sharp but brief recession. By 1940, therefore, we had recovered to the point where the value of goods and services which we produced and sold in this country and abroad was approximately 97 billion dollars, or just about equal in value to the goods and services produced and sold in 1929.

But in 1940 one striking difference relative to 1929 was evident. *In 1940, we could produce that ten per cent more with a labor force working four-fifths as many hours per week and still have on an average eight to nine million people unemployed.*

This teaches us something. It demonstrates forcibly that in our thinking about the future we must still reckon with what might be called a dynamic, expanding economy. It teaches us that a level of gross national product or income which was sufficient in one year to reduce unemployment to a practicable minimum is not sufficient a decade later and is not then a justifiable or satisfactory economic objective. This is true because our labor force itself has been expanding at the rate of approximately five hundred thousand per year, and it arises even more out of the fact that because of the increasing efficiency in the productivity of our nation's labor, capital, and equipment one man working one hour in 1941 was able to produce approximately 35 per cent more goods and services than the same man working one hour in 1929.

It is for precisely these reasons that the experts in the U. S. Department of Commerce, who have evaluated the question of the economic objective or goal toward which we must strive for the period after the war, have assured us that if businesses and government together plan individually and collectively for an economic performance similar to that which we were able to achieve in 1929 or 1940, we would have in this country some 18 to 20 million people unemployed, 50 per cent more than we had at the bottom of the depression in 1933. It is their considered and somewhat startling opinion that with unemployment reduced to a practicable minimum of perhaps 5 per cent of those desiring employment, we can produce a physical volume of goods and services in this country after the war 40 per cent larger than in 1940, even if this war should end so that we could swing into full-time production of civilian goods within the next three years.

We entered into the period of defense and later war spending with 8 or 9 million people in this country unemployed, even after seven years of almost uninterrupted expansion in our employment and output from the depression low in 1933. What is more reasonable then than to expect that after this defense and war spending, creating the present expansionary tendencies, we would again relapse into a period of anemic and sluggish business activity and employment. These observations we could not and did not dismiss lightly three years ago.

A Reversal

Recently, however, there has been something of a tendency to go the other way. The military situation itself has proceeded at a more satisfactory pace than we dared hope at the dark outset of the war.

Furthermore, we have been educated in the rudiments of certain factors which after the war will tend to create expansion. One of these is the large holdings of war savings bonds which the average individual will have for a reserve purchasing power when the war is over. Another has been the remarkable tendency thus far evidenced by individuals to get themselves out of debt, not only for automobiles, radios, and other durable goods, but also for houses, real estate, and other long-term debts.

On the other side of the picture, we have been educated to the heavy demand which may exist after the war for such durable items as automobiles, refrigerators, radios, and rubber tires. These items are off the market now and there will be a good deal of "catching up" as soon as these goods are flowing into distributive outlets and into the hands of consumers again. All of these factors combine to lend to a greater feeling of optimism about what the postwar economic situation will hold in store for all of us.

We American people are subject to the criticism that we all tend to think one way or the other at the same time, and that we think what we think wholeheartedly. The consequence is that when we were pessimistic about the future we believed in really being pessimistic. Now when the picture looks somewhat brighter we all believe not only that the picture looks brighter but that the postwar economic destiny of the American people is in the bag when the war is won and that our horizons are unlimited. To this vision of the postwar plenty add a backdrop of teardrop automobiles, helicopters, stratoliners, plastic houses and the other advertised paraphernalia of the postwar paradise and there results what tends now to be our dream world of the postwar period.

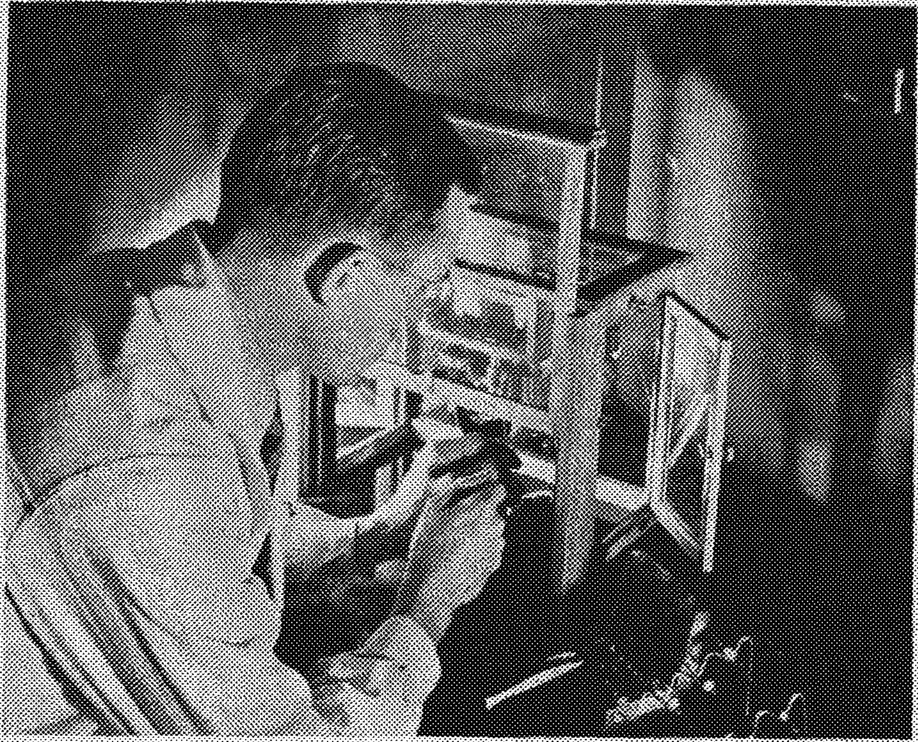


PHOTO COURTESY OF WESTINGHOUSE

ENGINEERS are constantly finding through experimental work new products to place on the postwar market in order that peacetime industry may quickly relieve the unemployment caused by the reduction of war production and return of servicemen.

A dispassionate analysis of these complex problems would certainly reveal that both extremes are unjustified.

This much we do know. This stage of the game is not too soon for us to assess as best we can the economic forces with which we must deal if we are to have any chance of turning in an economic performance after the war which will have some hope of winning out on the principles for which men now fight. This "satisfactory performance" can only mean a level of production high enough to reduce unemployment to a practicable minimum, a gross national product or income perhaps 40 per cent higher in real terms than that of the last pre-war year.

What possibility is there that this goal can be achieved? We know that in the past our selling problems have been considerably more difficult than our production problems (abstracting from the war). What is the postwar market-demand outlook? Few would question that in general it is bright.

Potential Demand

First potential demand. Construction has always been a peculiarly strategic factor in prosperity. We had heavy expenditures of this nature in the Twenties, and we were also prosperous. We had a low volume of construction in the Thirties, and we had a hard time getting recovery more than into second gear. An immediate postwar annual construction activity 40 per cent higher than in 1925, the highest year in the Twenties, is suggested by the U. S. Department of Commerce. And this has been called conservative by some authorities in the construction industry.

Another strategic sector of the economy is all of those factories producing durable goods—automobiles, refrigerators, radios and electrical equipment. Automobiles will serve as an illustrative example of this group. It is possible to calculate within reasonable limits the number of cars in use as of any given year and which would not be replaced even if new cars were available. (This we can do because we have detailed data on the age distribution of our present stock of cars, and we now have available car "mortality" tables which can be applied to this age distribution.) By the end of 1944 this figure would be about 23 million cars if none are produced for civilian use by that time. On the other hand consumers with their present incomes would demand in the neighborhood of 33 million cars. Here will be a backlog of deferred demand of 10 million cars by the end of 1944—twice the level of sales in the highest sales year in the industry's history. Added to this would be an annual replacement demand of 2,500,000 cars. It is not difficult to see in this picture a potentially heavy demand for new cars after the war. And the same is essentially true of other durable goods.

It is evident, furthermore, that large reserves of purchasing power will be available in the form of liquid assets. Again the U. S. Department of Commerce has surveyed the situation and has found that individuals' holdings of cash, bank deposits, and government bonds increased by almost 50 billion dollars during the calendar years 1941-42, a figure almost equal to our gross national income in 1933. The increase this year will be of larger proportions. Consumer installment debt will decline to an irreducible minimum within another year and could expand by 8-10 billions after the war.

These reserves of liquid assets act in two ways to bulge effective demand. First they themselves represent a large volume of purchasing power. Second, they will, if our economists have been correct in their analyses, tend to increase the propensity or willingness of individuals to spend out of the incomes which they receive.

These areas of deferred demand plus reserves of "piled up" purchasing power point clearly to one inescapable conclusion. There can well occur for a considerable period after the war an excess of money demand over available supplies only different in degree from the war period itself. If this occurs, horse sense demands that some measure of control over the price-cost structure must continue until a reasonably stable and equilibrated demand-supply relationship can be achieved.

Possibility of Inflation

Without the retention of some of these necessary controls, a real postwar price inflation could be generated in this country. This is far from beyond the realm of possibility should our impatience prompt us to discard our safeguards too soon. The catastrophic German inflation occurred in 1923, not during the last war. The really damaging price rise in the United States developed in 1919-1920, after the Armistice.

Nothing could so nearly guarantee that the American people would lose their grip on their economic and political destiny as for them to experience the volcanic chaos of a postwar price inflation. Success on this price-inflation front is the first necessary condition of the achievement of a satisfactory economic performance after the war. Our wartime success has been heartening; there are increasing signs of hope that we will exercise the necessary judg-

BALANCE SHEET OF POSTWAR SOURCES OF NEW EMPLOYES AND THEIR PLACEMENT

Employes		*Jobs*	
Discharged from manufacturing	4.0	Withdrawal from labor force	3.5
Discharged from government	1.0	Increase in unemployment	2.0
Discharged from transportation and public utilities	0.5	Increase in trade employment	2.0
Discharged from armed forces	8.0	Increase in service employment	4.0
		Increase in construction employment	2.0
Total	13.5	Total	13.5

ment and restraint for a similar postwar victory.

For most of us billions of dollars of savings which may be spent by thousands of people on millions of new cars or refrigerators or houses leave us a bit cold. What the average citizen is concerned about is whether there will be a job for him when the war is over. Thus we land in the middle of the complex problem of postwar employment.

The largest group of people who will want jobs will, of course, be the perhaps 8 million men and women who will be discharged from the armed forces, and who will certainly have every right to expect ready and productive employment.

There is fairly general agreement that manufacturing enterprises will on balance reduce their employment by perhaps 4 million even after the slack of reconversion unemployment is pretty well taken up. Government agencies, their present payrolls expanded by the pressure of war, can be expected to reduce their employment by as much as 1 million. Transportation and public utilities may reduce their wartime high level of employment by 0.5 million.

It is evident, therefore, that there will be about 13 or 14 million people now employed who must be absorbed in some way by the postwar civilian economy.

Postwar Employment

On the other side of the balance sheet must be pictured the probable absorption of these 13 or 14 million people discharged from the armed services or civilian work when the war is over. First, perhaps 3.5 million people can be expected to drop out of the labor force after the war—working wives, those now continuing employment beyond the age of retirement, young people returning to school, etc.

Another 2 million will be represented by an inevitable increase in unemployment. This may seem to be a peculiar method of "providing" 2 or 3 million people with jobs. The fact is, however, that even with the current severe shortages of manpower we still had in August of this year 1 million technically unemployed. The transition from one job to another plus the structural shifts from one industry to another will make it difficult to reduce unemployment below a practicable minimum of about 3 million without more rigid controls than would be tolerated in a peacetime democracy by its own citizens.

Expansion of employment in the construction industry is one of the most perplexing and crucial puzzles, but if the suggestions about construction expenditures mentioned previously are roughly correct, as many as 2 million new jobs might be provided here.

According to our table the two sides balance with no difficult surplus remaining. The skeptic would be justified in remarking with an arched eyebrow: "How nice. They must do it with statistics!" As a matter of fact two critical factors have been left out of the picture. The first is that many of these new jobs will be available only after the industries have reconstituted their producing and marketing organizations for peacetime business. The second is that the labor force is not completely mobile or fluid so that a surplus of labor on the one hand and jobs available on the other can exist concurrently for a considerable period of time. This may arise because the people wanting the jobs and the jobs themselves are not located geographically in the same region or because people needing jobs do not possess the technical qualifications which the work would require. An excessive supply of engineering positions might not help to remedy an excessive supply of economists. (There will be a slight pause for the engineers to comment.)

Reconversion

The problem of reconversion unemployment cannot be examined in detail here. That it may well be serious few would deny, but there are reassuring factors. First, it is easy to exaggerate the extent of industries which have a physical problem of reconversion. Many now producing "war goods" will continue to produce the same product after the war for the civilian market. One cannot generalize from the automobile industry to the economy as a whole.

Second, there is reason to anticipate that the war in Europe may draw to a close before the war in the Pacific. Should this occur, reconversion can more gradually be done and over a longer period of time, thus eliminating the necessity of facing the total reconversion problem at once. This would in itself reduce considerably the magnitude of reconversion unemployment.

Third, those who may for a time be out of work can be expected to come out of the war with liquid assets (war bonds, larger cash reserves and reduced debt) which can provide a cushion for a period of no income. There is for this reason alone a considerable degree of economic rationality in the relatively higher wages paid in those industries whose employes will face the most uncertainty when war production starts tapering off.

Fourth, social security payments plus dismissal wage plans will tend to continue the payment of income even during the months of little or no employment.

Unemployment arising out of lack of mobility (geographical or otherwise) is a more difficult and complex proposition.

Should the problem be inadequate training, the provision of some sort of educational facilities would seem to be the answer. With the development of progressively more efficient transportation facilities, even the problem of geographical immobility may be alleviated. As this becomes progressively more true an adequate supply of labor (and perhaps plant facilities) in an area may be in a stronger technical position to attract business activity to itself.

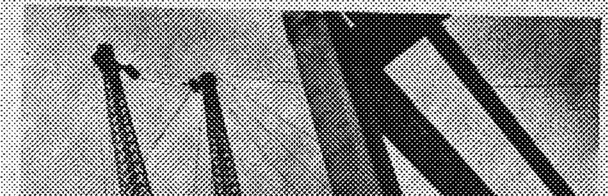
Even if one feels justified, however, in being optimistic about the success of these factors in mitigating the problem of these geographical and technical pockets of unemployment which may develop after the war, there may well be a considerable problem remaining which will require federal aid. This is only fair and just. To expect a ship-building city, whose labor force has perhaps tripled relative to the pre-war level, to solve its own problems entirely would be naive and selfish. These problems arose out of the total need of a society at war, and the resulting burdens of the dislocation must to some extent be carried by all.

A military victory is obviously our first aim and primary responsibility. When this is achieved, we shall still confront many difficult economic and financial problems not unlike those faced during the war both in character and intensity. Even if wisdom and restraint is exercised with regard to these matters, we shall face employment problems much more difficult in their particulars than in general.

These problems can be met.

They can be met if we understand as clearly as possible the character of the disequilibrating forces which will tend to be dominant in the postwar period and the resulting policies which must be instituted to achieve a more stable, hard-hitting postwar economy.

POSTWAR CONSTRUCTION is predicted to be more than forty per cent higher than in the boom years before the war. This means an outlet for developments which would normally be produced many years later.



SEND IN A SUB!

For Critical Materials

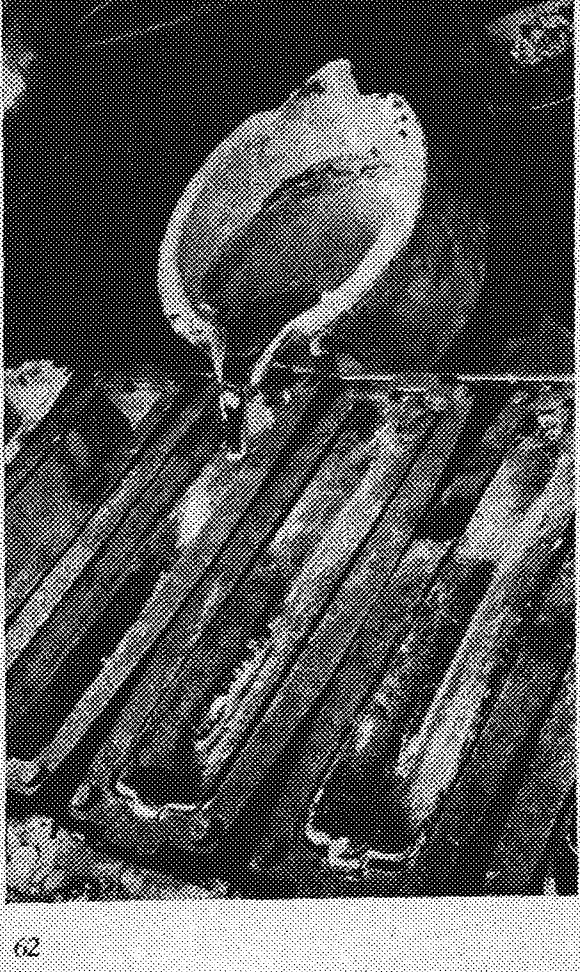
BY CHARLES AMANN, AERO. E., '46

PRIOR to the outbreak of the war one of industry's aims was to get the necessary raw materials at the lowest price possible. With the enormous increase in production resulting from international strife the available supply of materials has decreased so that in many cases this problem has been changed to one of acquiring the necessary materials at any price. To counteract this setback science has set to work to find substances which can be satisfactorily substituted for scarce materials. As alternates are introduced engineers must constantly change designs and specifications to fit the properties of the new materials; hence the subject of wartime substitutes is of vital importance to the profession. Let us look at a few of the substitutes which have been discovered to date.

On a recent list of critical materials put out by the War Production Board aluminum emerged as one of the most vital. Its wide use in structural parts depends largely on its light weight, its resistance to corrosion, and the relative ease with which it can be formed or cast into the desired shape. To show how aluminum has been conserved, in one of the nation's leading electrical manufacturing concerns over five million pounds of the vital metal were saved in making refrigerators by employing substitutes. This same company saved 175 tons of aluminum by merely replacing the aluminum name plates appearing on their products with tags of fiber, etched zinc, cast iron, and lead-base alloys. Statisticians estimate a saving of 500,000 pounds a year by using silvered glass in the manufacture of streetlights, floodlights, and spotlights. What is more, the efficiency of these illuminating devices is increased from 10% to 20% by the change. Large quantities of aluminum have also been saved in making street lights by changing some of the aluminum parts to malleable iron, steel, and bronze.

ALUMINUM, one of our most vital metals, is now being conserved for war production by the use of plastics for small articles and plywood in airplanes.

PHOTO COURTESY OF ALUMINUM COMPANY OF AMERICA



Tin is another metal of extremely high importance in modern industry. Its three chief uses are in tin-base bronzes, babbits, and solders. As yet no satisfactory substitute has been found for tin-base bronzes, but an alternate may be found in time as working with low-tin composition metals becomes more familiar. Experiments with babbits have been more successful, however. In one case a babbit containing 83⅓% tin has been satisfactorily replaced by a lead-base babbit containing only 1% tin. The composition of solders, too, has been changed. In many cases a reduction of 20% in tin content has been satisfactory. Even solders containing no tin at all have been tried out, and although they cannot be used as yet, modifications in technique and soldering irons may make the use of no-tin solders acceptable. Reductions of as much as 50% in tin consumption have resulted from conversions such as these.

There are still a few cases in which tin appears to have no satisfactory alternate, however. For instance, in the soldering of leads to commutators, pure tin joints appear to be the only ones that will resist the high temperature and the centrifugal force of a revolving armature.

A third metal vital to the war effort is copper. Because it is such a good conductor of electricity, large quantities of this metal have been consumed in electrical wiring. It is, of course, next to impossible to find another metal to replace copper when used in this capacity. In the new aluminum and magnesium plants however, silver is being used in busbars, and 16,000 tons of copper have been saved in this way. Copper, when used non-electrically, has in many cases been replaced by malleable iron, steel, terne plate, brass, bronze, and zinc.

Conservation of copper is not confined to industry, however. One interesting saving of copper was made by the Treasury Department. They have revised the specifications for the composition of nickels from an alloy using 75% copper, 25% nickel, to a metal using 56% copper, 35% silver, and 9% manganese. A considerable amount of nickel was also released for use as an electrical resistance material by this change.

In one instance copper has been conserved by the use of soap. It was found that a coating of a neutral soap-base solution applied to 35 mm. cartridge cases eliminated the use of copper plating as a lubricant before the following drawing process. Soap has also been mixed with greases to save on lubricants, and it has been discovered that a soap improves the strength of oil film.

The Non-metals

Now let us turn to a few non-metals for which satisfactory alternates have been found. For many substances falling in this class it is extremely difficult to find a substitute. Tung oil, for example, was used widely in certain insulating varnishes. Oiticica oil was found to be an excellent substitute, but it soon became almost as difficult to acquire as the tung oil itself. Now synthetic varnishes which do not require tung oil have been developed, and their use has cut tung oil consumption in this field some 35%.

Another nonmetal important to the war effort is formaldehyde, which is required for the manufacture of coil-treating varnishes and allied materials. For this substance no satisfactory substitute has been found as yet, and conservation measures have resulted in savings.

Toluol, too, has not been satisfactorily replaced. It is an important ingredient in many varnishes which have fast-drying characteristics and are used for treating materials and as adhesive agents, for instance in built-up mica. Its use has been cut 50% in some plants, however, by mixing it with a petroleum derivative known as Solvesso.

In the electrical manufacturing industry a shortage of shellac had been anticipated for some time, so when supplies of this material were low, a few practical alternates were available for use in electrical apparatus. However, shellac still remains the only known material that forms a satisfactory binder in high-class, built-up mica and in high voltage cylinders. In the case of the latter, phenolic resins have been proved an acceptable substitute for shellac, but shortages also exist of this material, and new alternates are still being tested.

Plastics Help

Plastics, too, are doing their share in conserving materials. In one case where a special thermo-setting plastic is used in a trench-mortar fuse cap, one pound of bar stock aluminum is saved on every fuse produced. Another military use of plastics is in machine gun bullets which are fired from an electrically fired training gun. The weapon, a replica of the 50-caliber Browning, fires the plastic pellets by means of compressed air, and the bullets, if given an occasional soap and water bath, can be used over and over gain. What is more, the plastic missiles cost but one cent apiece, while the regular 50-caliber bullets ordinarily used for training cost in the neighborhood of 30 cents each.

The state of Massachusetts has brought about a great savings in steel by using truck license plates of laminated plastics. Not only were 10,000 pounds of that metal conserved, but the postage bill for mailing the tabs was cut by 75%. Plastics appear to have such great possibilities that our soldiers may soon see the advent of plastic bugles, plastic canteens, and plastic tooth paste tubes.

Many uses of plastics are still on the list of military secrets, but the applications of this material which we do know about would fill a list of amazing length and variety. Among the uses which have been made public are water-cooled and lubricated plastic bearings, which are now replacing bronze for large steel mill roll bearings, waterproof glues of plastic, which are being used in the construction of Navy boats, and forms of rayons and nylons, classified under plastics, which are replacing silk in such roles as material for parachutes.

New plastics are constantly appearing. One entirely new family of plastics is now being built around the element silicon. Plastics in this group are able to stand extreme temperature. One recently developed plastic is expected to stand up for twenty-five hours without stretching, while it is flexed 900 times an hour. Another new metal-like material can be spun in a stream of hot or cold water for the same length of time without swelling or shrinking. Still another new plastic which can be melted or cast without pressure like any metal, is strong enough to stand up in dies used to shape aluminum sheets, and yet this plastic has a weight only one-fifth that of steel. One can readily see where such new plastics as these will take the place of metal in an ever-increasing number of articles.

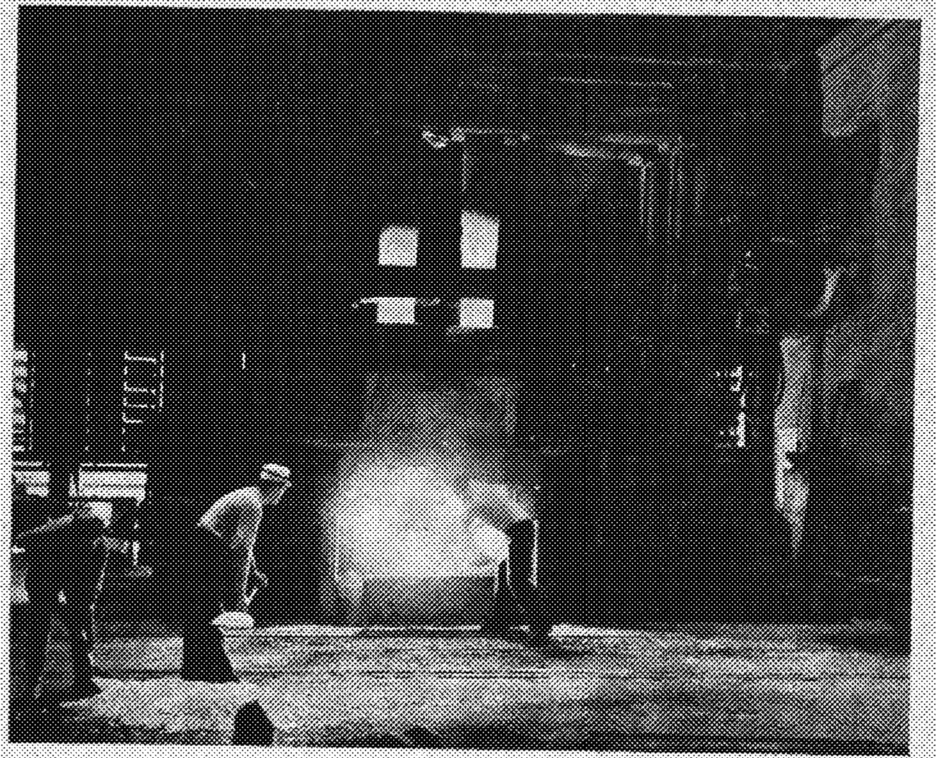


PHOTO COURTESY OF UNITED STATES STEEL CORPORATION

LACK OF CRITICAL ALLOYING ELEMENTS such as chromium, nickel, molybdenum, and vanadium to mention but a few, as well as a shortage of scrap and pig iron has forced many users of steel to turn to alternate materials that fill an amazingly long list.

Although few people realize it, wood is becoming of increasing importance as a wartime substitute. It is estimated that by making products previously of metal construction from wood, 5,000,000 tons of metal will be saved during the year. On the *average*, one thousand board feet of lumber will replace one ton of steel.

One example of how metal is being saved in this manner is in the furniture industry. Not so long ago production of metal furniture was stopped, and wood stepped in to take its place. This was quite natural, for in many cases the metal was finished to look like wood anyhow.

Soon after this change the production of steel springs was sharply curtailed, and again wood did the trick. Wooden springs were soon being manufactured that equalled their metal predecessors in quality. Among the variety of items in which wood is replacing steel are refrigerators, caskets, windowscreens, lawn mowers, weather strip, and even bath tubs.

Across the sea Hitler has not overlooked the importance of wood, for he placed it second only to steel on his list of critical materials. Although he was interested in the coal and iron to be found in the Scandinavian countries, he also had in mind the forests of Denmark and Norway when he conquered those lands. He has set up new chemical plants throughout Germany in which Nazi scientists are experimenting with new uses for wood.

As a result of such steps, 70,000,000 gallons of wood alcohol are annually consumed in aviation fuel. Wood is used in making synthetic rubber, in lubricants for the German mechanized armies, in raw sugar, which is hydrolized from cellulose, in proteins to supplement the meat rationing program, in fodder for livestock, in synthetic textiles and in airplane construction.

Here in the United States, wood is also being used in increasing quantities in aviation. At present, around twenty types of aircraft are built in part of wood plastics. England's most famous mosquito bomber, which has so often brought terror to the Nazis, owes much of its amazing speed to its light wooden framework.

Wood is not only seeing action in the air, but is also returning on the sea. From military barges and patrol boats to seagoing tugs and coastal freighters, wood is replacing metal in ship construction. Along the New England coast craftsmen who had been building pleasure boats have now been set to work on wooden cargo vessels, travelers, and mine layers, and on the Great Lakes and the Gulf Coast, shipbuilders are turning out wood into deadly mosquito boats. Our forests are certainly doing their part toward victory.

Another important substance, although seldom heard of, is sapphire. This jewel, which is used in searchlights, radio sets, and mobile power stations, had always been prepared by Swiss craftsmen. Now, of course, the Swiss supply has been cut off and American scientists set to work on the problem. At the present time a substitute glass jewel is being produced by the hundreds of thousands to fill the gap.

There are but a few of the many substances for which substitutes have been found. The number of alternates for steel alone would fill a list of amazing length. Extensive work with various types of synthetic rubber has also been carried out. The field has only been started, and every day new substitutes are being discovered. What new changes engineering will effect in this field can be answered only in the future.

Now and in the Future

NEW FIELDS FOR GLASS

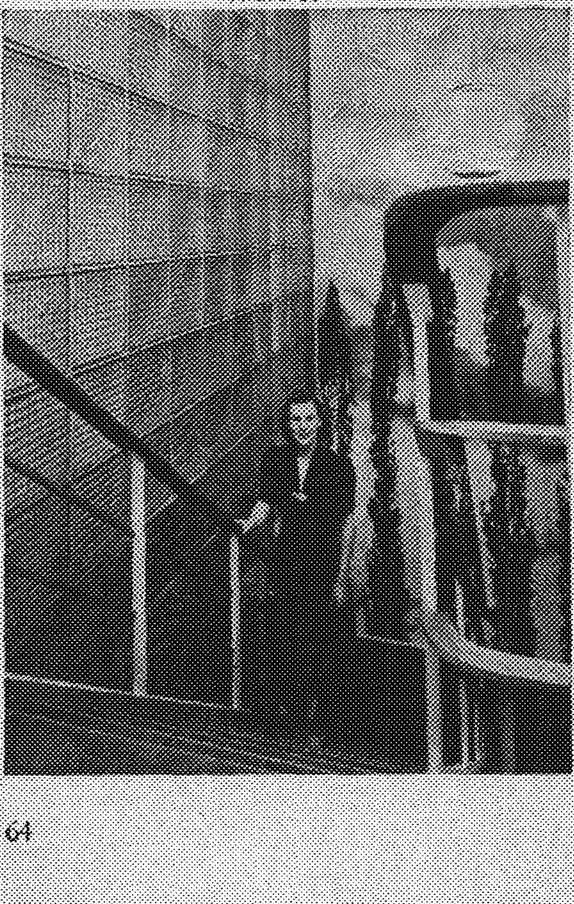
BY KAL LIFSON, AERO. E., '46

GLASS, its research hastened by the shortage of critical substances, promises to become one of industry's most valuable and versatile materials not only as a substitute but also as a unique material vital to both war and peacetime living. In the past two or three years the glass industry has turned out glass that is almost pure quartz, glass fibers, bullet-resisting laminated glass, all glass centrifugal pumps, and blocks of foamglass that weigh one-fifteenth as much as ordinary glass.

The higher the silica content of glass, the more highly resistant it is to chemical action, abrasion, and thermal shock. Scientists have perfected an economical method to produce glass with a 96% silica content—almost as pure as quartz. The process consists of leaching borosilicate glass with acid, leaving a sponge-like silicate material which is heated to 900° C., converting it into the 96% silica glass. This glass is so resistant to thermal shock that ice water can be sprayed on one side and molten metal on the other and yet it will not break. Uses for this glass are unlimited.

GLASS BRICKS will play an important part in postwar construction work. Their ability to transmit light will enable lighting fixtures to be placed in the walls.

PHOTO COURTESY OF WESTINGHOUSE



Foamglass is black, opaque, and buoyant; it can be sawed or drilled without chipping, and it weighs only about one-fifteenth as much as ordinary glass. Foamglass is made by crushing ordinary glass to finer particles than face powder and baking it with carbon dust. As the glass melts, the carbon gas swells it into a spongy mass. When cooled, it is a hardened foamy substance enclosing a mass of tiny air cells. It is a heat insulator, impervious to moisture, and it is more rigid and stronger than most insulating materials. As it is also buoyant, it is now used in floats and life rafts. In the future it will be used for roof insulation.

Glass Fiber

Fiber glass is being used in thermal and electrical insulation. After the war they will be used for fabrics. Light, fireproof, glass wool traps millions of tiny air cells, retarding the flow of heat. It is used for ship, factory and freight-car insulation. Because it can be pressed into boards, there is no necessity of backing it with aluminum, as was done with other insulation on ships.

In storage batteries, coarser fibers in the form of mats are placed as the outermost coating on both sides of the plates. They allow the acids to reach the plates but prevent the paste on the outside of the plates from seeping through, thus doubling the life of the battery. Other uses for glass fibers are as filters and as electrical insulators.

Glass fibers are made by letting molten glass flow through small holes and stretching it into thin filaments with jets of high pressure.

Thick, multilayered, bullet-resisting glass is being made for airplanes, army trucks, and tanks. This glass can be made thick enough to stop a .50 caliber machine-gun bullet. The production problem is to bend the layers of glass so that they will fit. This is done by setting the layers over a hollow metal cradle and heating. When the temperature is high enough, the layers sag into each other without touching the metal.

Glass is used in other ways in airplanes. Ultra-violet absorbing glass is used as a glare absorber on instrument panels and gunsights. Precision bore (0.0001 inch tolerance) glass tubing is used in oxygen-flow meters. Light glass electrical insulation is used in planes. Another use for glass is increasing the performance of the airfoil. By covering the wing surface with glass fibers, the turbulence which occurs between the thin layers of air adjacent to the wing and the outer air is prevented. The fibers are inserted so that they stand upright when the plane is still and are bent when in motion, reducing skin friction.

Glass Piping

Many food, dairy, and bottling companies have installed glass piping because it is non-corrosive and is easy to clean. To utilize the sanitary properties of glass piping to the fullest extent, centrifugal pumps made of glass have been manufactured. Although the pumps are reinforced with metal and have metal power transmission, the fluid never comes in contact with anything but glass. After the war glass piping will be used extensively.

Replacing the jewel bearings used in electrical measuring instruments, glass is standing up under enormous abrasion and crushing forces. Because of the many instruments and the few jewels, a substitute had to be formed. Glass can do it, and it is very much cheaper than the jewels.

Glass Gages

Glass gages, originally designed to alleviate the steel shortage, have proved to be just as accurate and longer wearing as steel gages. There are two methods of molding these gages—the font and precision shrinkage methods. The font method is like the injection molding method for the manufacture of plastics. Molten glass is forced into open-and-shut molds by compressed air or mechanical plungers. The precision shrinkage method is more accurate, permitting tolerances of 0.0001 of an inch. In this process molten glass is forced down a mandrel, and due to the difference in coefficients of expansion, the glass and mandrel separate on cooling.

New Processes

Previously, methods of joining glass to glass have almost all involved some kind of a metal fitting with a rubber gasket. These systems have never been entirely satisfactory because the joint is difficult to make, and there is some leakage. Now, because of the shortage of metal and rubber, glass welding has been developed. It is similar to metal welding in that the ma-

(Continued on Page 70)

Co-operation Needed for

TWIN CITY AIRPORT

BY WILLIAM HOCH, M. E., '44

The past year has seen much discussion about the twin city area as a future air terminal. It is of international as well as national importance that the problem be settled in the near future; many of the proposed great circle air routes pass through Minneapolis and St. Paul. Various plans for a twin city airport or system of airports have been submitted and examined. Officials from both cities have visited Washington to discuss the matter there. During the last session of the State Legislature a committee was appointed to investigate the situation. And the problem even found its way to Congress. In view of these facts the following article was written and is presented here so that the readers of the TECHNOLOG will be better able to understand the possibilities involved.

THE twin cities of Minneapolis and Saint Paul are in reality only one large metropolitan area separated by an imaginary line. Each city has its own government, however, and along this boundary there are constant squabbles, many of which arise from the lack of co-operation between the communities in regard to zoning ordinances. It does not matter upon whose head the fault rests—even if it were possible to determine it. The arguments that arise are merely a crystallization of a general failure of the cities to work together for their mutual benefit, and the most obvious expression of this failure is found at the border of the two cities.

Expense of An Airport

There are many other less-obvious examples of inefficiency and poor cooperation between the cities, some of them leading to duplications of facilities that could easily be consolidated with advantage to both parties and injury to neither. An outstanding example of this, and one that will loom ever larger in the future, is that of a twin-city airport.

At present, each city operates its own airport. "Why," one might ask, "should two cities, geographically so close together, have duplicate facilities for so large an investment as an airport?" Why, indeed? Perhaps an examination of the problems encountered will answer this question.

To begin with, the modern transport plane is a heavy vehicle, the largest of which now in use weighing approximately 65,000 pounds. CAA regulations require a class four airport to have a minimum of 4,500 feet of runway, and variable weather conditions make it necessary to have these runways extend in four directions. Because of the size and weight of the planes, the runways must be made of concrete. This, of course, makes them expensive, and the requirements are essentially the same if five planes are to use the facilities or five hundred. The initial expense of grading and laying runways is large, but it is sharply decreased in proportion as the number of planes in operation is increased. It is estimated that a dual runway system can handle approximately six hundred take-offs and landings in one twenty-four hour day, even assuming that the schedules may not be laid out for greatest efficiency in avoiding concentrations at certain hours. Since runways and the development of the land area of an air terminus is the major expense to a city, the more traffic that can be confined to one major airport, the more efficient the relationship between cost and traffic will become.

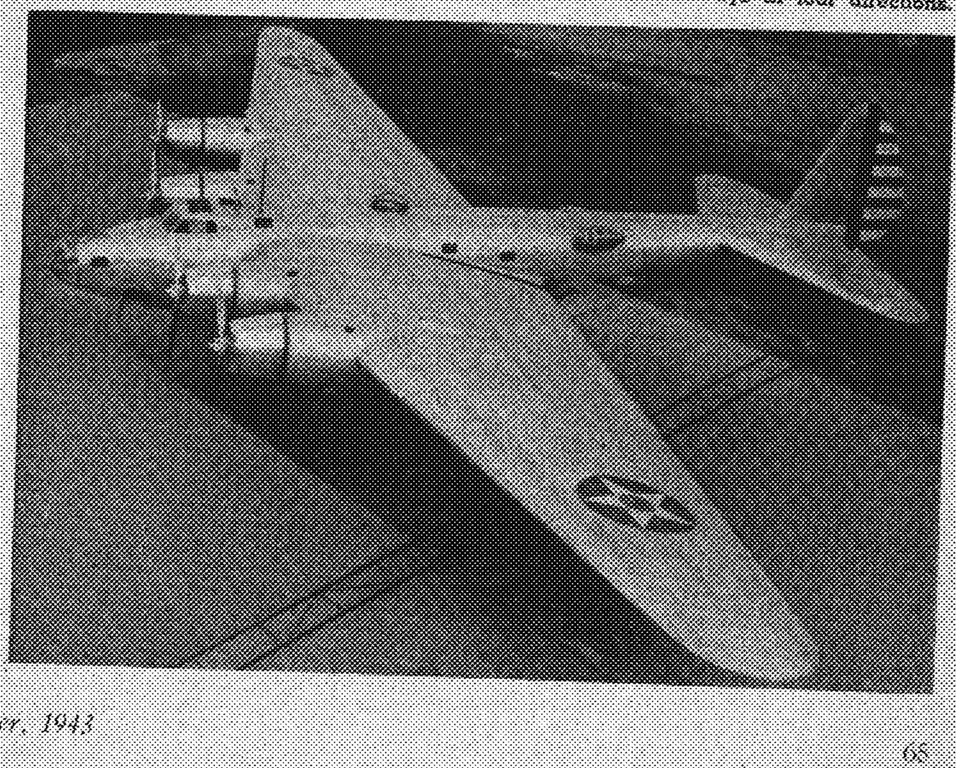
Another major item in the operation of an airport is the terminal building. This would, of course, vary entirely as the amount of traffic that it would be required to handle. However, it does seem reasonable to assume that the cost of building and maintaining one large building would at least be no more expensive than that of two smaller structures handling the same load. In addition, the larger building would probably have more complete facilities for passengers, and represents some advantage from the customers' point of view.

Municipality Improvements

The third consideration is the facilities such as water, sewer, electricity, and other city services that must be extended to a municipal air terminal, as well as connections with urban transportation systems. In all of these there are certain minimum conditions, and it is possible that day to day use may not use even these minimum requirements to their maximum efficiency. In any event, the initial cost of laying or extending water pipe, for instance, is less in proportion for one large main than for two small ones each going to a different destination. Telephone and electric wires

(Continued on Page 72)

HEAVY MODERN TRANSPORT PLANES like this bomber will require expensive concrete runways with a minimum length of forty-five hundred feet. Greater efficiency and variable weather conditions make it necessary for dual runways in four directions.



Can You Supply It?

A SUBSTITUTE FOR PAPER

BY GERALD JOHNSTON

THE enemy has gained control of many strategic materials. How lucky we are that we produce our paper! Paper has innumerable uses and it is only natural that it assumes an important position in every part of the war effort. Paper plans the production. Papers delivers the materials. Paper maps the attack. Paper writes the peace.

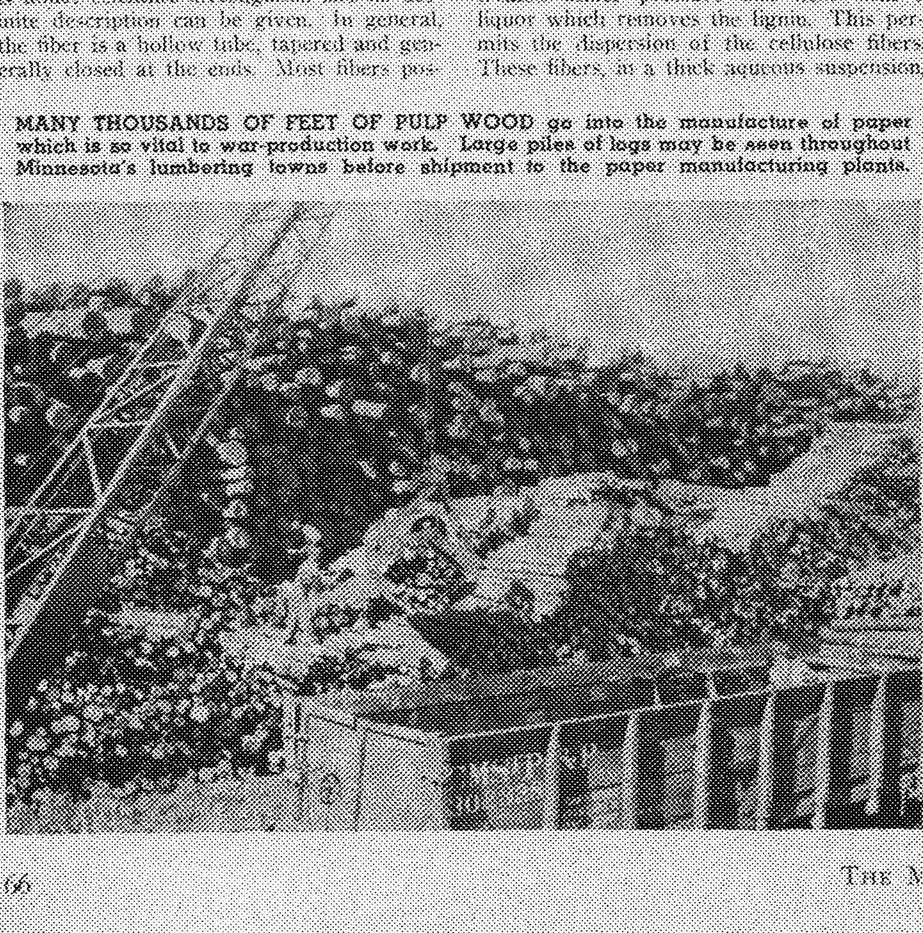
At the present time, there is an acute shortage of paper. Substitutes for such a versatile and economical product are practically out of the question. This will become more apparent as we consider the art and technology of paper making and its many essential uses. This description is concerned with paper board but most of it is applicable to all types of paper.

The raw material consists of cellulosic factions of wood, straw, or other plants. In these plants the cellulose is in the form of a fiber. Usually the fibers will be very similar in any one particular wood but there are many that differ. Fibers vary in length but it has been said that the average fiber length for coniferous woods is about 3 mm., and 1 mm. for broadleaf woods. The width is roughly 1/100 of the length. The exact structure of these fibers is under scientific investigation and no definite description can be given. In general, the fiber is a hollow tube, tapered and generally closed at the ends. Most fibers possess orientated openings of some sort. These are commonly called pits and these are of great importance in fiber identification. The walls of these fibers are evidently made up of smaller units called fibrils. These may be wound spirally around the fiber and their frayed ends can be distinguished after the fiber is subjected to the chemical and physical action of paper making. The chemical unit, or molecule of cellulose, which makes up the fibrils is rather constant in its chemical characteristics. Various samples appear to vary because of their past history or due to presence of lower carbohydrates and other materials. In the manufacture of paper, the ability of cellulose to combine chemically with other materials plays no important part since it remains in its original chemical composition. The chemical structure does affect its colloidal and physical nature and is of primary importance in paper manufacture. The relative chemical inertness of cellulose makes possible the separation of the lignin, waxes, resins and lower carbohydrates which exist with it in the wood. This also insures the permanency of suitably prepared paper. In the pulping process the wood chips are treated under pressure and heat with a liquor which removes the lignin. This permits the dispersion of the cellulose fibers. These fibers, in a thick aqueous suspension, are subjected to a mechanical rubbing and cutting action in a device appropriately called a beater, which cuts and bruises the fiber, opening the fibrils so that water is absorbed with a resulting swelling action. A phenomenon termed "hydration" also takes place. It may be described as a colloidal interaction between the fiber and the water resulting in a coating of the fiber and appears to account for the cohesive forces binding the fibers together in the sheet. This complex action still baffles the paper chemist. In fact, we still do not know exactly why a sheet of paper stays together.

Since one of the most remarkable properties of cellulose is its affinity for water, it is necessary to use special processes in order to obtain water resistance. The results are no less than miraculous when one compares a non-waterproof blotting paper with a liquid tight container. The most common and most important waterproofing process is known as "sizing." Rosin is admirably adaptable to this process. It is composed largely of high molecular weight acids (abietic acid) and was an original associate of the cellulose in the wood. The sodium salt prepared by saponification is dispersable within the paper stock in the beater. This dispersion is then precipitated upon the fiber by the addition of aluminum sulphate (Paper Maker's Alum). In this free form, or combined with the aluminum ion, rosin causes the fiber to resist transfer or absorption of water. Since 4-5% rosin will make paperboard waterproof, it is inconceivable that this could be a simple coating action on the fiber. The vast areas involved preclude the fact that this amount of rosin could form a continuous coating. Therefore, the success of sizing has been explained by the Contact Angle theory. That is, the pores of the paper are coated with an amount of rosin which repels a drop of water at a high contact angle. Thus, since the water does not wet the paper, it does not pass through it. A sieve coated with oil or wax will carry water. After the beating and sizing process, the fibers are separated from the water to form the sheet of paperboard. Naturally, there are many different methods of separation but they all operate on the basis of screening the fibers from a dilute suspension into a continuous mat. This mat is then gradually pressed between woolen felts until sufficient water is removed so that the mat can support its own weight. After further pressing, the mat is passed around steam-heated rolls to remove the remaining water. The paper can then be cut into sheets or

(Continued on Page 70)

MANY THOUSANDS OF FEET OF PULP WOOD go into the manufacture of paper which is so vital to war-production work. Large piles of logs may be seen throughout Minnesota's lumbering towns before shipment to the paper manufacturing plants.



Tau Beta Pi Essays

FOOD FOR THOUGHT

Culture and the Engineer

THE word culture is a very difficult one to define. In general when one thinks of culture, he thinks of what are termed the nicer things in life, good music, literature, poetry, and the arts. There is more, much more, however, to the true meaning of the word. Culture is what man has been passing down from generation to generation. It is the culmination of mankind's achievements. It is represented by what is called good in all fields since only the best can survive down through the years. It is, therefore, worthy of the highest appreciation one can give to it.

Cultural subjects are those which all people can use as a basis for conversation. They are common bonds which cement together people from all stations in life. For example, if an ordinary housewife were to engage in conversation with the chief chemist of a chemical company, she would not be interested in the details of the manufacture of B-anthraquinone sulfonic acid, nor would he be interested in knowing how many eggs she used in making an angel food cake. However, if they both have trained interests in some of the aforementioned subjects, they will be able to carry on a conversation to which both can contribute an equal amount.

Students of science, literature, and the arts spend their entire four years of college taking such courses as philosophy, ancient history, humanities, music appreciation, psychology and language to improve their general knowledge along these lines. Engineers, on the other hand, must follow a curricula entirely devoid of such subjects except for English composition. They, too, need this cultural background, but when can they obtain it?

A proper beginning for a true cultural background can well be made in high school, even in junior high school. The curricula includes literature, history, science, music, and the like, all of which are truly representative of the essence of mankind's achievements. If the student applies himself at this time, he can sow the seeds of intellectual curiosity. These seeds, if once started in fertile ground, will continue to grow in spite of every obstacle.

When taking an engineering course, one is usually required to carry about eighteen hours per quarter and has, therefore, little time to be devoted to anything but his technical books. Yet, must his cultural development cease? The answer, of course, is no. Even if he read nothing but technical literature, and even if he talked to no one outside his own field, he would be able to expand. Good history, the history of science, is in every textbook. In this modern world of machines and synthetic chemicals, this history is every bit as important as the political history which for the most part is dependent on the former. Thus a student continues to grow culturally even during his highly technical training. He must, however, avoid becoming a technical introvert by devoting some of his scant spare time to purely cultural pursuits. This he must do so as not to localize the growth of the seeds he sowed long before.

After graduation he will have more time to spend as he wills. If he has maintained his interest in good things, he will always be using these hours to advantage. Not only will he provide entertainment for himself, but he, by knowing more about the world in which he lives, will be a more desirable and interesting person to know.

Although engineers make their living by their technical knowledge, they should have sufficient cultural background to enable them to be good envoys of a respectable profession.

ROBERT C. OLSON

What Is Right?

A BANK is robbed, a man is murdered, an animal is tortured, and we frown and speak of the wrongs of the world. A man smiles, speaks a kind word, or offers help where help is needed, and we laud his actions as being right and good. Yet, why do we say that one thing is wrong and another act good? Do we have some sixth sense, some sort of conscience that tells us absolutely what is right and what is evil? For several reasons, this seems unlikely. For one thing, ideas of righteousness vary from town to town, from country to country; hence, if we claim that our conscience tells us what is right, we must deny that it is absolute. If, on the other hand, we assume that conscience is absolute, we are led to the conclusion that either it does not tell us what is right or that it tells only one group in the world with a certain set of morals what is good and tells no one else. That conscience tells us nothing is a meaningless deduction and that it tells only one group what is right leaves us with the puzzle of who the favored group might be. To deny the existence of conscience would be to deny a feeling that nearly everyone has experienced. Therefore, it would seem that conscience does indeed say certain things are good and certain things evil, but that it is not absolute.

Once this conclusion is made, we are immediately beset by the problem of where conscience gets its ideas of morality in the first place. One need but observe a small child in action to get an answer. Probably everyone has seen a youngster do something like breaking a vase or dumping ashes on the floor and probably everyone has also noticed how the smaller edition then looks about and notes the reactions of the adults present. If the elders smile or laugh, Junior inevitably responds with a repeat performance, and if the elders look displeased, he fades into a corner. Thus, it appears that conscience learns "right" from "wrong" by way of the senses. This in turn means that we gain our ideas of righteousness from what we read, from what we hear, and from the attitudes of those with whom we associate.

But, since we cannot appeal to our conscience, where then can we find what is right and wrong in absolute terms? Unfortunately, this question cannot be answered so easily. The majority, of course, would answer in the light of their own tenets, and as a result there would be a large number of different answers. Yet, it doesn't appeal to reason that all these various doctrines are correct since often they are contradictory. One cannot therefore be any more sure of knowing right from wrong by blindly following one belief than he can by following his conscience. There is a possible way out of the dilemma, however, and it lies in the words, "by their fruits shall you know them." Of course, it was probably with men in mind that this phrase was originally used, but applying it to notions of morality also seems like a good idea. If "fruits" is taken to mean the welfare of mankind, this rule might be restated: "Good and right is that which results in the greater welfare of men."

By this rule of thumb, it can be seen that the doctrines of National Socialism would be immediately marked "evil," for they have resulted in more misery for mankind than mankind has known for many decades. Similarly, Shinto would receive a mark of disapproval because, not for decades, but for centuries it has resulted in poverty and degradation for the Japanese people and in death and terror for whomever was unfortunate enough to be in the vicinity of Japan. As a matter of fact, it would seem that, whether they are cognizant of it or not, the United Nations are fighting precisely in accordance with this notion of right and wrong.

EARL LINNE

Glass

(Continued from Page 64)

terial is raised to the fusing temperature for joining. A portable apparatus is used to generate a high frequency current and convey the arc to the glass with a small hydrogen flame.

Glass-to-metal joints are now made by electroplating the glass with copper, to which a thin metallic layer is bonded, thus forming a metal surface for soldering metal parts.

As a metal substitute, glass has to satisfy the same specifications of polish as metal. Formerly, tolerances of one thirty-second to one sixty-fourth of an inch on glass products were considered good, but now glass is turned out with a 0.0001 of an inch tolerance. Of course, the most accurate polishing ever done has been done on glass in the form of optical lenses.

The multiform process for cold-molding glass enables accurate perforations and intricate shapes. This process, just recently developed, can be used on a wide variety of glass products.

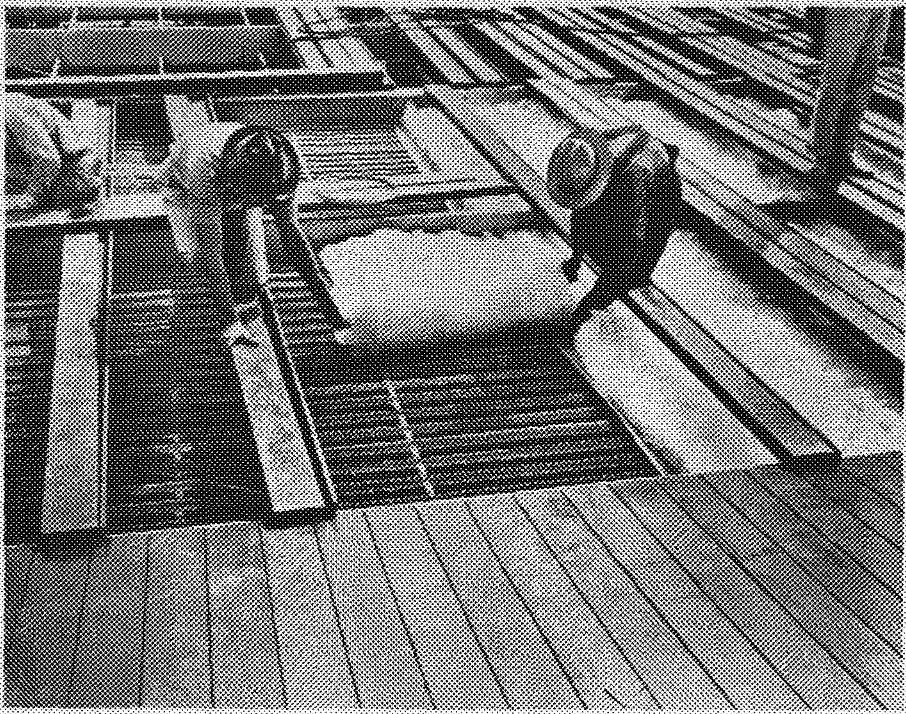


PHOTO COURTESY OF OWENS-CORNING FIBERGLAS CORPORATION

FIBER GLASS INSULATION is being used extensively in many war-housing projects. This same material when used for insulation of electrical equipment permits higher operating temperatures with the resulting increased ratings and efficiencies.

Glass in the Future

After the war all the developments in glass research will be converted to consumer interests. There will be large frying pans and roasters of glass. One glass company has dreamed up a glass refrigerator and a glass oven. The virtues of bent, laminated glass will be used in automobiles. Double-glazing, now used in Pullman windows, will be used to develop a solar-heated house. Glass blocks will be used in construction, and there will even be fire-proof curtains of glass fibers.

Glass is a material of almost limitless application. It is strong, workable, an insulator, abrasion-resisting; and it is inexpensive. It has shown its value in helping to win the war and its value in making the postwar world easier to live in.

Paper

(Continued from Page 66)

wound into rolls as desired and put to many uses.

The ordinary solid fiber shipping case has enlisted and gone through vigorous training under fire. The usual Solid Fiber container would separate into its individual laminates after several hours immersion in water. Now, a super shipping case of the same weight is being made from the same basic material—Solid Fiber paperboard. This has been accomplished by increasing the water resistance of the paperboard, increasing the water resistance of the adhesive and, introduction of scientifically placed water impermeable barriers to keep the interior of the fiber board dry.

The paperboard is made more waterproof by the judicial use of the present-day sizing methods. The main accomplishment has been the correct distribution of the water-proofness in the individual plies. It is necessary that the outer surface of the ply, next to the adhesive, be of exceptional waterproofness, eliminating wicking of moisture which has a dissolving effect on the adhesive permitting the plies of solid fiber board to separate. If this waterproofness is maintained throughout the entire sheet production drops rapidly. Therefore, process changes were made permitting different degrees of waterproofness in different parts of the sheet.

Even with the new waterproof board, a suitable solid fiber board could not be made without waterproof adhesives. The starch and resin manufacturers with the co-operation of the solid fiber industry have solved this problem. From innumerable plant trials a starch-urea-formaldehyde adhesive was developed which would operate on existing laminating equipment. The adhesive base is made up of modified corn starches. With the recent shortage of corn, even rye flour has been substituted for part of the starch. In order to render the adhesive more waterproof, a water-soluble urea-formaldehyde resin is blended with the starch solution. A catalyst such as ammonium chloride is also added to promote the gradual polymerization of the urea-formaldehyde resin, proceeding to the point where it becomes completely insoluble in water as it dries in the laminated board.

To this highly water-resistant board has been added a protective liner of water-impermeable material, reducing the penetration of water into the interior of the board, thus preserving its strength. Most of the penetrating water must come through the edge and not from the flat surface. The rate of penetration is a fraction of an inch per day so that it is only after several days' immersion that the interior of the sheet actually becomes wet.

The resulting "V" container made from such board is tough and ready for any conceivable emergency. It may be totally immersed in water for days or weeks and still carry the contents. Packed with its contents; for example, canned food, the container may be dropped on its corners on a concrete floor from a height of 30 inches as many as 20-30 times without failure after a 24-hour water immersion. In fact, the cans of food may be opened before the box fails. The problem at this time is to provide interior packing which will protect the contents under all conditions. Aside from these master shipping containers, many small cartons are used. Almost without exception they have been designed to do a certain job; for example, the Army K Ration, which is composed of a variety of foods in compact form, is placed in a highly moistureproof bag and shipped into a carton. The carton may then be dipped in wax and placed inside an outer carton which gives very efficient protection with disposable materials.

Some new cartons have developed along with new products. Eggs are being dehydrated and shipped to our allies, affording a great saving of space. Much more space and weight is saved due to the fact that suitable paperboard rectangular carton has been developed. It consists of an interior greaseproof surface laminated to the outer paperboard by a moistureproof barrier. After the contents are packed, the carton is dipped in wax for added moisture protection.

These and many other products are made largely from waste paper. There is a tremendous need for waste paper to replace the large amounts which are leaving the country today and to replace critical pulp. Until the day when the chemist can find a suitable substitute for paper, the best thing he can do is to SAVE IT and SELL IT.

Airport

(Continued from Page 65)

would require only one set of poles or conduits as opposed to two. For almost every service the cost of one large system would represent a saving over the expense of two smaller ones.

At this point a question naturally arises. A twin-city airport starting from scratch would have a definite advantage over two smaller units. Granted. But we are not starting from scratch—there are already two airports in existence, and both are now in operation. Would it not be better to make use of these facilities which are already set up than to follow the deal of a joint undertaking? If expense is so important, can we afford to throw away that which we already have?

Choice of Airports

The answer to these questions depends largely upon the airlines themselves and upon the future importance of air travel and transport. Specifically, no, we cannot afford not to make the fullest possible use of the airports we now have. But, on the other hand, airline companies cannot operate between two airports that are within ten miles of each other. They will set up their offices and shops at one or the other and use it exclusively. So it is not a matter of both airports getting an equal share of the traffic, but rather of one getting all and the other nothing. Whichever city gets the airline traffic—and one would most certainly get nearly all of it—would benefit enormously, while the other would have to take what is left.

The airlines have already decided upon which of the twin-city airports they will use, and there seems to be little likelihood that they will find it necessary to change their decision. The major airlines are now operating from the Wold-Chamberlain field in Minneapolis—in fact, one of them has now moved its main offices, and the facilities already erected represent a capital investment so great that only the most extreme conditions could cause a transfer.

Future of Aviation

As to the future of aviation, few persons can do much more than speculate. There are stories of colossal new sky ships that will be built immediately after the war. We hear of helicopters, rocket ships, and lighter-than-air craft that may revolutionize the industry. Some experts contend that all except the heaviest freight will be shipped by air transport, that practically all passengers and tourists will ride in luxury and safety in the sub-stratosphere conveyances of the near future. The ideas are many and varied, and some of them, at least, must be taken into consideration. But it is well to remember that such revolutionary changes do not come overnight; all such speculation must be tempered with reason. It is true that war has brought a tremendous stimulus to the field of aviation. It is certain that these advancements will have many peacetime uses. But while the changes may be accelerated, they will still be gradual. The dreamers suggest the direction and scope of the field, but their ideas are useful at present in only a general sense. From them two conclusions may be drawn about the airport of the future. First, that it will probably be a larger, busier place than it is now. Second, that its functions will certainly be more complex and more specialized than they are today. Because of our inability to forecast coming events, it is impossible to plan the future. We must, however, provide for it, and the only way in which this is possible is to allow room for expansion so that existing conditions may be expanded and changed as the need arises.

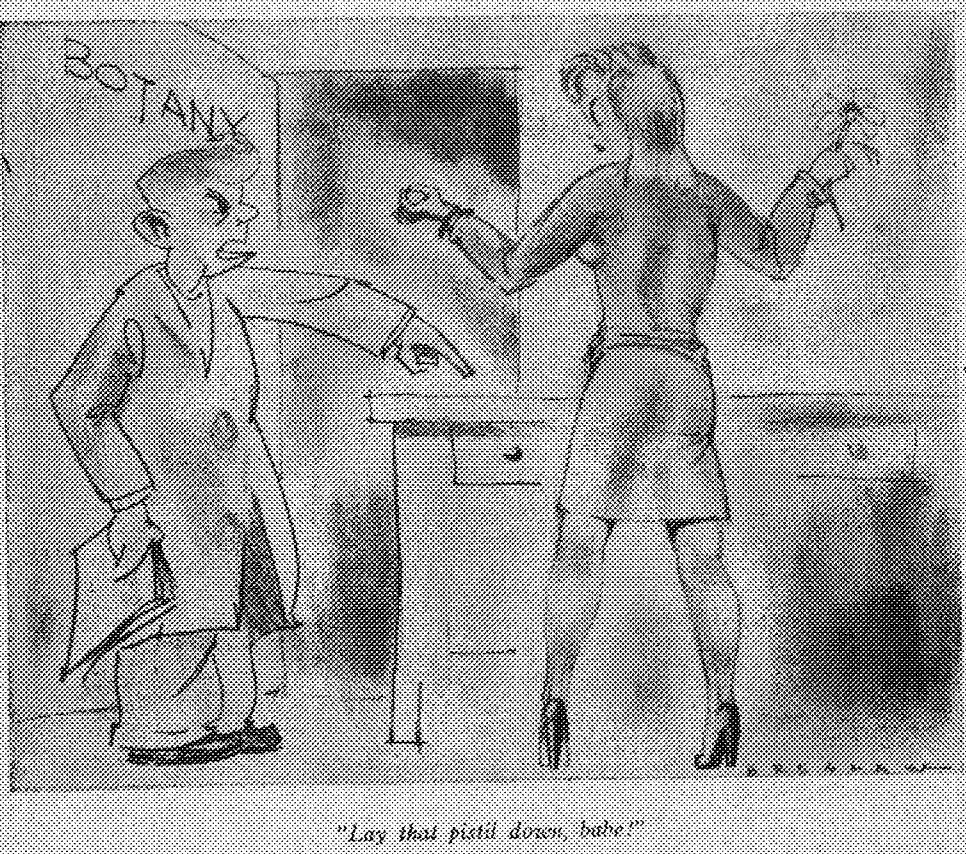
The fact that Wold-Chamberlain field has been chosen by the airlines would seem to indicate that there are possibilities of expanding it to fulfill any needs that may arise for a considerable length of time. A recent check on this has been made by the Minneapolis Board of Park Commissioners, who, in the report to the City Council stated, ". . . we find that its present size, length of runways, etc., are insufficient to meet ultimate requirements, but that by enlargement, all of the requirements can be amply met . . ." In its enlarged aspect, it can adequately serve both cities. With this report was given a plan of expanding the airport to the east and west, so that the runways may be extended to roughly twice their present length. This would also allow sufficient space for a corresponding expansion of hangars, shops, and other buildings.

Wold-Chamberlain Field

In addition to being a more developed project than the St. Paul airport, the Minneapolis field derives a considerable advantage from its location. It is almost ideally located to best serve both cities, the distances between it and the loop districts of the two communities varying by only a half-mile. Also, since it is servicing both areas as a passenger terminal, transportation to each is well defined. It is doubtful whether it would be possible to find a better site for a twin-city airport than Wold-Chamberlain.

Inspected from an impartial viewpoint, a twin-city airport appears to be an improvement for both areas. Under such a plan, Wold-Chamberlain exists as an almost ideal solution of its placement. The present St. Paul airport could be operated in conjunction with the program and used temporarily as a repair and overhauling depot. With the development of air transport and freight lines it might even become necessary to convert it completely to a cargo terminal. In any event, it would not go unused.

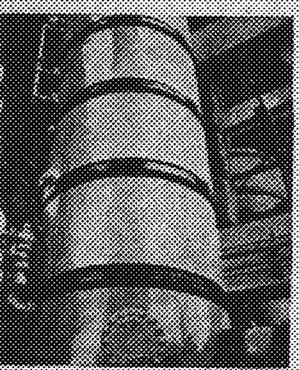
The legislators of Minneapolis and St. Paul will have to come to some sort of an agreement upon air terminal facilities—the sooner the better. Projected air routes and postwar developments in aviation will certainly call for rapid expansion and conversion of all air facilities, and, if such a route as the projected Chicago-Minneapolis-Edmonton to Alaska and Russia run is put into operation, the twin cities might well become one of the most important air terminals in the world. If the problems of joint ownership could be settled in the near future, Minneapolis and St. Paul would be in a position to make the most of whatever the field of aviation has to offer at the close of the war.



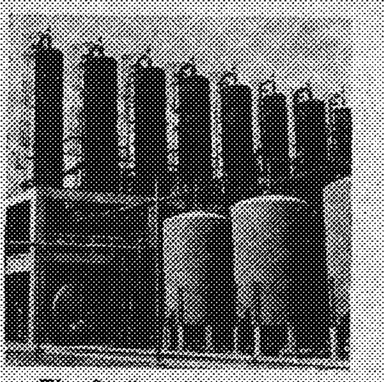
"Lay that pistil down, babe!"

TEN YEARS' WORK IN TWO

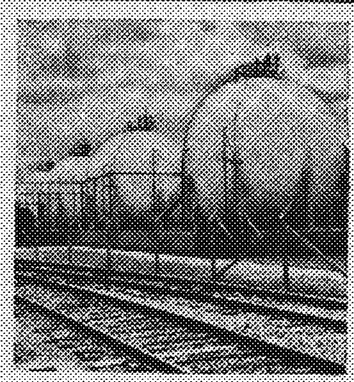
is the story behind Butadiene and Styrene for Synthetic Rubber



Distillation Column for Styrene



Where Distillation Columns separate and purify the Butadiene



Butadiene Storage Spheres

WE WISH YOU could see the first of the Government's large integrated synthetic rubber projects, complete at one location. What you see here is a night scene and some daytime views of the immense butadiene and styrene plants that CARBIDE AND CARBON CHEMICALS CORPORATION, a Unit of UCC, has designed and built at Institute, West Virginia, for the Government's Defense Plant Corporation and is operating for the Rubber Reserve Company.

Carbide and Carbon also has completed another butadiene plant at Louisville, Kentucky —and has released plans to Koppers United Company for a third butadiene plant near Pittsburgh, Pennsylvania.

Butadiene had never been manufactured in the United States in large quantities before the plants at Institute went into production. The task involved in providing the mass production facilities the Government asked for was an unusual one…but one that took full advantage of the experience and processes developed by Carbide and Carbon.

Generally, it requires seven to ten years for a company to take a process developed in the laboratory, put that process to test in a pilot plant, iron out production problems, design a full-size plant, and then actually build the plant and go into mass production.

By working at top speed for twenty months —Carbide and Carbon telescoped research, development, engineering, and construction work that would have taken 10 years in normal times. In this short time laboratory research was translated through chemical engineering into larger and more modern facilities for producing the chemicals for synthetic rubber than existed anywhere else in the world.

This achievement could never have been possible had it not been for the years of research and experimentation which, prior to the emergency, Carbide and Carbon had devoted to the production of synthetic—or man-made—chemicals of the organic series.

Business men, technicians, teachers, and others are invited to send for the book "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol" which explains what these plants do, and what their place is in the Government's rubber program.

* * *

BUTADIENE, (bew-ta-dý-een). A highly volatile liquid which is the principal chemical in the manufacture of Buna synthetic rubbers.

STYRENE, (stý-reen). A liquid, like benzene, but having the property of reacting within itself to form a solid, clear, plastic mass. It is used as one of the principal ingredients of Buna S synthetic rubber.

BUY UNITED STATES WAR BONDS AND STAMPS

CONSTRUCTION RECORD AT INSTITUTE

June 25, 1941 — Carbide and Carbon submits definite production estimates.

July 31, 1941 — Design work starts on 10,000-ton-a-year butadiene unit.

Aug. 22, 1941 — Government authorizes construction.

Dec. 7, 1941 — Pearl Harbor

Dec. 15, 1941 — Design "frozen" for 20,000-ton-a-year alcohol-to-butadiene plant.

March, 1942 — Japanese occupy Malay Peninsula and Dutch East Indies; cut off about 90 per cent of U.S. natural rubber supply.

April, 1942 — Construction on the first of four 20,000-ton-a-year butadiene units starts at Institute, W. Va.

July, 1942 — Construction of 25,000-ton-a-year styrene plant starts.

Sept. 10, 1942 — Rubber Survey (Baruch) Committee report accepted.

Jan. 29, 1943 — First large-scale, alcohol-to-butadiene unit goes into operation two months ahead of schedule.

April 7, 1943 — First styrene unit begins operation.

May 25, 1943 — Fourth 20,000-ton-a-year butadiene unit begins operation at Institute plant.

August, 1943 — Four 20,000-ton-a-year butadiene units producing at rate of 120,000 tons a year—50% over rated capacity.

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York 17, N. Y.

Principal Products and Units in the United States

ALLOYS AND METALS
Electro Metallurgical Company
Haynes Stellite Company
United States Vanadium Corporation

CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS & BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS: Bakelite Corporation • Plastics Division of Carbide and Carbon Chemicals Corporation

AS WE SEE IT

Our Good Neighbors

The bugler's call of "Assembly" for battle has been answered by the American engineer and he has heard "Taps" sound the end to the careers of many colleagues. "First call" to postwar activity is on the air; increasing activity and interest are reflected in the work of planning commissions and groups in all walks of life. We cannot overlook this opportunity to point to the foresight of our distinguished alumnus, co-author of the 2B-2H resolution, Senator Joe Ball.

Of growing interest to the engineer are the inter-American relationships, both as war measures and as permanent activities. Today coöperation is concentrated on support of the United Nations in their struggle to eliminate Axis aggression. When this objective has been reached the Americas will be free to raise their living standards. Inter-American coöperation is built on the good-neighbor policy which ten years ago President Roosevelt outlined at the beginning of his administration.

The work of the Office of the Coördinator of Inter-American Affairs is based on this policy. This organization was formed after the fall of France in 1940. Latin America was facing the problem of loss of foreign markets on which they were so dependent. The United States realized this and did its best to help. Our imports from these stricken South and Central American countries increased in 1941 to almost a billion dollars; double the pre-war level.

Before the war the Inter-American Development Committee was created to collaborate between private industries and the 21 American governments to foster new industries and trade. The U. S. Export-Import Bank is another important agency coöperating in the promotion of the general policies of this country along these lines.

After Pearl Harbor the inter-American program went into high gear. Projects for the development of strategic materials, improvement of transportation and communications, and expansion of food supplies were undertaken. These are for war needs; but they are forerunners of a better economy. What is being done is not just temporary—it will probably continue at a greater rate and on a basis such that eventually governmental aid will be unnecessary.

The days of the pioneer in engineering are not over by any means. There are real frontiers in South America; hydro-electric resources have just been tapped, only two million kilowatts in operation out of a potential 80 million or two and one half per cent utilization as compared to the 76 per cent in the United States. Current professional publications are full of articles on future developments in Latin America, ranging throughout the engineering and industrial fields—communications, transportation, power, manufacturing, sanitation, irrigation, highways. And in this development the engineer will play an impressive and important role; but whether it is in foreign relations, inter-American trade, or engineering endeavor, coöperation will be the keynote to success.

Build Now

Now is the time to build a firm and sound foundation—a foundation for your life. Most of the engineers in the Institute claim they are getting a good foundation. In engineering, yes, but there is more to life than engineering. We have our curricula all made out and all we do is select the appropriate hours to fit the classes. Occasionally, we drag ourselves away from the engineering building and pay (homage) to the cue-ball parlor in the Union. And that is our University existence. We do not take advantage of all the opportunities offered here. Now, while we have the chance, and the facilities, is the time to round out our lives and build our background.

Those of us who are socially backward can overcome it if we put our mind to it and try to participate in Union activities. If you want to learn how to dance, the variety dances will teach you the how of it.

The University speech clinic will help you to be able to approach people and conduct an interesting and pleasant conversation. And if you don't think that is important (in industry) look at all the successful wolves around.

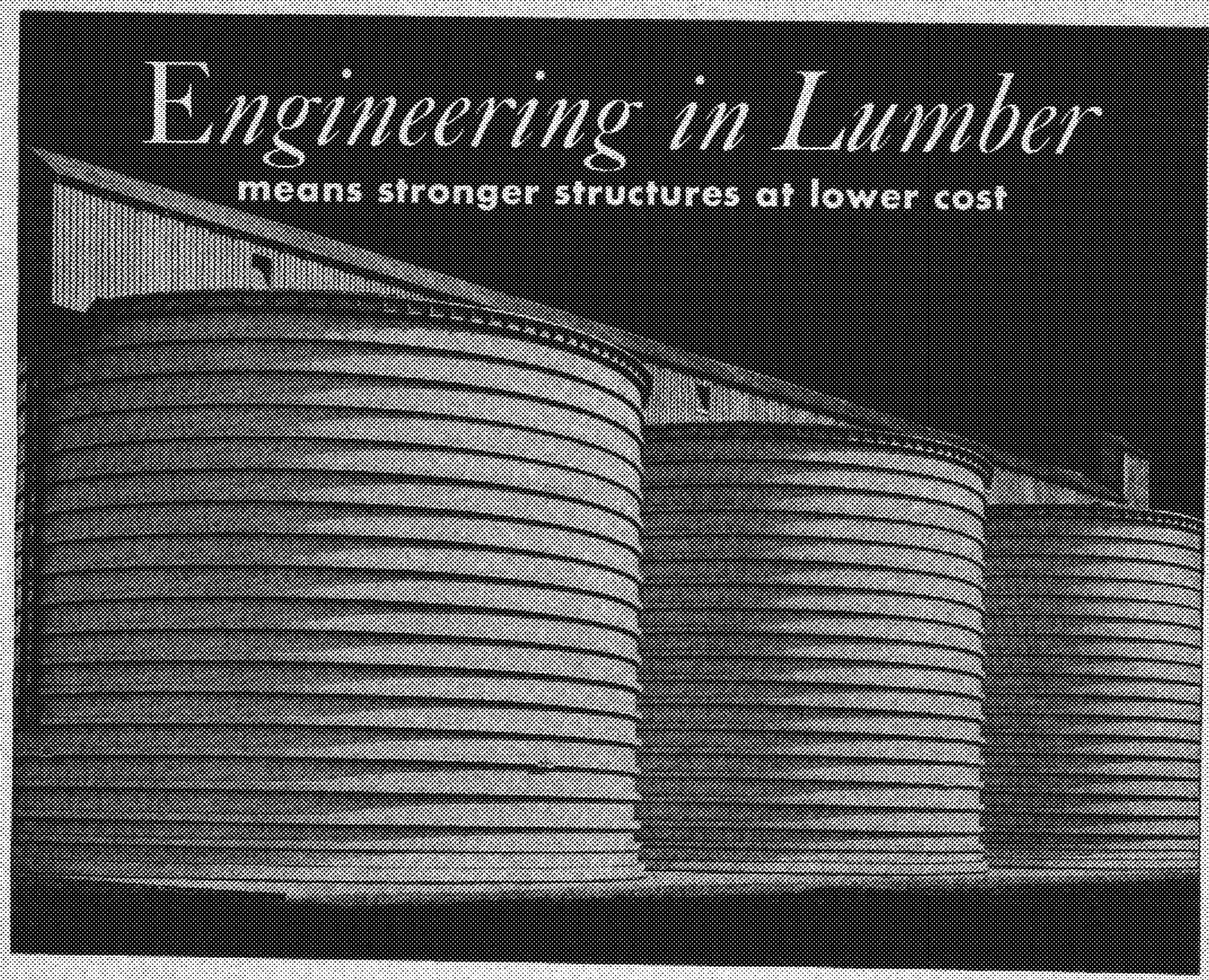
Should you want to express yourself on paper, the TECHNOLOG is always willing to accept material.

There are also many fraternities and societies open to students to help them to meet friends and give them opportunities to be leaders.

Besides obtaining a social background, we should have an understanding knowledge of the other branches of engineering. Fine lectures and other material are presented here to the student body for just such a purpose. Not enough of us take advantage of it though.

The purpose of a university is to make you a more useful and happier citizen. The opportunity is served on a golden platter, for never again will we be able to get another chance. People in general and employers in particular, prefer a person with a well-rounded education, rather than straight technical knowledge.

Are you taking full advantage of the University? Rate yourself and act.



● In these soy bean storage bins wood again demonstrates its wide adaptability as a structural material that delivers the finest type of storage at the lowest cost per bushel.

The development of modern structural glues made possible the fabrication of strong laminated wood bands. These bands were engineered to meet the load requirements. As the pressure decreases at the top of the bins the number of plys in the bands are reduced. The wide, laminated wood bands in tension provide adequate resistance to bursting pressures. Their broad bearing surfaces permit the use of relatively thin (1¼ inches) Douglas Fir flooring applied vertically which forms rigid walls and saves material.

The frame work supporting the conveyor housing, which extends along the top of the bins, consists of two timber Teco connected trusses. The span is forty-seven feet between the supports.

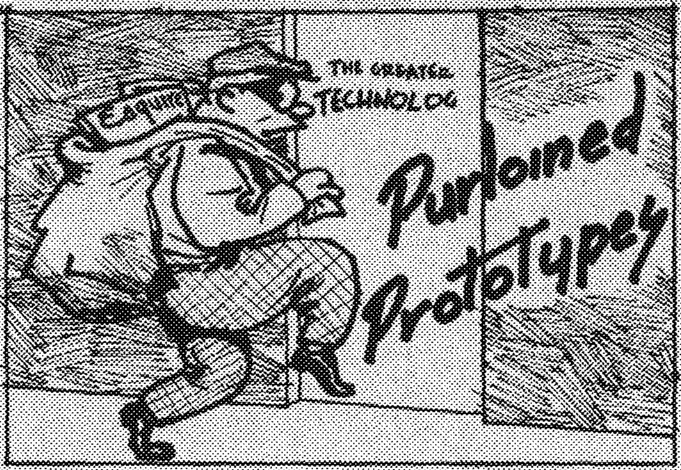
Advances that have been made in better and more economical use of lumber through wood lamination and the Teco connector system of construction, are well demonstrated in these bins. This cylindrical storage offers more cubage per linear foot of wall than any other type of structure.

Engineering in lumber will continue to broaden the field for lumber-built structures, because it will bring to our peace-time needs more efficient and more economical methods of building with wood.

As a result of the marked advances in Lumber Engineering, architects designing the future homes, service and commercial buildings, will find in wood a new versatility through which to assure more practical building functions.

WEYERHAEUSER SALES COMPANY
FIRST NATIONAL BANK BUILDING • SAINT PAUL, MINNESOTA

4-SQUARE LUMBER



BY BILL SANFORD, M.E., '44, AND HERB ROCHEN, A.E., '44

The jawbone of an ass is just as dangerous a weapon today as it was in Samson's time.

* * *

"Papa," queried the son, "what is the person called who brings you into contact with the spirit world?"

"A bartender, my son," replied the father.

* * *

He: "Do you know the difference between being good and being bad?"

She: "What's the difference?"

He: "That's what I say. What's the difference?"

* * *

An old farmer and his wife were standing before their pig sty looking at their only pig when the old lady said, "Say, John, it will be our silver wedding tomorrow. Let's kill the pig."

John replied with disgust, "What's the use of murdering the pig for what happened 25 years ago?"

* * *

Coed in S.L.A.: "I like guys with blue eyes and greenbacks."

* * *

Army Doctor: "Have you any physical defects?"

Selectee: "Yes, sir. No guts."

* * *

"Oh Mummy," said wee Annie, "look at the funny man across the street."

"What's he doing?"

"He's sitting on the sidewalk talking to a banana skin."

* * *

Many an argument is sound—just sound!!

* * *

Old Jim Bidwell, a pioneer of California, married a squaw. After forty years, she died, and Jim went East, married a school teacher in his old home town and brought her back.

The Bidwells hadn't been home long when kind and loving ladies of the town came to call.

"Of course," they said, with many smirks and side glances, "of course, Mrs. Bidwell, you understand, or maybe you don't know, that your husband's first wife was an Indian—that he married a squaw."

"Yes," replied the second Mrs. Bidwell sweetly, "I have been told so, and judging from the white women I have seen here, I don't blame him."

* * *

Caller: "Is your mother engaged?"

Little boy: "I think she's married."

* * *

Jock MacDougal had blown his lassie to a movie and hailed a cab to take her home. When he assisted her in, she, knowing his natural bent where money was concerned, remarked: "Oh, Jock, it does make me feel awfu' wicked, ridin' aboot wi' you like this."

At that Jock brightened perceptibly. "Then, mebbe," quoth he, "it'll be worth the money after all."

OUT OF THE ARK

Q: "Do you know why the little bee buzzes?"

A: "You'd buzz, too, if somebody stole your honey and nectar."

* * *

The following sentences were taken from actual letters received from mothers and wives of men in the service. They were either making or correcting applications for allotment:

1. Both of my parents is poor and I can't expect nothing from them as my mother has been in bed for one year with the same doctor and won't change.
2. Please send me my wife's form to fill out.
3. This is my eighth child. What are you going to do about it?
4. I can't get my sick pay. I got sex children. Can you tell me what this is?
5. I have already had no clothing for this year and have been regularly visited by the clergy.
6. Sir: I am forwarding my marriage certificate and my two children. One is a mistake as you can see.
7. In accordance with your instructions, I have given birth to twins in the enclosed envelope.
8. I have already wrote to the president and if I don't hear from you, I will write to Uncle Sam and tell him about you both!

* * *

Knees are a luxury. If you don't think so just try to get hold of one.

* * *

Oh, what a lovely world t'would be,
And folks, I don't mean maybe,
If Mamma Schickelgruber
Had never had a baby.

* * *

Comstock coed (to doctor): "I blush so easily, Doctor. Whenever I sit down and think, I blush. What can I do about it?"

Doctor: "Try to think about something else."

* * *

The moon was yellow,
The lane was bright,
As she turned to me in the Autumn night.
And every gesture,
And every glance,
Gave a hint
That she craved romance.
I stammered, stuttered,
And time went by.
The moon was yellow,
And so was I!

* * *

Waitress (looking at nickel tip left by a close guest): "What are you tryin' to do—seduce me?"

* * *

A fellow we know has a broken arm which he received fighting for a woman's honor.

——It seems that she wanted to keep it.

* * *

No one knows what a short skirt will be up to next.

* * *

The tired businessman arrived home. The cook had left that morning without giving notice. The market had been depressed all day, and, now, he found a farewell note from his wife.

He knew that a shot would end all his troubles. . . . So he opened a bottle and took a big one.

* * *

She: "I'm perspiring profusely."

He: "I'm sweating like hell myself."

* * *

You ain't got money,
You ain't got looks;
So you better carry
Your own books.

* * *

Remember, sweater girls are observed in the best places!?!

* * *

Barmaid: "Oh, yes, I married a man in the village fire department."

Sailor: "Volunteer?"

Barmaid: "No, Pa made him!"

THE ? MARK

SLIPSTICK PHILOSOPHY BY MELVIN MARK, M.E., '44

Truly, the automobile has become a great moral force—it seems to have put a stop to horse stealing.

* * *

You cannot fly with the owls at night and keep up with the eagles in the daytime.

Note to Sibley "Claw Marks" Stuart.

* * *

The wife had been put on the budget plan. At the end of each month she and her husband would go over the account together. Every once in a while he would find an item, "G. O. K., $3.00," and a little further on, "G. O. K., $6.00."

Finally he said, "My dear, what is this—G. O. K.?"

"God Only Knows," she replied.

* * *

Advertisement: "You get the girl; we'll do the rest."
That's hardly fair.

* * *

Judging from the socks LaLone wears, he must be getting triple credit in the seminar sections. Each one speaks for itself.

* * *

The president of a large educational institution recently married his secretary who is at least a generation younger than he. The nuptials were adequately reported in the society part of a large city newspaper. But the make-up man went haywire, for the story appeared under the following headline:

"Old Power Plant Resumes Operation."

* * *

There was an old man from Nantucket,
Who kept all his cash in a bucket,
But his daughter named Nan,
Ran away with a man,
And as for the bucket, Nantucket.

* * *

Way down in Georgia a traveling man found himself stranded for the night and in his rambles around town noticed there were two Baptist churches. He asked a colored man why there should be two churches of the same denomination.

"Well, boss, Ah'll tell you," said the informant. "Dey jus' can't agree. One of de churches believes dat de Pharaoh's daughter found Moses in de bulrushes. De odah church claims dat's what she sez!"

* * *

I'm all done with dames,
They cheat and they lie;
They prey on us males
To the day that we die.
They tease and torment us
And drive us to sin.
Say—Look at the blonde
That just came in.

* * *

A colored preacher was hearing a confession. In the middle of it he stopped the young sinner, saying, "Young man, you ain't confessin'—you's braggin'."

* * *

TYPOGRAPHICAL ERROR DEPT.

"Coach Pelham again is active after having been laid up for several days with a bad coed."

* * *

The one who thinks our jokes are poor,
Would straight-way change his views,
Could he compare the jokes we print
With those we could not use.

Stepping Up . . . and Keeping Up the STEEL CUTTING PRODUCTION *of the United Nations*

WITH the outbreak of war in 1939, the Allied Nations—abruptly cut off from Germany as a principal source of supply for carbides—diverted the full flood of their carbide demands to the United States.

Fortunately, American industry had established—as far back as 1928—its own independent sources of supply. These American suppliers were ready to meet the emergency with a background of 10 years' experience in the development, manufacture and application of this urgently needed material. They had the skill, the equipment, and a generous margin of reserve capacity.

To the hard pressed Allied Nations—struggling to offset the tremendous output of a German war production long since tooled with carbide *by official decree*—went tons of American carbides in steadily increasing quantities. Foresight and preparedness enabled American carbide manufacturers to fill this urgent need and at the same time meet the pyramiding demands of domestic industries.

Today, you will find carbides a factor of vital importance in stepping up and keeping up the production of not only the United States but also such countries as England, Russia, Australia, Canada, China, India, Mexico and many others among the United Nations.

The full extent to which carbides are being used in the cause of victory is difficult to visualize. Carboloy Company production alone, for example, is at an annual rate 45 times greater than that of any pre-war year. Monthly production of carbides—formerly measured in pounds—can today be expressed in tons—many tons per month! Yet the average carbide tool contains but a fraction of an ounce of carbide at the cutting edge—and a single tool during its usable life machines hundreds of parts for the implements of war. Particularly important is the use of carbides for cutting steel—a major field of use for Carboloy tools. (More than 60% of the Carboloy Cemented Carbide produced today for machining purposes is for cutting steel.)

A high order of performance—so high as to have been once considered incredible—is now commonly expected, and obtained, with carbides. Such things as increases in output of 3 to 1, lengthened tool life of 10 to 1, finish cuts that eliminate arduous grinding, machining of former "non-machineable" alloys, reductions of 25%, 50%, 75% in machining costs—results such as these are every-day occurrences in war production today.

This widespread use of carbides in war, indicates a new era of production economy when normal commerce returns. Manufacturers who have converted to carbides to meet the present emergency will then have at their immediate disposal an economic weapon of unusual advantage in seeking world markets.

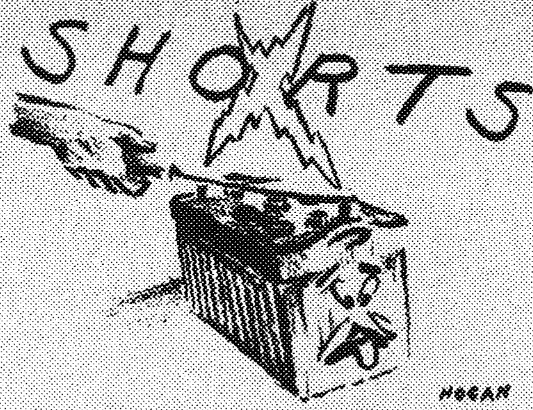
Carboloy Company, Inc., Detroit, Mich.

Authorized Distributors: Canadian General Electric Co., Ltd., Toronto. Foreign Sales: International General Electric Co., Schenectady, N. Y.

CARBOLOY

TRADEMARK

TITANIUM — TANTALUM — TUNGSTEN CARBIDES



On the same week end as Hallowe'en a few of the staff managed to find their way up to the Apple River in Wisconsin for a day in the open. The day was a bit on the rainy side but this did not dampen the ardor of one who now knows his natural calling. It so happened that sheep were grazing along the trails on the bluff where the campers were cooking their lunch. With so many points on the hoof that were so close his natural instincts got the better of his civilized being and he let out with a very natural Baaaaaaaa. At first the sheep did not know quite what to make of the individual from which the sound had come but after several more bleats it answered and came a little closer. It was not long until the sheep ambled right up to his two-legged friend. But when he got the scent of the lamb steaks the campers were cooking he tore like mad down the hill because he knew they were just wolves in sheep's clothing. We think that the sheep probably was a ewe.

• • •

When the Homecoming issue of *Skum* appeared on the tables in the Union and Football Hall a chart on the osculatory techniques appeared in connection with an article by one Tommy Clareson. Upon perusal of this handy table and its accompanying explanation we noticed that it was lacking the important details of how to distinguish between the various types of females and also of the correct approaches. We felt that for the benefit of all frustrated males who are without knowledge of the details something should be done. And so we have our staff of experts at work on the subject conducting extensive experiments on the river bank, the results of which are to appear in a future issue of this magazine.

• • •

With finals just three weeks away we awoke to the fact that the Curtiss-Wright girls will be leaving shortly, and we thought that if they are to leave Minnesota with happy memories, a fitting farewell should be given them. Now we've heard of fraternities serenading sororities so why not have the engineers do a litle vocalizing outside of Shevlin Hall some night. The way the senior EE's and some of the Civils harmonized at the marriage course, November 10, we think that our idea has possibilities.

• • •

One day when one of our staff was down at the Oak Street Laboratories working in the Log's newly-acquired darkroom he heard quite a commotion upstairs and proceeded to investigate. It seems that the janitor had gone home and a few students had been locked in the building. Now it so happens that the staff member who was present was and still is a member of the Naval ROTC. Chow formation was in the immediate offing and our friend had to be there, or else. Since he was in desperate straits and being a very resourceful fellow he set out on a search for an exit. The rest of the imprisoned tried to reach someone by telephone to come and open a door. In the meantime our hero had found an exit and hurried off to eat. We still wonder what time the rest of the fellows got out.

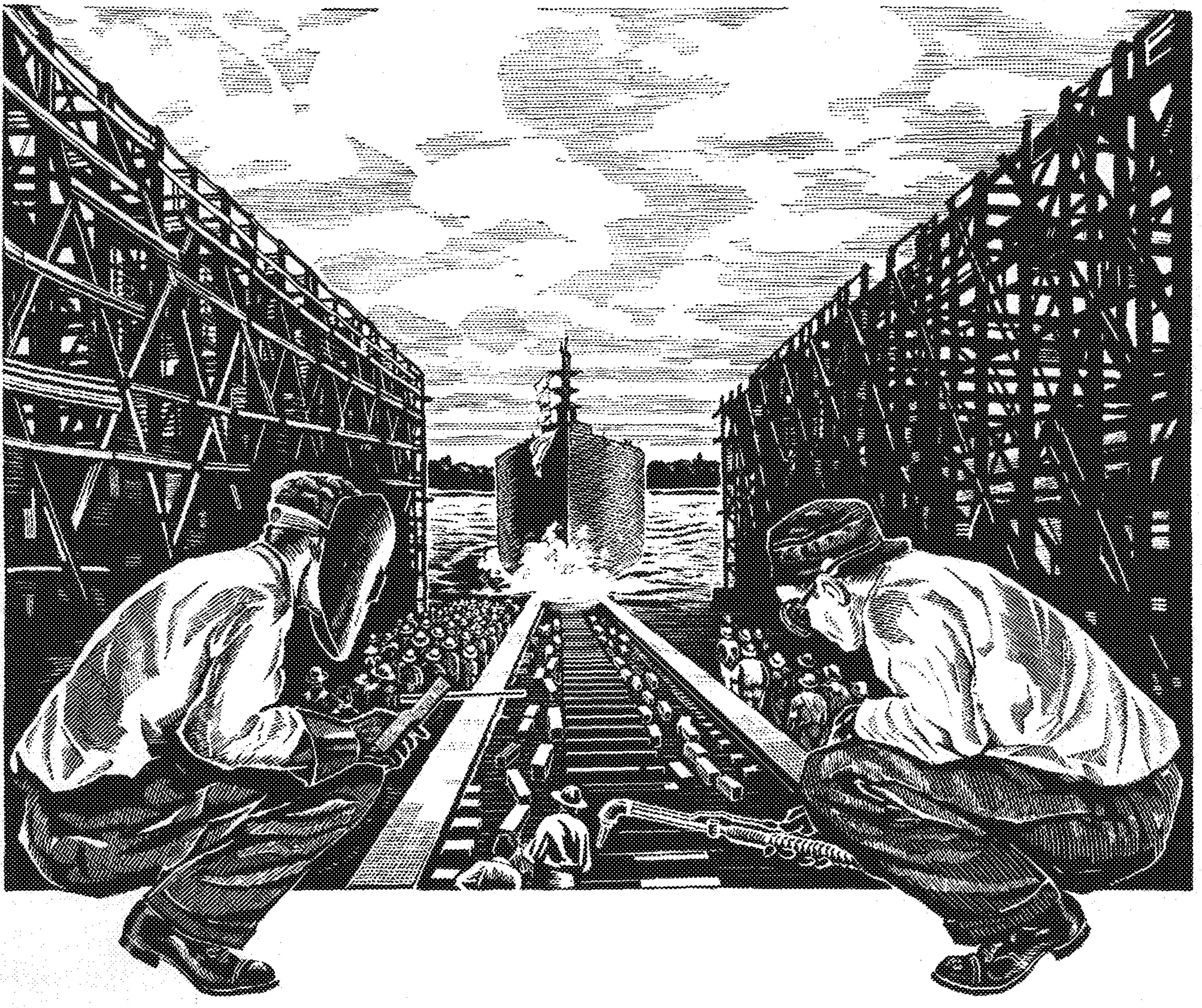
• • •

Our apologies to Helen Helland, more commonly known as Chips around the office. She worked hard on the October issue of the magazine but her name was omitted from the staff by some terrible mistake.

• • •

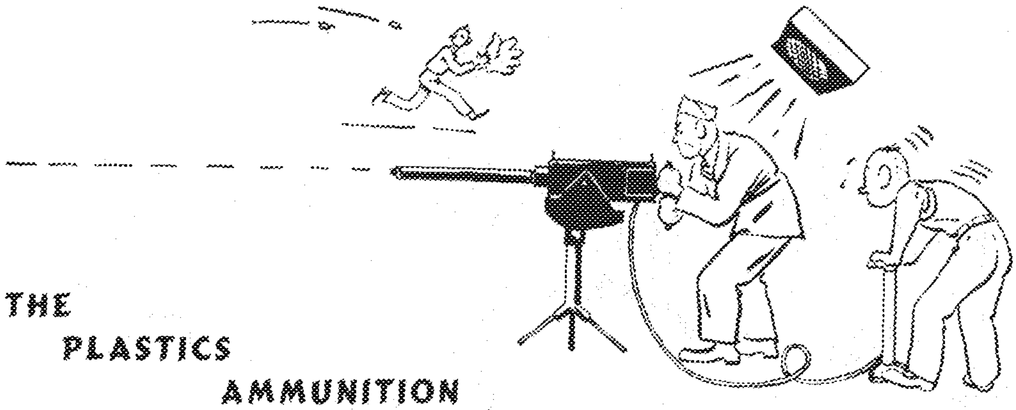
Harry Brenner who was managing editor for this issue of the Log also has the hard job of obtaining feature articles. If you don't believe us just try to get somebody to write an article some time. Harry did a good job and we want to thank him for his hard work.

G. V.



Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

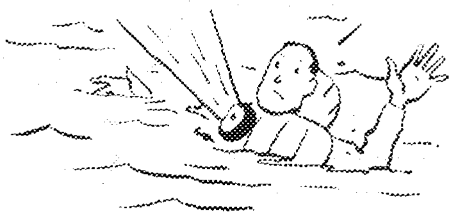


. . . PASS THE PLASTICS AMMUNITION

INSTRUCTION instead of destruction is the purpose of the new machine gun developed recently by the Edison General Electric Appliance Company. Designed to train soldiers, the new gun uses plastics bullets and compressed air instead of expensive bullets and gunpowder.

Operated by electricity, built to the actual size and appearance of the 50-calibre Browning machine gun, the new model will fire 600 rounds of plastics bullets per minute—the same rate as the Browning. But the new bullets cost less than a cent apiece (and can be used over and over), compared to the approximately 30-cent cost of each Browning bullet.

Amplified "explosions" of compressed air accustom the trainee to the sound of actual firing and tend to eliminate the jitters he might otherwise experience in his first combat.

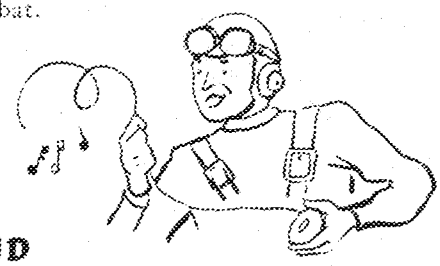


TO THE RESCUE

BY the summer of '43 about the only new tail lights left were those on lightning bugs. The other kind were helping to save shipwrecked sailors who were often lost at night, because rescue parties couldn't see them.

When the Coast Guard asked G.E. for a tiny lamp that could be attached to rubber life suits, that would glow all night long, the Company supplied the lamps that they had been making for bicycle tail lights—small, rugged lamps that lasted a long time and used very little current.

These were enclosed with their tiny batteries in waterproof cases, with safety pins for attaching to the suits. And now their red glow guides the rescue ships to the sailors in time.



THE SOUND GOES ROUND AND ROUND

WINDING up words on a doughnut-sized spool, the new sound recorder being redesigned for mass production by General Electric under license from the Armour Research Foundation will eliminate the use of pencilled notes by observers on reconnaissance planes.

Sixty-six minutes of continuous speech can be reeled up on the 11,500 feet of thread-thin wire within the recorder's small box. Though employing much the same principle as the dictaphone, the observer's words are recorded magnetically on the wire, instead of being scratched into a wax cylinder.

When the recording has served its purpose, the words can be erased magnetically, and the wire is as good as new for future use. *General Electric Co., Schenectady, N.Y.*

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.

TECHNOLOG

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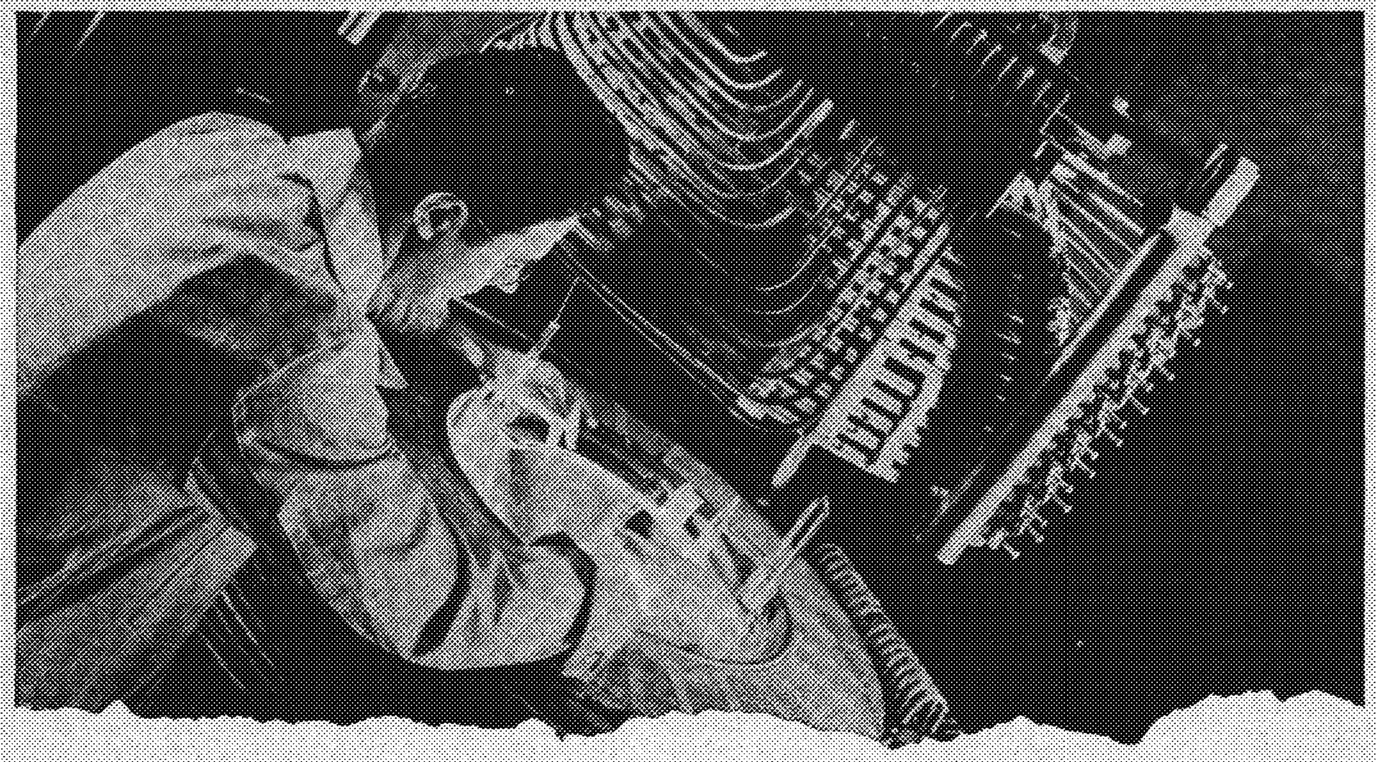
MINNESOTA

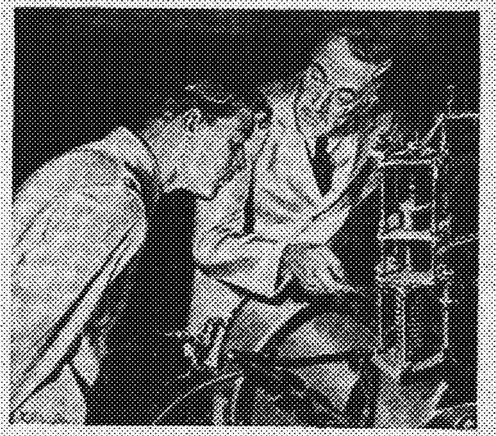


Helping the tire maker: Pictured here is a laboratory model of the new Westinghouse-developed "mass spectrometer," an adaptation of which analyzes gases with incredible swiftness and accuracy. Right now, one of the most important of its many uses is speeding up tremendously a step in the making of synthetic rubber.

Westinghouse research accepts every wartime challenge . . .

Under the spur of war, Westinghouse research is delving into numberless mysteries, not only in the vast field of electricity and electronics, but also in chemistry, physics, metallurgy, plastics. And as a result, out of the great Westinghouse laboratories has come a steady stream of new war products, and new and better ways of making old ones.

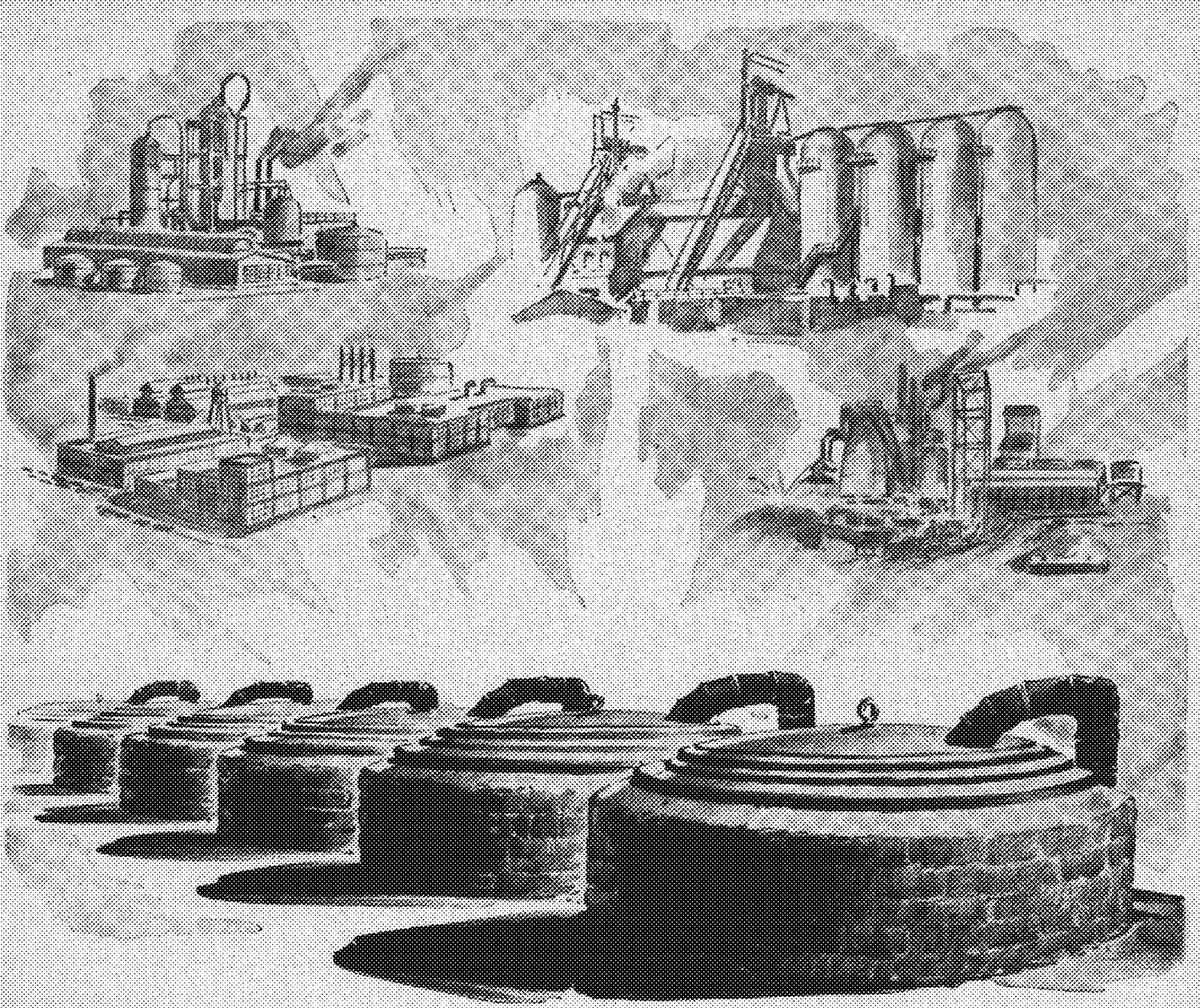
Westinghouse research develops new talent for America . . .



To Westinghouse, each year, come several hundred budding scientists and engineers—to work, to learn, to blaze new trails in electrical research. And each year, through more than 100 Westinghouse scholarships, young men enter America's engineering colleges to develop the native skill and talent that have made America great and will make it greater.

Westinghouse research promises new wonders for peace . . .

You have heard much talk of the marvels science will offer you after the War. Well, there *will* be marvels—plenty of them—and Westinghouse research is working to contribute its full share. But we will never lose sight of what we consider our first duty: seeing that, beyond all question, each Westinghouse product, old or new, is the very finest of its kind. Westinghouse Electric & Manufacturing Co., Pittsburgh, Pennsylvania. Plants in 25 cities, offices everywhere.



CAUSTIC SODA—a key chemical in industrial growth

Caustic Soda is an indispensable chemical needed by industry in huge quantities. A long list of products—notably petroleum, soap, paper and textiles—use it as an essential material in various manufacturing processes. The production and availability of this hard-working chemical are consequently of genuine importance.

Following the course dictated by its own initiative, Dow began many years ago to specialize, step by step, in the chemistry of brine. Original methods for the production of bromine led to chlorine, and the process for making chlorine produced caustic soda as a co-product. During the intervening years, Dow has become one of the leading producers of this key chemical, with plants so strategically located that they are prepared to serve the entire nation.

This development is cited merely to emphasize the importance of self-reliant enterprise.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Cleveland • Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

DOW

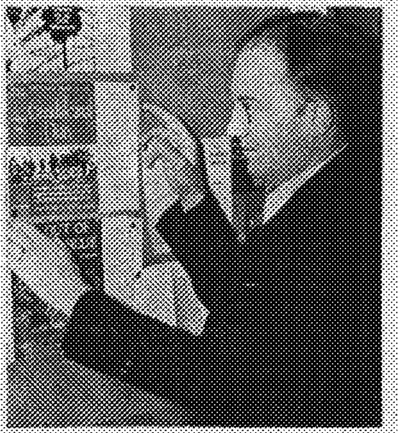
CHEMICALS INDISPENSABLE
TO INDUSTRY AND VICTORY

this month

BY HELEN HELLAND

In "Not Texts But Treasures," Mr. Kenneth Seeley gives his ideas on how to choose a book for everyone from "your 15-year-old *Mademoiselle*-reading sister to your serviceman in a far-away camp."

Mr. Seeley is a native of Abbotsford, Wisconsin. He attended high school in Minneapolis and graduated from the University of Minnesota in 1926. In 1927, he



began teaching as an English assistant at DePaul University in Chicago. He taught at Marshall High in Minneapolis, and came to the University of Minnesota as an English instructor in the Institute of Technology two years ago.

He is a member of Phi Beta Kappa, Phi Delta Kappa and the teaching organization on campus.

Ed Proszek, who hopes to graduate from his combined Electrical Engineering and Business Administration course next August, is an enthusiastic man. He believes very strongly in the value of extracurricular activities. This may account for his active participation in so many campus organizations, among them the American Institute of Electrical Engineers, Eta Kappa Nu, Iron Wedge, the Tech Commission, and the TECHNOLOG Board. He is president of the last three. But Ed's enthusiasm does not end there. He loves golf, canoe trips in the "north country," and someday hopes to travel all over the world.

And he is an advocate of the theory "music is good for the soul." In this issue he discusses the effect of music on war production in "Blues in the Nite Shift." Ed himself plays the "bull fiddle," the violin, and the cello, and prefers classical music, although he enjoys almost every type. Those of you familiar with the Engineering building have undoubtedly heard at one time or another the harmonious strains of some old melody rendered by that well known barbershop quartet, "Buck" Carter, "Dynamite" Swanson, Bert Holmberg and Ed.

Here's a tip for you younger electricals from Ed: "When she starts to smoke, put her back in the pile and get another one!"

"G. V.," known to the registrar as Jerome R. Giantvalley, IT '43, is the well-known and well-liked editor of the MINNESOTA TECHNOLOG. He keeps his hard-working staff happy by always observing his prominently-posted motto "KEEP SMILING" . . . this is undoubtedly the secret to his success.

"G. V." was a native New Yorker until he reached the age of ten and decided that Minnesota was better suited to the pursuance of his favorite hobby, ski-jumping. Then he came to Minneapolis where he attended University High, and resolved to become an electrical engineer. "G. V.," assuming variety to be the spice of life, found time to work as a caddy, lifeguard, for the navy, in war production, and in a foundry in addition to his studies at the "U." He loves to swim, canoe and go camping, too . . . interests he developed during his long career, not yet finished, as a Boy Scout.

To keep up the engineers' great tradition, "G. V." has also done scouting along other lines. He recently completed a research survey on the Curtiss-Wright Cadettes. This study may have prompted the title of his current article "Super-Hurricanes" . . . although it deals scientifically with the gas turbine.

"G. V." graduates at the end of this quarter, and will enter the Navy in December. We want him to know the TECHNOLOG staff, all of St. Patrick's engineers, and many faithful Tech readers wish him all the luck in the world!

"The Allison Engine," one of the articles featured in this issue, was written by Bill Sterling, Mechanical Engineer, '44. Bill's home is in Rockford, Illinois.

Bill loves all good music, but especially favors the classics, and for several years he played the cello in the Rockford Symphony Orchestra.

Bill has no special philosophy of life, but manages to "get along." He has been known as a friend to the masses and to the over-dog, counselor to the freshman, and critic of the senior, cracker-barrel philosopher and man-about-town. He has been called radical, conservative, venturous, and cautious, brilliant, dull, fascinat-

ing and repulsive. Bill refuses to comment, so you may draw your own conclusions.

He is a member of the American Society of Mechanical Engineers, and treasurer of his fraternity, Sigma Alpha Epsilon. "That job," says Bill, "keeps me hopping most of the time."

MINNESOTA TECHNOLOG

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The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is two-fold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

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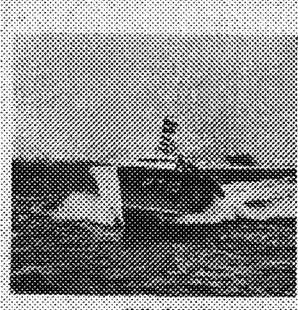
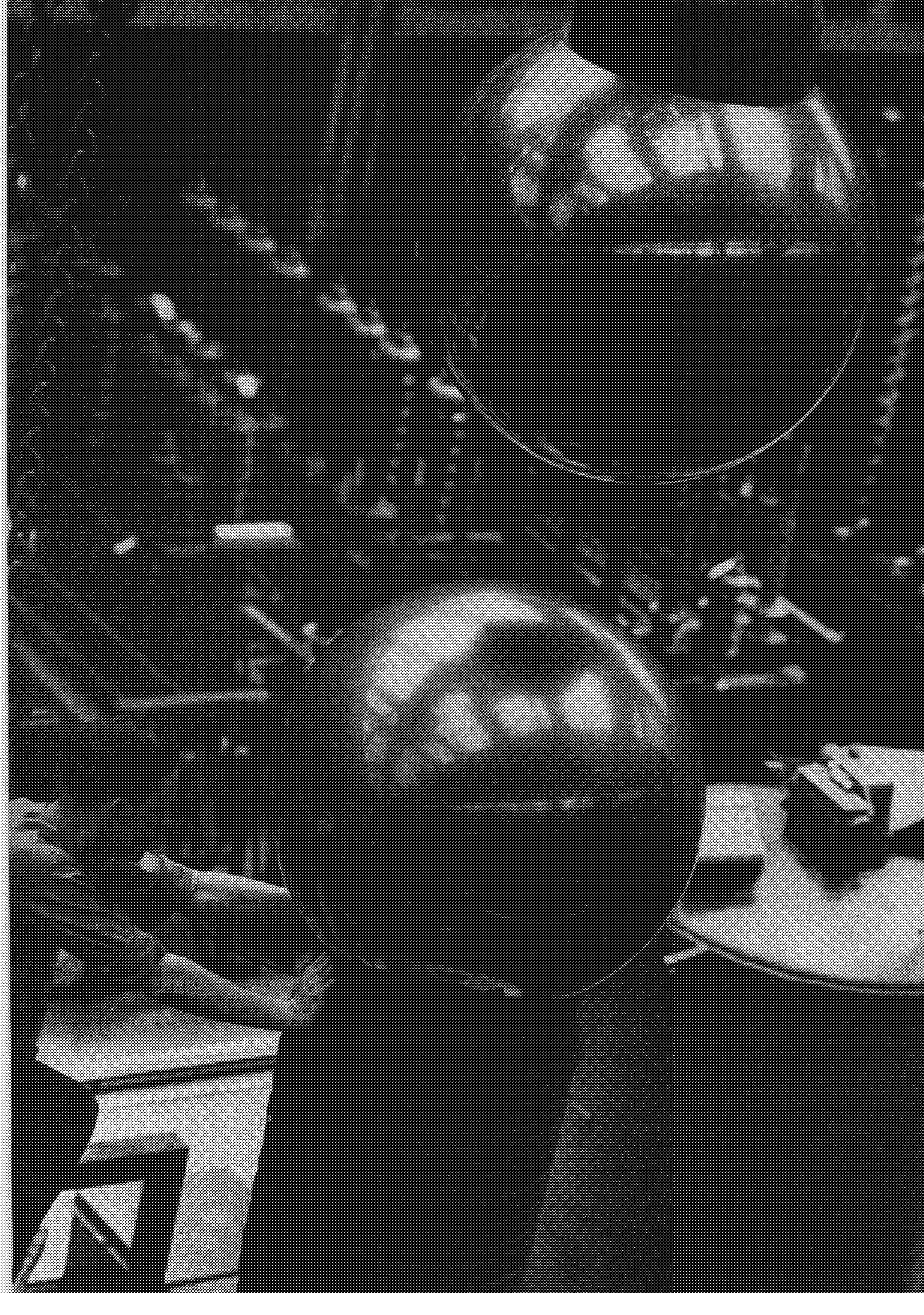


THE COVER. Three 1,350 horsepower engines give the assurance of tremendous speed and almost unlimited cruising range to the PT boat. Photo courtesy of Packard Motor Company.

FRONTISPIECE. These two spheres are adjusted in order to regulate voltages for application to circuit breakers under test. Courtesy of Westinghouse Electric and Manufacturing Company.



blues in the nite shift

BY E. L. PROSZEK, E.E.B., '44

"I love to sing a song all day,
It helps me chase the blues away."
—Anonymous

A CRISIS has been reached in the war program! In the face of ever-mounting war demands the production of the arsenal of democracy is leveling off! The huge expansion of industry has ceased. Where material and machine shortages were limiting factors to this period, a new, more critical bottleneck has arisen—a shortage in the working force.

One of the heartening features of the entire war program has been the response of management, technology, and labor to the many crises that have developed. New techniques of production and personnel control and labor-management coöperation have time and again overcome the difficulties. And now a new technique, a morale and production builder has mushroomed across the country—music in the factory. The success of using music has been so great, particularly in stimulating morale, that the available material and agencies for making the installations cannot meet the demand.

The culture of many peoples reflect their surroundings and industrial growth. Many of the folk songs known were used to accompany the peoples at their labors. The Volga boatmen sang as they towed barges up the river, the Slavs joined in harmony as they worked in the wheat fields, the Greeks sang during battle, and the British followed the bagpipes in the historical battle of El Alamein. Industrialization, however, moved the worker into factories where surroundings were not suited to singing. In the dislocation of individuals from their natural surroundings many maladjustments in personality arose.

Psychologists Interested

During the '20s and '30s psychologists became very interested in the stimulatory and therapeutic effects of music on individuals. Numerous laboratory experiments demonstrated the physiological reaction to musical stimulus in the human being. Control of muscular energy, respiration, pulse rate, sensory perception and fatigue was successfully accomplished by varying the tempo and color of music used as a stimulus. The study of group reactions was accelerated by the outbreak of the war in 1939. Perhaps it was tried out over already installed public address systems in England just for novelty. In any event the reaction of the workers and management was so predominantly in favor of the program that it is now used almost universally in that country. Morale had in most cases improved greatly. Increases in production up to 23 per cent have been reported although production studies have not been made to large numbers nor not always under controlled conditions.

With the tremendous and overwhelming success of the program in England, it was not long until the United States adopted the practice. The largest impetus came in 1941.

As in all newly developed techniques, the objective behind the research in applied music was to find the physiological reactions to emotional stimulus and to reduce the stimulus to quantities of intensity, spectrum and cyclic qualities, so that the emotions could be controlled to help suit the worker to his job. The semi-automatic nature of modern industry does not require the full use of the worker's mentality and the repetition of tasks long mastered induces boredom with its negative effect on production.

In studies made by Wyatt and Langdon, it was found that factory workers found the first two hours of each half of the workday dragged the heaviest. It was believed by 97 per cent of the workers that they could think of other things while doing their tasks and that if they did the time passed much more quickly. Music adds imagery to the consciousness of the worker and lifts him into a world of ideals thereby reducing boredom, the arch-enemy of production. Still further, it occupies his mind with pleasant thoughts and aids in preventing brooding over incidents.

Individual reactions to music stimulus are quite varied. Generally it has been found that the application is best for repetitive, monotonous types of work. Where a great deal of mental activity is required or in executive offices, the musical background is detrimental.

Scientific research to determine the quantitative effect of music on production and morale leaves much to be desired. There is an abundance of opinion stating favorable results obtained. Typical of these statements is an opinion of Wynford Reynolds in a report from the British Library of Information. "It is like a cup of tea, something to cheer the mind. You will get increased output, all right, but it will be spread over the workspell as a whole. You will not necessarily get it while music is actually played." In a recent survey by the War Production Board covering 100 factories over the entire United States, it was found that there was nearly a unanimous opinion to the effect that the musical programs greatly improved morale. A large number reported production increases ranging from 2 to 11 per cent, depending on the length of program each day.

Statistical Study

Perhaps the best known statistical study made in this country is that of Professor Harold Burris-Meyer of Stevens College. The original work began with an investigation of theatre acoustics and branched into the industrial music field as it developed. It was felt that the results of production studies made under laboratory conditions were not applicable to the factory because in the laboratory the subject knew he was being observed, a factor which tempered the results, and also the effect of the group reaction on the individual was missing. At first it was believed that a study of production records previous to and after the installation of music was all that was necessary; but it was found that in most cases the existing records were inadequate. The result was that completely original investigations were necessary, and these were extended to numerous factories.

In an attempt to prevent any other factors to influence production during the course of the experiment a control of the working conditions as far as possible was attempted. All production figures recorded during which there had been any change in the following conditions were cast out: significant weather changes, ventilation, light, noise, labor turnover, labor-management relations, plant and product changes. The results obtained, as admitted by Professor Burris-Meyer, are not unassailable but definitely "shows which way the wind blows."

A brief summary of the experimentation and results of his study must be considered in terms of large and small groups.

In a typical case of 16 experienced employes who did not know that they were being observed, an increase of 6.25 per cent in daily production based on the average production before music was installed was realized. About 75 per cent of the cases showed significant increases. Of course, the results are dependent on the type of job performed.

For the large groups, in which 100 employes of all experience were used, increases in weekly production of up to 11.4 per cent were noted. A comparison of the weeks before and after installation showed very significant increases in the unit output.

Not Limited to Production

Burris-Meyer did not limit his study to merely production. It was found that by using a scientifically prepared program the morning and afternoon production dips, which are induced by boredom and fatigue, were reduced by 14 per cent. In piece work tasks the rate of early departure was decreased from an average of 2.52 per cent to 0.845 per cent. Monday absenteeism was surprisingly lowered from an average of 22.75 per cent to 2.85 per cent. Evidently the workers enjoyed their jobs much more when music was supplied than when not. A case is recorded (not in this study) in which the workers went on strike because the musical program was discontinued. There are numerous other cases where an interruption of the program has brought strong protests. Burris-Meyer found, also, that the morale in the plants was improved but at the time no adequate scales for measuring this intangible were available.

An investigation by J. L. Humes of the scrappage rate among radio tube assemblers showed that the decrease accompanying the application of music depended on the type of program presented—mixed programs being detrimental. Employe surveys by Kerr indicate that the former feel that music does aid them to increase their output.

At the present time in the United States about 500 factories have instituted programs as part of their production drive. The music is supplied either from commercial studios over leased telephone wires or from permanent installations in the plants. In either case, however, a full-time operator is generally necessary and planned programs are essential. The technique has been widely adopted in the electrical, aircraft and clothing industries. It has also been successfully attempted in shipyards during lunches and rest-pauses.

In making the installations management has found that the prime consideration has been to stimulate morale rather than production. Where the workers feel that they are being exploited, slow downs appear. Numerous other uses made of the public address system such as paging, announcements, fire warning and air-raid warning helps the equipment to pay for itself.

To derive the maximum effects of a musical program scientific planning is a requisite. The workers must be made to feel that it is their own program, the music must be familiar and their preferences must be accounted for. Even with every precaution and aid the effect of the program may not be noticeable for some time.

The length of the musical period and the starting time have been found to be quite crucial. Although little statistical investigation has been attempted, standard practice considers about two or two and one-half hours per day in 12- to 30-minute periods as adequate. Typically, where the nature of work permits, music is played at the beginning of the shift, at mid-morning, lunch time and mid afternoon.

The character of music utilized profoundly affects the success of any program. In general slow waltzes, rhumbas, "hot" music, vocals and thickly scored numbers are avoided except occasionally for variety. Hymns have been tried but have a bad effect. In this country popular numbers are most commonly used with a generous inclusion of semi-classics. "Deep in the Heart of Texas" has been abandoned because the workers all stopped to clap their hands. For obvious reasons the "Strip Polka" has not been used—

As in any concert the industrial program must be designed for the audience that is to receive it. Age, sex, nationality and culture must always be taken into account. Foreign-born have been found to enjoy opera very much, older workers like the hit tunes of yesterday such as "East Side, West Side" and "Bicycle Built for Two." The younger generation goes strongly for the Hit Parade selections of today. It has been found that the female workers exert a stronger preference for swing than do the males. Preference, however, must not be the only guide inasmuch as those numbers do not always exert the desired influence. A good proportion of semi-classics, Strauss waltzes, and band numbers is very desirable as is a sprinkling of miscellaneous items for variety.

Recordings available at the present time are somewhat inappropriate for the factory. The volume is not constant enough so that an irritating blarring often occurs. Ornate orchestrations and change of key produce distractions and the tempo and rhythm do not always create a bright, cheerful atmosphere. Here is a complete new field for composers to exploit in producing uplifting moods for the factory.

Rather surprising is the range of conditions under which the musical installations have been successfully used. By the proper selection of frequency ranges, it is possible to overcome the terrific din of 105 decibels. The attempt is made not to overpower factory noise, but to penetrate it with an undercurrent of melody. To the worker the music is similar to entering a theatre from the full light of day. At first little is discernible; but after becoming accustomed to the surroundings, the individual items may be easily picked out—and thus it is with the factory melody.

High fidelity and quality sound equipment installed by competent engineers are essentials to a successful installation. Small, well-distributed speakers also produce best results. Many of the public address systems found in plants previous to the addition of music have been found inadequate due to limited frequency ranges.

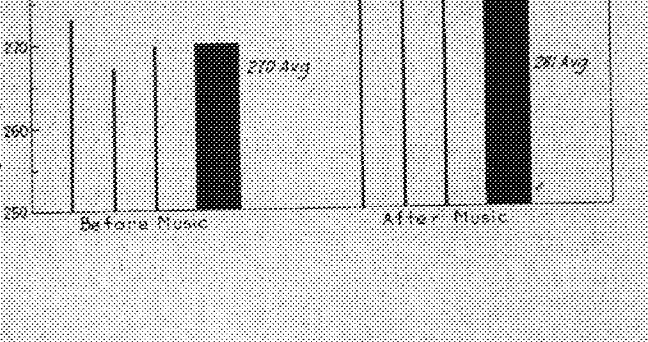
Far-Reaching Possibilities

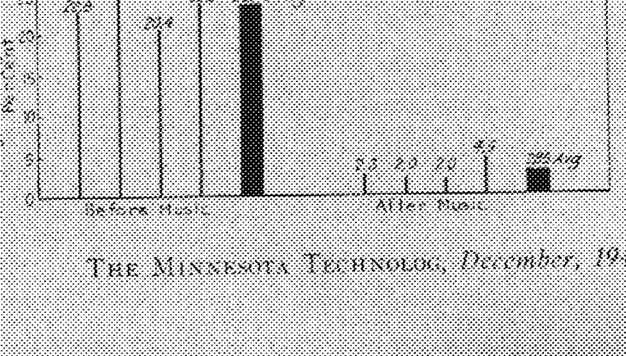
And so, a new emergency has produced a new technique that has far-reaching implications and that may considerably alter our industrial life. There is a great possibility that the use of factory music will be extended into the postwar industry. Extensive new fields have been opened for original research and exploitation. To the musical world has been offered opportunity for expansion, new expression, and for bringing music to the largest audience that exists. The possibility is great that the American culture and ideals may undergo profound changes. For industry the wholehearted approval of management, unions, and workers to the movement may usher in a new era of cooperation among the productive factors for the benefit of all. And most important, the factory is becoming an enjoyable place to work!

There may come that time of which every composer dreams of, when he can say,

"I hear America singing!"

CUTS COURTESY OF *MECHANICAL ENGINEERING*





NOT TEXTS BUT TREASURES

Oh boy! A book!

BY KENNETH SEELEY
INSTRUCTOR OF ENGLISH

FACED with the problem of picking out in no seconds flat a Christmas book, absorbing, sound, hilarious, original or important—"good," in short—the service man, college teacher, or student realizes with a sudden qualm that he is not buying the book for himself. A dazzling rainbow of new books arrests him with an insistent and semi-paralyzing question—not only which are latest, which good, but which will thrill the recipient to the marrow?

Alas, the Voice of Experience does not come on the air at this point. The suggestions on tap are definite, but limited. Potential thrills embedded in the list which follows are strictly confined to persons who have some stake in the fight against enslavement or in related background subjects, like the air. For men buying presents for a *Mademoiselle*-reading fifteen-year-old, or for a rampant Sinatra fan, the limitations of the list which follows are at once apparent. You can't have everything.

And further, as we pick out a book for a service man, father, wife, relative or friend, we ruefully reflect that the days of interest in "just anything about the war" are over. For one thing, readers are more discriminating. For another, they are now more deeply, more personally, involved in events. People's hearts in these days are pretty closely tied up with some individual fighter or campaign or ideal or branch of service.

Question: Anyway, supposing this to be the case, what kind of tastes are there?

Answer: Why, probably at least four kinds. There are, first, the readers who, if they are interested at all in any of the new books about the war are interested in its pleasant side; second, those for whom the hostages they have literally given to fortune are the only consideration, and whose interest is constantly in very special campaigns, services or areas; third, those readers of public spirit and intelligence who are interested in ideas; and, last, those lay readers whose interest is chiefly centered in the technical background.

Among the 1943 books on war's pleasant side are four or five distinctly worth mentioning. All of them are for those who want to grin while they bear it, and one has other qualities which have not only brought a nomination to "Imperative" rank, but threaten to top the famous W. L. White's *They Were Expendable*.

This is the graphic, humorous and panoramic series of adventures by sea from "The Rock" to Darwin, fascinatingly and saltily (in more than one sense) narrated by Lieutenant Commander John Morrill and Pete Martin in *South from Corregidor* ($2.50). This book will probably remain a historic source—one eyewitness account of the fall of "The Rock" by a participant. When the hell-hole reality of today becomes the future's romance, it is the book such as this that may lie behind imaginative art.

Morrill, by his own account, was "raised in Minneapolis." Human, witty, kindly, a rough and ready leader, yet cool and above all intelligent, Morrill, one can see, was unquestionably the idol of his seventeen men. The book is a subtle object lesson in morale of the highest possible type.

The work of a *Star-Journal* writer and a Minnesota alumnus, Thomas St. George's *c/o Postmaster* ($2) is sufficiently cockeyed to be pleasant and sufficiently tart in its sardonic philosophy to carry a strong appeal of originality. Those with commitments in Australia or on the way to it will find here some of their most revealing insights into the voyage there, the land, the customs and the language of the natives.

Writers with a lighter touch, in fact, often seem to convey more information about actual living in the South West Pacific than do their more heavy-handed brethren. Such a one is Ely Kahn (*G. I. Jungle: An American Soldier in Australia and New Guinea, $2*), who, bearing the *imprimature* of *The New Yorker*, brings cheering news:

American soldiers who have returned from the Southwest Pacific will be unable to refrain from laughing out loud at the alluring women and romantic scenery exposed to their knowing, skeptical gaze, and Hollywood will have to change its line.

Mr. Kahn liberally flavors his pictures of duty in Australia and New Guinea with an aboriginal if unromantic humor. His "First Wallaby," for example, is crammed with droll anecdotes of Aussi-American contrasts.

In Jerry Doyle's *According to Doyle: A Cartoon History of World War II*, now to be seen on bookstore counters, the smashing intensity of the graphic is soon outdistanced by the penetration and continuity of ideas depicted from 1932 to the present. Piercingly satiric, as in its treatment of both Lindbergh and Lewis, the war's slashing ideas and forces are seen in their most assimable form.

"There's some corner of a foreign field
That is forever England."

wrote Rupert Brooke in his most memorable poem. For those whose hearts in the form of loved ones are chained to "The Rock," or to the Aleutians, the Solomons, to Cap Bon or the *Skyways of Europe* or

(Continued on Page 100)

Gas Turbines Control

SUPER-HURRICANES

BY J. R. GIANTVALLEY, E.E., '43

ARE the Diesel engine and steam turbine headed for the scrap pile? Will the gas turbine eventually replace such reliable and time-tested power plants as the gasoline engine? It is very possible that in the future central stations and airplanes alike will rely on gas turbines for motive power. This ancient device has not just recently been perfected by some crank. It is not just in the blueprint stage. The gas turbine has arrived. *Business Week* reported as many as 27 units in operation throughout the country as important power producers. However, it is a matter of speculation as to whether the relatively simple gas turbine will replace the conventional prime movers and their complex auxiliaries.

The advantages of the gas turbine over the Diesel are many. For the same amount of power produced, a gas turbine weighs half as much as a Diesel and is correspondingly smaller; it costs less to build and burns cheaper fuel; it needs no cooling system and has many less moving and rubbing parts; thereby substantially simplifying maintenance. But its one disadvantage is lower efficiency.

And the story is repeated in its comparison with the steam turbine. The gas turbine requires no high-pressure boiler and superheater; it is independent of a water supply and the usual feedwater problems and equipment; and it eliminates the condenser and all its allied apparatus. But again the disadvantage is lower efficiency.

The problems involved in the development of the gas turbine as an active challenger in the power field have been high temperatures, unusual stresses and design of an efficient compressor. Work of skilled metallurgists and aerodynamicists has finally made possible an economical design.

The devastating high altitude bombings like the recent ones on Berlin have in part been made possible by the exhaust-gas-driven turbosupercharger. Every time a B-24 *Liberator* or a B-17 *Flying Fortress* climbs into the lower reaches of the stratosphere these turbosupercharger units permit full engine power to be developed in the thin air of high altitudes. But the significance of the turbosupercharger is not limited to high-altitude flying. Work led by Dr. Sanford A. Moss, of General Electric, in developing materials and designs to withstand the high temperatures (1800° F.) at which most metals glow bright red, the many-time hurricane velocities of expanding gasses, and the centrifugal forces due to rotative speeds as high as 33,000 rpm encountered in the gas turbine, has done much to advance it as a means of converting fuel into mechanical energy.

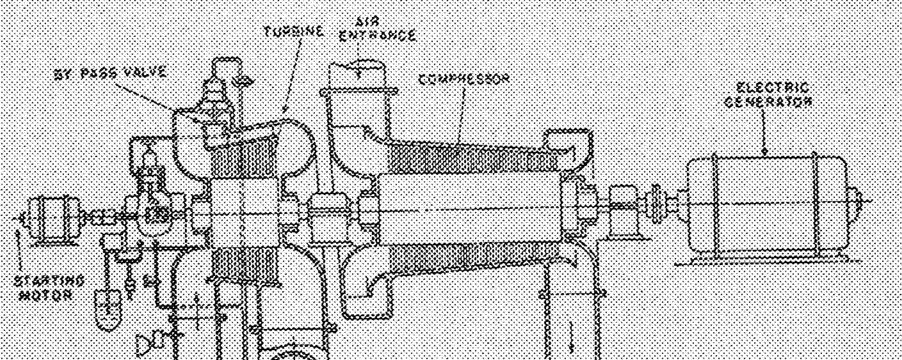
Operation of the gas turbine is closely related to that of the steam turbine. But instead of depending on the expansion of steam to turn the rotor, the gas turbine eliminates the steam boiler and all its auxiliaries by utilizing directly the expansion of the burning fuel. In order to accomplish this, compressed air is supplied to the combustion chamber where the fuel is introduced and ignited. Then the combustion gases expand enormously and speed from the combustion chamber to the turbine where they spin the rotor. The rotor is coupled directly to the compressor and indirectly to the load, either by means of reduction gears or electrically.

In addition to the turbine, compressor, combustion chamber, and fuel burner mentioned, lubrication, control, and starting equipment are necessary. The starting motor is needed to bring the unit up to 25 per cent speed, which is required before the turbine can drive the compressor.

Construction Critical

Modern gas-turbine construction requires special alloys to take terrific punishment. The casing usually is cast of chrome-molybdenum steel, and the spindle forged from nickel-chrome steel. Spindle blading, which must endure high centrifugal forces as well as high temperatures, has had the tendency to "creep" or flow out of shape while under stress. Because of the small clearances necessary between moving and stationary turbine blades for maximum power, excessive creep would be fatal. As a result of diligent metallurgical research, the creep in some turbine metals has been reduced to as low as one ten-thousandth of an inch per inch per year. One type of stainless steel now being milled into spindle blading is alloyed with 19 per cent chromium, 9 per cent nickel, and small amounts of tungsten, molybdenum, titanium, and columbium. Cylinder blading, which is not stressed by centrifugal force, is rolled from straight sections of 15 per cent nickel steel.

The problems involved in the design of a successful gas turbine were not limited to the development of new alloys. A vital part of the unit is the compressor, which only recently has been perfected. As early as 1791, 23 years after James Watt invented the steam engine, John Barber, an Englishman, had produced a device in which high-velocity gases impinged on an impulse turbine wheel. The invention was not success-



Diagrammatic arrangement of gas turbine-axial blower electric generating unit.

ful however, because it used practically all its power in feeding itself—just driving the compressor. A gas turbine very similar to present-day models was built by Dr. F. Stolze, of Charlottenburg, in 1872. This so-called "fire turbine" was equipped with a crude axial compressor, but because of its inefficient design, no useful work could be produced. Shortly after the turn of the century Armengaud and Lemale, who were working in conjunction with the *Societe des Turbomoteurs* in Paris, produced one of the first practical gas turbines. It had a thermal efficiency of *three* per cent. In other words 97 per cent of the heat available in the fuel used was wasted.

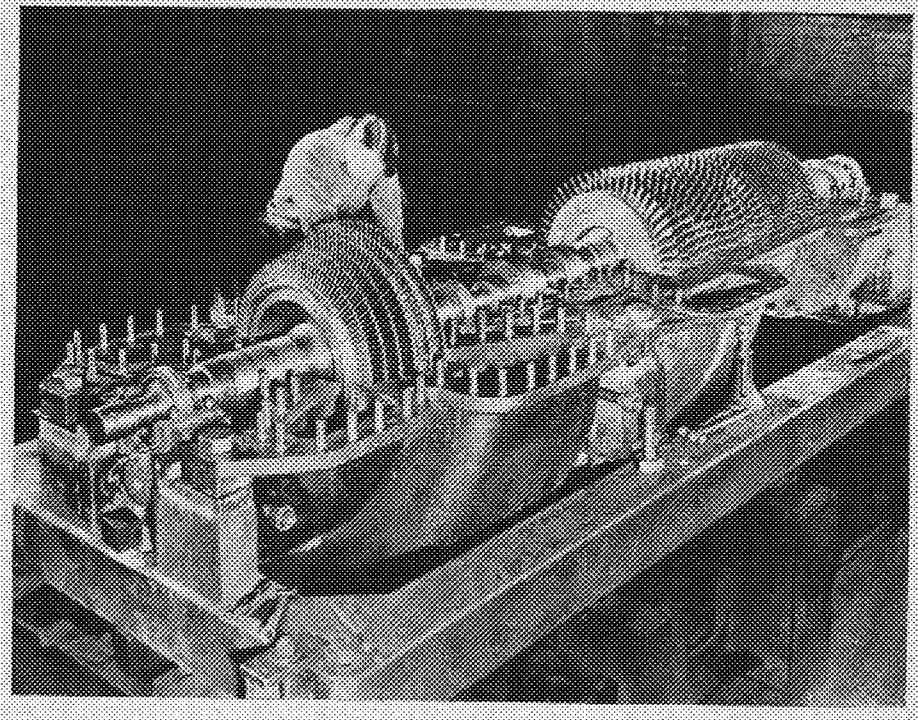


PHOTO COURTESY OF ALLIS-CHALMERS

VIEW OF A GAS TURBINE-AXIAL COMPRESSOR UNIT with the top half of the casing removed. From left to right along the shaft are the rows of turbine reaction blading, compressor blading, and power takeoff. Essential components of the unit not shown are the combustion chamber and fuel controls.

Efficient Compressors

In the meantime aerodynamicists in working out the most efficient airfoil designs for airplane wings and propellers had discovered principles which made possible the present efficient axial compressors. It was not until 1936, however, that Dr. Aurel Stodola, a Swiss turbine expert, conducted efficiency tests on the first successful axial compressor whose blades were of well-designed airfoil cross section.

The fuel-burner for those turbines using oil as a fuel is a good deal like the domestic oil burner. Adjustable louvres around the periphery of one end of the burner provide a means for varying the amount of air supplied from the compressor. The excess air is bypassed through an annular space around the fuel-burner and is given a whirling motion by projecting fins. This turbulent excess air then enters the combustion chamber to mix with the burning gasses and cool them from temperatures of 3300°-3600° F. to turbine inlet temperatures of 1000°-1200° F.

More and more high-octane gasoline is being produced for our fighting planes. The oil refineries are continually increasing their output. But what has the gas turbine got to do with it? Large quantities of air are required for reactivation of catalysts used in the Houdry process of cracking petroleum products. Because of the high efficiency of the compressor and the abundance of low-grade fuel, the gas-turbine unit is admirably suited to the job. In this country the principal application of the large gas turbine has been for such duty.

Abroad, the most work on application of the gas turbine has been done in Switzerland by the Brown-Boveri Company. Just before the start of World War II they had installed a 2200 horsepower unit in a locomotive for the Federal Railways of Switzerland. Operation is on a regenerative cycle and the power takeoff is through a direct-current electrical transmission. Reported figures on the performance show a speed of 80 mph with satisfactory efficiency. The entire locomotive weighs 108 pounds per rail horsepower.

In the United States, the Allis-Chalmers Company of Milwaukee, Wisconsin, has designed a 5000 horsepower locomotive to be powered by gas turbines through a hydraulic-transmission system. Incorporated in the design is provision for separate turbines; a small one to drive the compressor, and a large one to provide the tractive effort. Such a plan is intended to improve the efficiency over the entire speed range. If the proposed plans are successful, the single-car gas turbine unit will produce the same power as the four-car Diesel installation pulling the *City of Denver*. The maximum speed of this locomotive with cars attached will be 100 mph at a weight of 112 pounds per rail horsepower.

In connection with these locomotive drives, the gas turbine has been considered for rail-car installation as a portable power-plant. Quite familiar now is the restoration of electric power to stricken seacoast cities by utilization of ship power-plants. Lightning strikes and cripples a substation. The town is plunged into darkness, and vital war production stops. Work is started immediately to repair the damage, but what will light the lights and drive the motors in meantime? Here is the answer. Tugs warp a ship equipped with electric drive into a pier that is close to the power mains. Connections are made. Suddenly the darkness disappears as lights flash back on and the crisis is over.

Portable Power

How is such a solution possible where deepwater vessels cannot go? Our extensive rail system serves almost every load-center where electricity is used. Portable units could reach any place in the country within a few days. The gas turbine as a prime mover for such a power source offers several distinct advantages. It is independent of a water supply; it will burn practically anything; it can be built at lower cost than an equivalent steam or Diesel unit in the sizes required (about 5000 Kw.); and its operation is simple, requiring few operators (two should be sufficient for a 5000 Kw. installation).

In Europe, where the natural elements are not the only enemies to strike swiftly and unexpectedly, the problem of supplying emergency power from underground bomb-proof power plants arose. Brown-Boveri turned to the gas turbine because of its independence of water for steam or cooling. The unit installed in NenChatel, Switzerland, operates nonregenerative at 1000° F. inlet temperature. In preliminary tests the 4000 Kw. unit operated with slightly better than 18 per cent thermal efficiency.

After the war the progress in steam-turbine development will be gradual and in the nature of minor improvements. Turbogenerators rated at 100,000 Kw. and 3600 rpm are possible in the normal ranges of safety and reliability. Development of the commercial gas turbine may be much more rapid. The initial steps toward its use as a prime mover in generating stations will be in small installations located close to the load centers. These units will probably be rated about 3000 Kw. and 15,000 rpm, geared to the load and operating on the open cycle.

If gas turbines are ever used to produce large outputs of power, two arrangements are possible. Either many small units operated in push-button style for peak plant efficiency, or a large unit operating on the closed cycle with efficiencies comparable to modern steam units, may be utilized. It must be borne in mind, however, that improved metals for the gas turbine will be just as beneficial to the steam turbine. Temperatures for steam-turbine operation are limited to the same range as in gas-turbine operation for the same reason. Other factors that cannot be overlooked are the development of the binary or two-vapor cycles and steam cycles with

(*Continued on Page 102*)

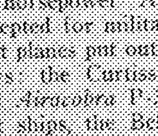
Fighting Power in

THE ALLISON ENGINE

BY WILLIAM STERLING, M.E., '44

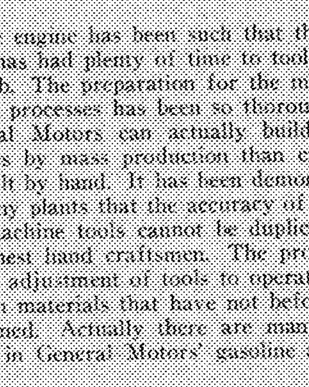
THE coming of the war has brought about many important developments in aircraft engines. Such is true with the making of the well-known Allison engines used in the combat and striking arms of our Air Corps. Because of the great speed required for the varied aerial tactics now employed in combat, engines have to be made in the range of 1,000 horsepower and more. In the United States there are three manufacturing plants turning out such high-powered engines. Two of these, the Wright Aeronautical and Pratt-Whitney, make air-cooled motors. The third of these plants is the Allison Division of General Motors at Indianapolis, which makes Allison liquid-cooled motors, ranging from a twelve-cylinder one rated at 1,090 take-off horsepower to a twenty-four cylinder one rated at 2,300 horsepower. This latter engine is still in the experimental stages.

The lower horsepower Allison engines have been accepted for military use in several of the best planes put out. These planes are as follows: the Curtiss *Tommahawk* P-40, the Bell *Airacobra* P-39, both single engine pursuit ships, the Bell *Airacuda*, a twin-engine multiplace fighter, the Bell *Airabonita* a single-engine navy fighter, the Lockhead *Lightning* P-38, a twin-engine interceptor plane and the North American *Musting* P-51.



In order to determine the fitness of the engines for the above uses the government put the motors on a model test conducted in the experimental shop. The production rate of these high-powered engines is increasing all of the time. The annual rate of production is expected to reach the 27,000 mark. Because one engine is always held in reserve for every two in service, this would mean that the engines would supply approximately 18,000 planes.

One of the main reasons that the government has such high hopes for the above factory is the fact that it is being operated as a specialized plant in the manufacture of the one engine. As the Allison plant is a branch of General Motors, the government naturally felt that this industry will achieve mass production in its work on this engine. The Allison engine now is made in mass production. The development time on the engine has been such that the company has had plenty of time to tool up for the job. The preparation for the manufacturing processes has been so thorough that General Motors can actually build better engines by mass production than can ever be built by hand. It has been demonstrated in many plants that the accuracy of American machine tools cannot be duplicated by the finest hand craftsmen. The problem is in the adjustment of tools to operations on certain materials that have not before been machined. Actually there are many tolerances in General Motors' gasoline automo-



tive engines, and especially in its Diesel engines, that are as fine as those in the Allison. There are, however, more parts of the Allison engine that require micrometric attention to limits than in the other General Motors engines.

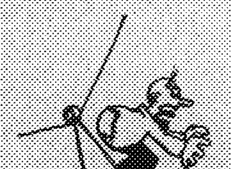
Engineers who designed the Allison engine believe that it is superior to the air-cooled type for several reasons. The first of these is that the air resistance or drag is less than in the other radial types; the second, that the Allison engine does not have to be placed directly behind the propeller but can even be placed behind the pilot, thereby adjusting the total weight of the ship; and the third, that the Allison can maintain top speed for a longer period of time than can the air-cooled motor.

The first reason, pertaining to air resistance, is based chiefly on the difference in frontal areas of the respective engines. For the same horsepower, the radial type type has a frontal area of over sixteen square feet while the Allison has six and one quarter square feet. This smaller area is due mainly to the fact that the engine is of the "v" design, with the cylinders in a line along the crankshaft, while in the radial type the cylinders are in a sun-burst arrangement around the shaft. This is an important factor, as it has been shown that the drag varies directly as the square of the speed.

The second fact of importance is that the Allison does not have to be exposed to the air, and hence can be placed further back in the body of the plane. This gives the designer a better chance to increase the speed characteristics of the plane, which also gives the plane the better maneuverability that is so valuable in the present war. With the engine behind the pilot better vision for combat is afforded, as the cockpit can be placed further to the front of the plane. The body of the plane has to be only about thirty-four inches wide to accommodate the engine.

The engine can maintain top speed longer than the radial type because it is much easier to cool. Instead of using water as the cooling medium, as was used in the old Liberty engine, ethylene glycol is now employed. This substance flows quickly and smoothly around the cylinders. It is a very good cooling medium in one respect for its boiling point is 387°, as compared to the boiling point of ordinary water, 212°. It is forced through the engine by high speed pumps so that the heat absorption is fairly uniform from all the cylinders.

Those not working on the Allison find fault with the engine. Most of those finding



fault will agree that the Allison is a good engine for streamlining, but they say that the problems of installation are fairly great.

The history of the Allison goes back many years, as far back as the last war. Jim Allison and a friend started together in a small partnership that led to the development of the famed Indianapolis Speedway. As they wanted plenty of space and time to do their experiments on engines, they set up their own machine shops to do the work. Norman Gilman, a mechanic, was put in charge of operation of these engines.

When the war was over, Allison was able to get a contract to overhaul a number of the old Liberty engines. Gilman took over the work, and he himself developed the famous Allison bearing, made of bronze in steel. With this development more horsepower could be obtained from the Liberty engines. This bearing has since been further developed by using other alloys, and has meant a great deal in the continuance

(Continued on Page 102)

Many Products

TAILOR-MADE

BY ALLEN WAGNER

MINNESOTA MINING AND MANUFACTURING

TYPICAL of American ingenuity in turning even its small products, originated for peacetime civilian use, into implements of war, is a manufacturing company of St. Paul.

Playing no small part in the transition of peacetime goods to "speeder-uppers" of war materials production are the laboratories and technical staff of some 200 employed by this concern, which has developed from a little-known, one-product company to one with an enviable record of creating and producing "tailor-made" products of such a diversified variety that they range from sandpaper to "Scotch" tapes and from floor and furniture polish to synthetic rubber and oleum for the manufacture of explosives.

Yes, the products of 3-M Company, as the concern is known throughout the industrial world, have gone to war. Abrasives, which once revolutionized the automotive industry, are now finishing and polishing guns and parts for tanks, ships and planes. And its other products, large and small, plus some new ones which have been fathered by its laboratories, likewise have been transformed from daily help in peaceful places of business, to indispensable tools for the production of enemy-destroying weapons in America's humming war plants.

Back in 1902, a group of Crystal Bay, Minnesota, men organized a company to mine what was believed to be a deposit of corundum along Lake Superior's North Shore. Their objective was to sell this mineral to eastern manufacturers of grinding wheels. The deposit turned out not to be corundum after all and of very little value to the grinding wheel manufacturers, but the new company, named Minnesota Mining and Manufacturing Company, proceeded to use the mineral, together with other minerals, in the manufacture of coated abrasives.

One of the outstanding results of the work of the research department, and one which in today's war is playing a vital part in speeding up production, just as it did in the days of peace in which it was originated is "Scotch" tape. More than 100 "Scotch" tapes ("Scotch" tape is the company's trade name) are produced virtually each of which was made for a specific use or a specific industry. Best known of the "Scotch" tapes is the "Scotch" cellulose variety.

Yes, it is the same "dime store" item you have in mind only now instead of being the handy "fixer upper" for mending school books and torn window shades, covering jelly jar labels and 101 other tasks, this little soldier is virtually not obtainable in the civilian market. For like a good soldier it has marched off to war.

"Scotch" Tape

The origin and development of "Scotch" tape offers an interesting story. It all began peacefully enough back in 1924, when automobile manufacturers and paint shops were having trouble painting the cars anywhere near as rapidly as mass production was turning them out. The automatic spray gun and quick-drying lacquers, both new then, increased painting speed tremendously, but some way had to be found to mask off parts of the car when a second color was used. Surgical adhesive tape, homemade paste and newspapers, and many other methods were tried by the automotive and car-painting industries which were crying for a masking tape that paint would not penetrate and yet would remove cleanly and easily after the paint had dried.

In coating paper and cloth and making its mineral grits stick to the paper and cloth the 3-M Company gained enough experience to try to produce such a tape with a paper backing and pressure-sensitive adhesive. Plenty of headaches followed, and cumbersome method after cumbersome method was discarded in the experimental stages. Finally, however, success marked the perseverance of the coated abrasives workers in their efforts to treat the paper for tape in such a manner as to make the product commercially usable.

Similarly, when cellophane packaging began in the late 1920's, it required considerable experimenting to perfect a transparent tape which would seal such packages. Continued research and experimentation followed, resulting in perfection of the "Scotch" tapes which lent themselves to so many home and office and industrial plant uses in peacetime.

Now "Scotch" tape has gone to war in such a big way that, upon request of our armed forces, some airplane manufacturers include three rolls of "Scotch" tape—the same magic-sealing, transparent tape you use for a myriad of jobs around your office and home—as a standard spare part in the bombing and fighting planes they turn out. In addition, this peaceful-looking product is serving on all fronts today—in pursuit planes over Europe, with ski troops in Alaska and in the steaming jungles of the Pacific.

Today there are more than 100 different types of "Scotch" tapes, rainbowhued and

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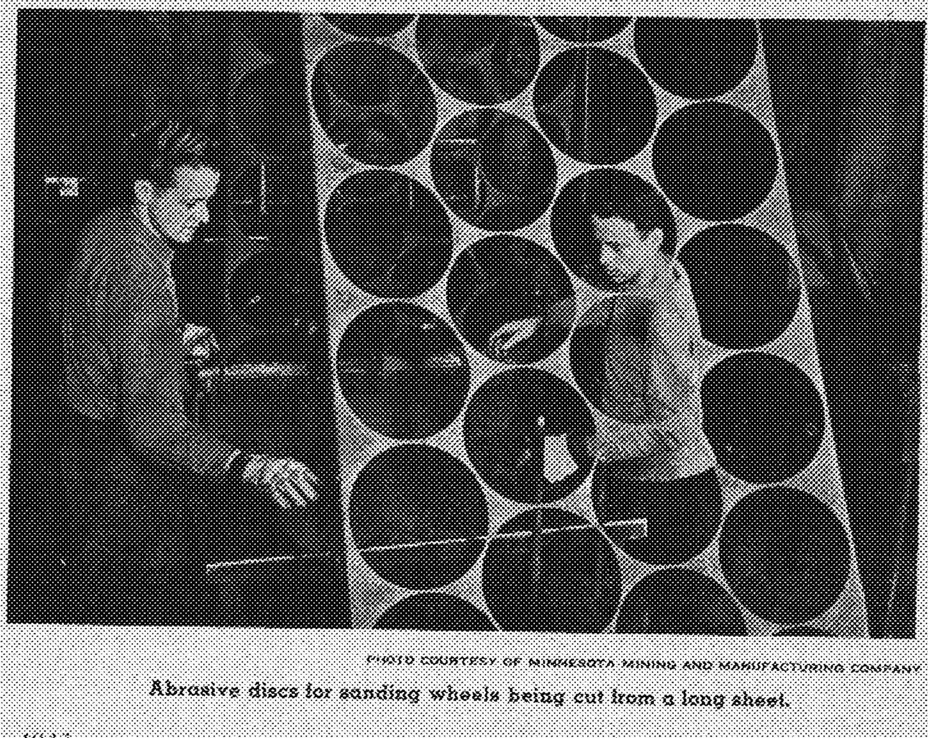


PHOTO COURTESY OF MINNESOTA MINING AND MANUFACTURING COMPANY

Abrasive discs for sanding wheels being cut from a long sheet.

Tech Teachers Are MUSIC MASTERS

A TECHNOLOG SURVEY

WOULD you recognize your thermodynamics instructor if you saw him in a zoot suit diggin' it with a hep band? And what would happen if your surveying professor decided to sing his lecture some day?

Sometimes the student forgets that his classroom lecturer, too, has an extracurricular life fully as fascinating as his own. The professorial energy outside class is exerted along numerous channels, from magic to farming.

The spotlight focuses on music as a major diversion in after-hours of the University of Minnesota engineering faculty. A recent survey of musical interests and abilities among this section of the faculty reveals at least one popular orchestra leader, two university band directors, one chamber music quartette, eleven singers of glee club and church choir rank, a radio vocalist, and a number of musicians with a flair for playing brass, woodwind, and string instruments. Some of these talents lie dormant now; but the interest in music is always alive.

Millard LaJoy, now Assistant Professor of Mechanical Engineering, was former "front-man" for his own "ork" in Duluth and on the Iron Range from 1932-35. "Sidemen" of his band are now with Abe Lyman, Freddie Schnickelfritz, and in Hollywood writing music for the studios. Mr. LaJoy plays the guitar, banjo, piano, sax, and fiddle, and time was when he vocalized with his band. The LaJoy eleven-piece jazzers—the period of jam and boogie hadn't arrived—were the only group to broadcast from the Iron Range in their time. The leader combined his pre-sliderule education at Duluth Junior College in the daytime with orchestral engagements at night.

The orchestra was a beginning for Charlie Koenig, bass fiddler with Schnickelfritz; McGrath, pianist with Abe Lyman; a trombonist who writes music for Hollywood studios; and two men who were later with Ben Bernie's "Playboys." At the University as a student, Mr. LaJoy devoted less time to music, playing only in a four-piece band and occasionally in other groups. Now as a faculty member, he looks forward to the day when he will again have time to develop his hobby.

The Mechanical Engineers boast another dance band player, albeit he was an "Aero" student in his undergraduate work at Minnesota. Dr. R. C. Jordan, Associate Professor of Mechanical Engineering, was banjoist in an orchestra (of which he swears he can't remember the name) at college dances and for a summer at the Cotton Club, now known as the El Patio. Three preceding orchestras were turned down by the Club owners after trial engagements, but this particular group of music-makers found favor in the eyes of the patrons and lasted out the summer. Dr. Jordan minored (extracurricularly) in violin and piano. Despite his obvious success in the musical field, Dr. Jordan insists that "any resemblance between a musician and myself is purely coincidental."

Music in its more serious aspects has long been an important sideline of O. S. Zelner, now Associate Professor of Civil Engineering. His record speaks for itself. He played the tuba in the University of Michigan band for three years and managed the band in his senior year. He sang in the University quartette of the University Glee Club, and for four years was church soloist. As a freshman, he won a two-year voice scholarship in the Ann Arbor Conservatory for his performance in "Elijah." The scholarship was sponsored by the University of Michigan Choral Union.

From the time he came to the University of Minnesota in 1910, Professor Zelner has shared his engineering career with one fully as fascinating in music. For six years he led the Andrew Quartette and sang bass with them in a program over WCCO; for six years was in the quartette of Central Lutheran Church. He is a past president of the Minneapolis Evergreen Club, a group of men in constructive music for over 25 years, and is a member of the Minneapolis Apollo Club, well known for its promotion of civic music.

Professor in Symphony Orchestra

Another professional in music was C. A. Mann, Professor and Chief of Chemical Engineering, who keeps up his interest as a hobby at present. He was in charge of a University of Wisconsin band and symphony orchestra musical shows in Madison from 1905-1919. His career was highlighted by a 60-day trip when he took the group to the Pan-American Exposition in Los Angeles and San Diego in 1915. At the University of Minnesota he was with the symphony until 1938. The cello, viola, and trombone are all within his range. Professor Mann now finds an outlet for musical expression in a faculty club called the "Crotchets and Quavers."

The tie between engineering and music was strengthened by the quartette of C. T. Boehnlein, Associate Professor of Aerodynamics, H. A. Doeringsfeld, Assistant Professor of Mathematics and Mechanics, H. B. Wilcox, Professor of Mathematics and Mechanics, and W. E. Brooke, Professor Emeritus and former head of Mathematics and Mechanics. Professor Boehnlein, who claims he was a "terrible" clarinetist, says that the quartette played purely for its own amusement. "We were only asked once to play in company and we knew enough to refuse that time," chuckles Professor Boehnlein. Doeringsfeld played the flute, Wilcox the clarinet, and Brooke the bassoon. Professor Brooke, however, had more than an amateur talent, for he also practiced his art in both the Minneapolis and the University of Minnesota symphony orchestras at different times.

Music Still a Favorite Hobby

The piano provides a musical hobby for R. M. Cornell, Instructor in Municipal Engineering; Robert Eustis and Harry Priest, Instructors in Mechanical Engineering. Mr. Priest has also a fingering acquaintance with the banjo, and could handle the drums or perhaps the "sax" in an emergency. J. R. DuPriest, Professor of Mechanical Engineering, played cornet in a college band and has always encouraged students to take up music if they were so inclined. The ukelele provides a personal diversion for Ray Kullberg, Instructor in Mechanical Engineering, and the accordion for C. E. Lund, Associate Professor of Mechanical Engineering.

You might ask any of the following instructors to sing for you some day instead of lecturing: John H. Ballard, Instructor in Chemical Engineering, who was a member of the St. Thomas Glee Club in 1935-36; J. O. Hougen, Instructor in Chemical Engineering, who was a member of the Luther Memorial Cathedral Choir in Madison, Wisconsin, from 1933-36; Tom Murphy, Instructor in Mechanical Engineering, who warbled with his high school glee club for three years; or G. H. Montillon, Professor of Chemical Engineering, who vocalized in his early 'teens in church and school programs.

What the singing world missed in the way of probable achievement will never be known because of pranks of nature. A. J. Madden, Instructor in Chemical Engineering, sang lustily with a children's church choir until his voice changed; and Myrl A. Lindeman, Instructor in Mechanical Engineering, was frustrated in his role in a high school operetta by having his voice give out the night before the performance.

So the engineering faculty gives you everything from a symphony leader to an accordionist, plus no one knows what talents the too-modest ones have hidden.

Army Engineers

DAM THAT RIVER

BY MALCOLM C. CUTTING
U. S. ARMY ENGINEERS OFFICE

THE system of locks and dams in the Upper Mississippi River, adapting the age-long course of nature to the more immediate needs of man, was one of the great engineering feats of the U. S. Army Engineers. It provided an assured nine-foot channel throughout the length of the upper river for powerful towboats, great fleets of barges, and a dependable water highway for heavy river traffic never dreamed of in this section before.

But in a flood year, as we had it on the upper river and its tributaries this year, wherever low-lying property is subject to overflow there is unvoiced suspicion, sometimes loud-voiced complaint, that the damage is caused by the government's system of locks and dams. People forget, or do not know, that these lowlands were flooded just as frequently and just as seriously at similar stages of the river before the first dam was built.

For Navigation

The dams were erected primarily for purposes of navigation. They were not designated to prevent floods or to control their flow, and in the nature of their special construction it usually is not possible for them to do so. Just as certainly they are not the cause of floods, which occurred before and would still occur if the dams had never been built.

From the earliest days of the river steamboats, navigation on the upper Mississippi above the confluence of the Missouri River was a precarious undertaking. Low water, uncertain depths, a winding course with many secondary channels and sloughs to divide the volume and decrease the depth—all these made dependable navigation difficult and at times impossible.

As early as 1878 Congress adopted the original project for improvement of the upper river, providing for a 4½ foot channel. A later project, in 1907, provided for a 6-foot depth in the upper reaches. Finally, in July, 1930, Congress adopted the Upper Mississippi River 9-foot channel from Minneapolis to St. Louis, to consist of a series of 26 locks and dams supplemented by dredging where necessary.

That part of the project extending from Minneapolis to Guttenberg, Iowa, a distance of 238 miles, comprising 11 locks and dams, lies within the St. Paul District of the U. S. Army Engineers. In this area the river meanders through a flat alluvial plain widening to a width of about three miles and situated between high rock bluffs.

There is so little rise between the river banks and the foot of the bluffs that major floods occasionally cover the entire valley floor except for incidental ridges and knolls. Situated on the valley floor are numerous cities, villages, farms, trunk line railroads and main highways.

This high state of development precluded the use of high locks and dams and made necesary a system of low-lift locks and dams. They were spaced at intervals of 10 to 44 miles apart, with lifts varying from 5½ to 38 feet (Twin Cities dam), in most cases 7 to 12 feet. The dams back up the water during period of low flow to maintain a nine-foot depth for navigation but are opened wide in period of high flow so as not to cause flooding.

What the engineers did was to take the Mississippi as nature fashioned it, with the surface of the water in a continuous slope, and transform it into a giant stairway for boats consisting of a series of steps over which, by means of locks, the boats ascend and descend the river. The faces of the dams are the risers of the steps and the lakes or pools of water they impound behind them are the treads.

A system of structures of this type, with low lifts and comparatively small pools, requires more careful operation, especially in periods of high water, than is the case on rivers where the banks are higher and larger structures can be used.

Survey for Floods

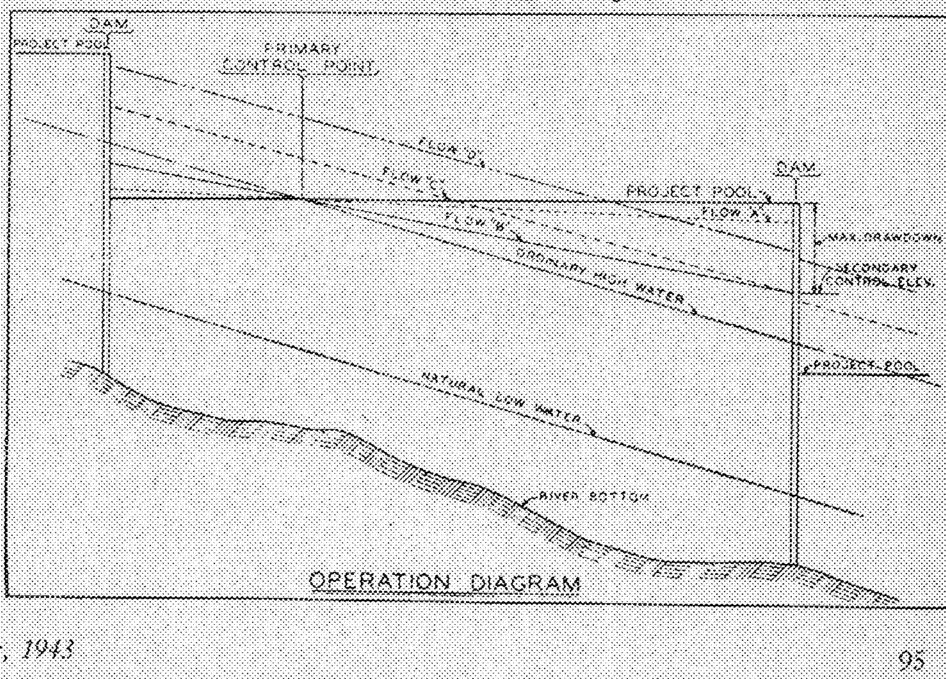
When construction of the dams began, a survey of signs along the entire river was conducted to determine what elevations of ordinary high water within the banks—not occasional floods overflowing the banks—might be expected. This ordinary high water line, of course, under natural conditions has a slope.

At the same time the engineers planned the dams so that the pools, when filled during a low-water period and with a level surface practically would maintain a nine-foot depth throughout the length of the pool. This they called "project pool elevation."

In a profile or sectional diagram of a pool, project pool elevation is represented as a horizontal line sufficiently above the

(Continued on Page 100)

PROJECT POOL: elevation of pool, level surface, if theoretically, there was no flow in river; very low flow approaches this level. Flow "A": slight increase in flow, requiring tilt about primary control point. Flow "B": moderate flow, with maximum tilt about primary control point and passing through secondary control point at the dam; for higher flows, control shifts from primary to secondary control. Flow "C": high flow, with tilt increasing about secondary control; gates raised clear of water and dam out of operation; flow line as in nature, except for slight swellhead shown by break in flow line at lower dam. Flow "D": extremely high flow, beyond control of the dam; river flowing as in nature except for slight swellhead at dam.



OPERATION DIAGRAM

SEEING IS BELIEVING

Through University of Minnesota Visual Education Department

The Visual Education Service was established in 1932 as part of the General College. At present, the Service gives five thousand shows a year—thirteen hundred each quarter, and a little more than one thousand during the summer school. There are eight full-time employes and twenty-five part-time student projectionists, most of whom are drawn from the Institute of Technology because of their greater background of knowledge about amplifying systems.

The Visual Education Service offers forty-one different types of auditory and visual education services. In the headquarters of VES in Room J, Wesbrook Hall, are stored quantities of portable equipment. All this is for rent at a nominal rate by any University department or organization. Projectionists and operators are provided wherever required.

VES also operates all permanently installed motion picture projectors and sound systems on both campuses. Some of these are in the Coffman Memorial Union Ballroom, in Northrop Memorial Auditorium, in the Museum of Natural History, in the Administration Building and in Greene Hall on the Ag campus.

In all, the Visual Education Service is responsible for the maintenance and operation of over $100,000 worth of projection and sound equipment. The largest single installation is the sound system in the Coffman Union which cost $20,000. The heart of the system is the control room located in the basement where all the turn-tables, amplifiers, and control equipment is located.

To date, VES has completed over seventy-six motion picture film productions for University departments in both 16mm and 35mm, sound and silent, black and white and color. The latest of these is a three-reel color sound film NURSE STUDENT IN WARTIME, made for the School of Nursing. Another is PTOSIS IN BOTH EYES, an addition to the long series of color films on eye operations produced for Dr. Frank Burch at the University Hospitals. Just starting is a three-reel color sound film for the President's office on the Armed Services at the University.

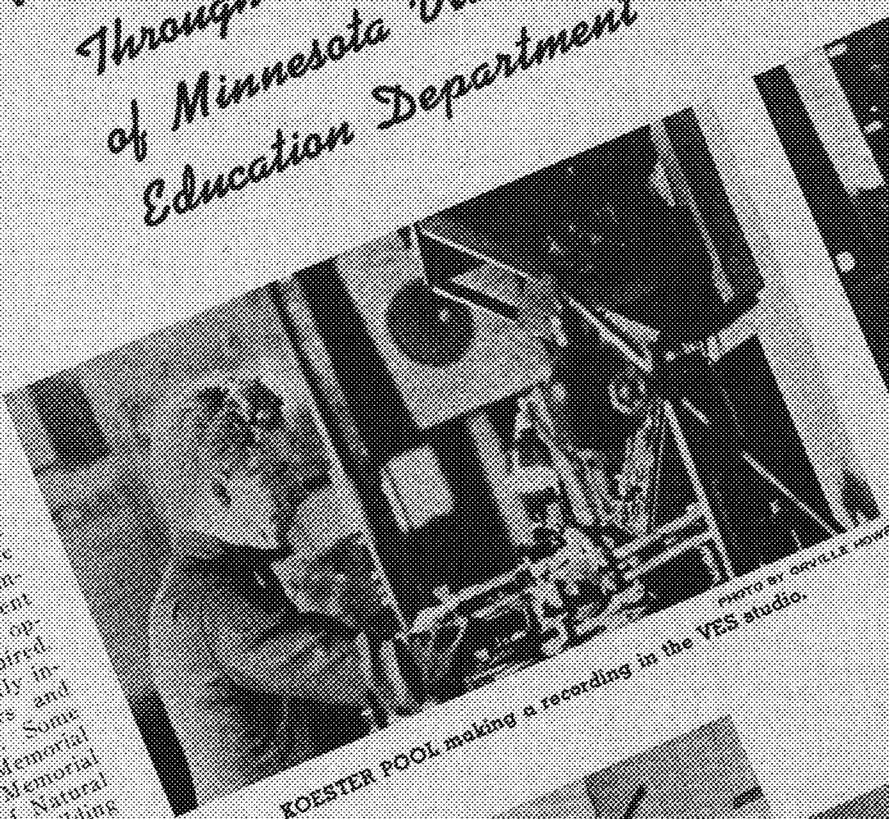
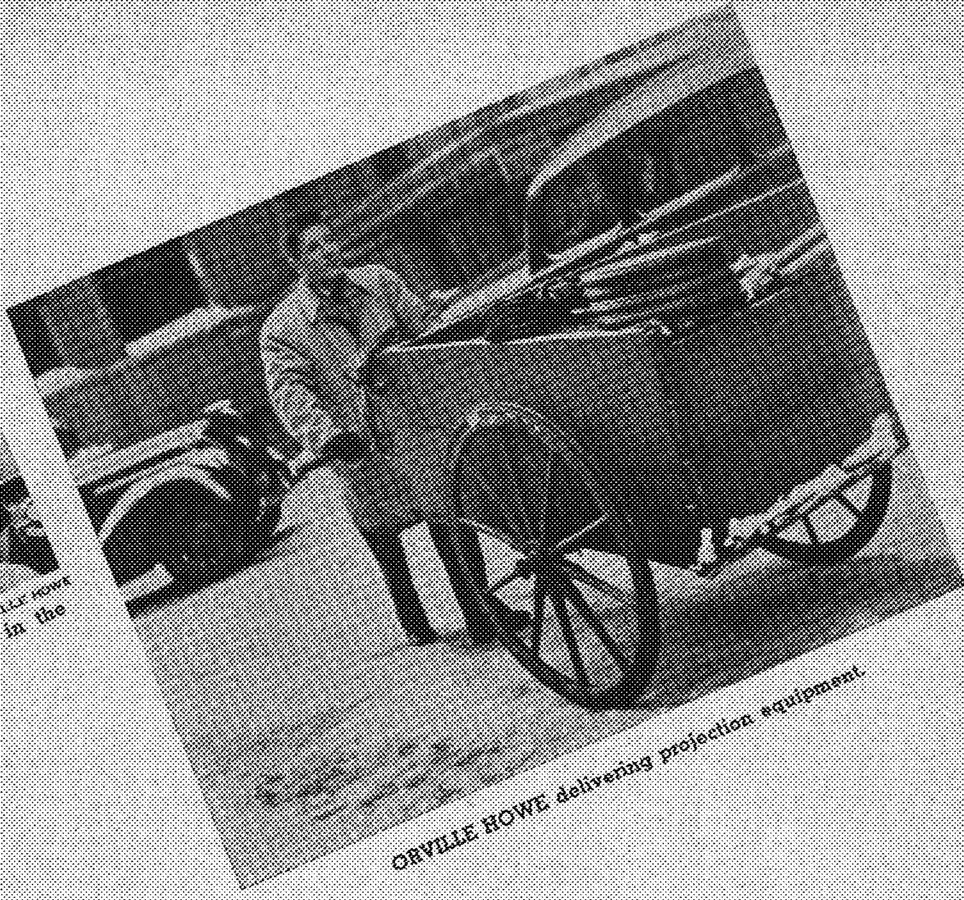


PHOTO BY ORVILLE HOWE
KOESTER POOL making a recording in the VES studio.


PAUL WENDT, director of VES, shooting a close-up in the VES stu

PHOTO BY ORVILLE HOWE

...ORGE HORST AND WINSTON BERGSMAN of VES in the Union control room.



ORVILLE HOWE delivering projection equipment.

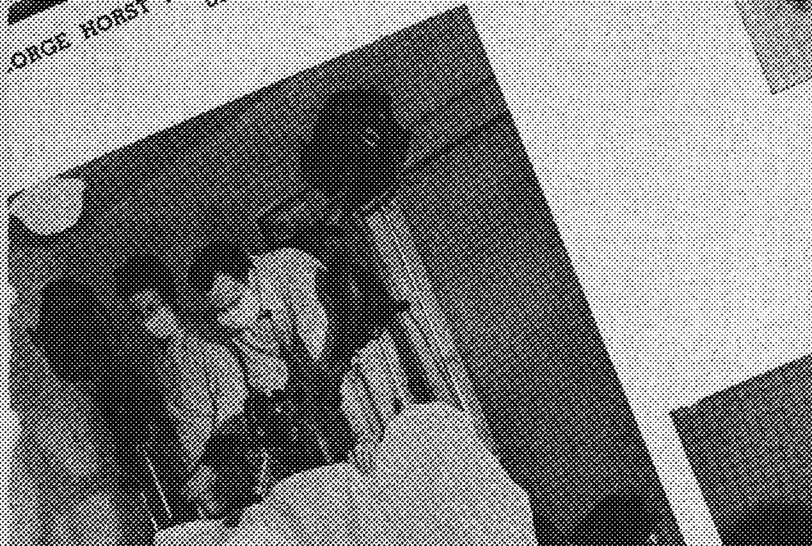


PHOTO BY VES

MR. HAMILTON AND MR. POOL of VES shooting a color film of an eye operation for Dr. Frank Burch at the University Hospital.

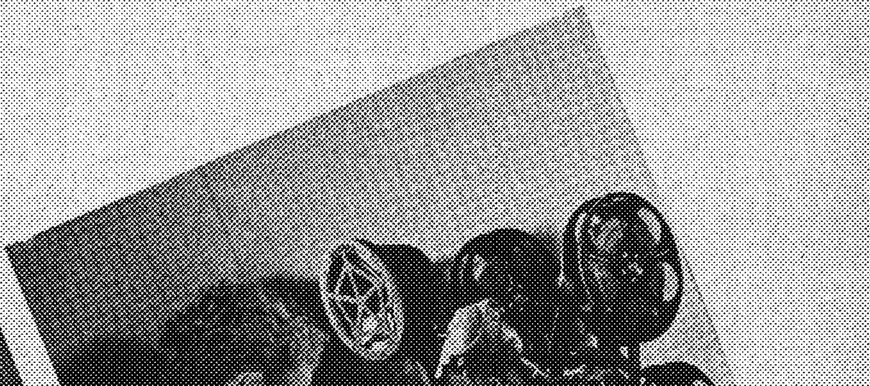
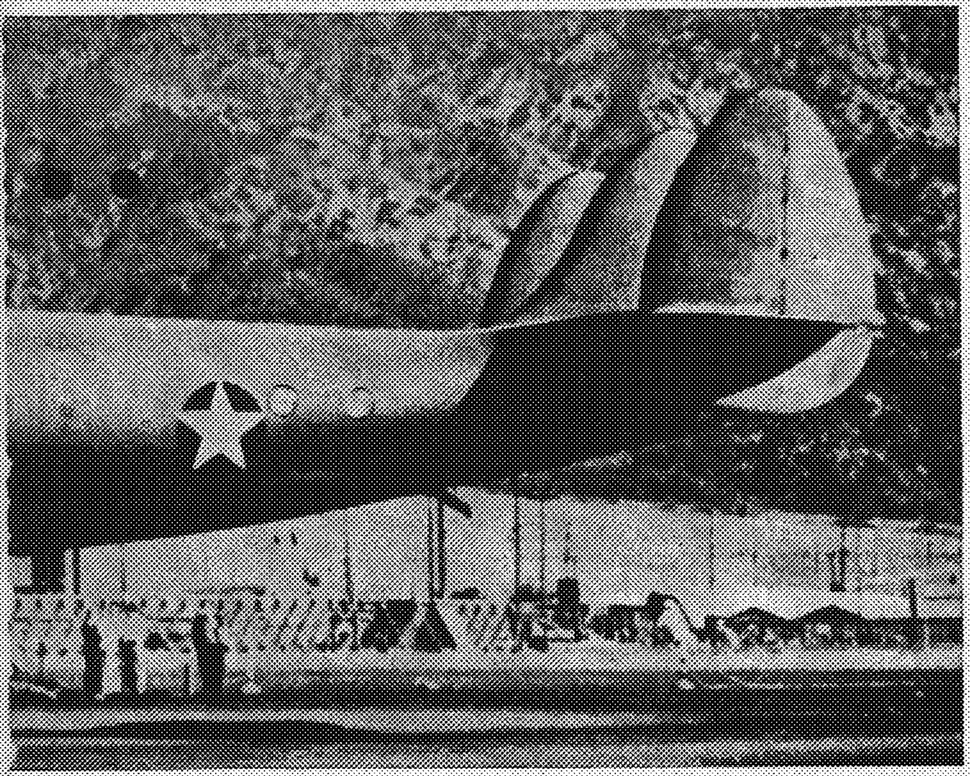


PHOTO BY VES

KOESTER POOL editing motion picture sound film.



the Nation!

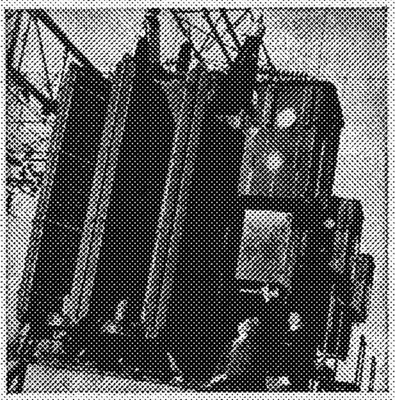
erate the tremendous electric power needed.

A-C motors, drives, controls keep production flowing . . . and Allis-Chalmers also produces equipment for making aluminum and removing precious magnesium from the sea.

1600 different industrial products come from this one company. And Allis-Chalmers engineers are helping plane makers and other manufacturers *produce more*, not just with new machines—but with *machines on hand!*

It's a tremendous job—and out of it Allis-Chalmers men and women are gaining experience that can mean better peacetime planes, better peacetime goods of all kinds.

ALLIS-CHALMERS MFG. COMPANY, MILWAUKEE, WIS.



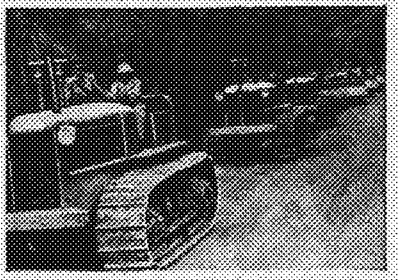
One of many Allis-Chalmers transformers that help transmit vital electrical power to U. S. war plants.

VICTORY NEWS

A-C Maintenance Booklets Now In Spanish, Portuguese! More than 200,000 Allis-Chalmers booklets on wartime maintenance of motors, pumps and rubber V-belts have been requested by men in industry whose job it is to keep machines running.

So great a demand has also come from South American countries that these booklets are now being printed in Spanish and Portuguese.

They are packed with practical information which is particularly helpful in training new men for the important job of making motors, pumps and rubber V-belts last longer during this critical war period. Write for your copies (English, Spanish or Portuguese) today.



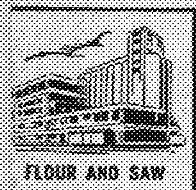
Good Neighbors get together! The picture above shows Allis-Chalmers equipment ready for an important road-building job near Rio de Janeiro.

A-C Aids Ship-Building Program: America's shipyards have already smashed every ship-building record in the book—and production of merchantmen and warships is still climbing.

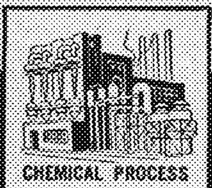
A-C is one of the companies which is feeding these yards. It supplies a larger variety of equipment for ships than any other company in the U.S.A.

Belts, blowers, castings, condensers, control devices, generators, motors, turbines, rudders, complete hull sections, transformers, pumps are just a *few* of the items which we are supplying.

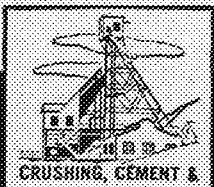
FOR VICTORY
Buy United States War Bonds



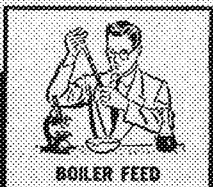
FLOUR AND SAW MILL EQUIPMENT



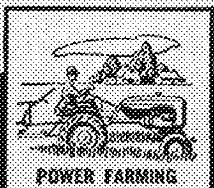
CHEMICAL PROCESS EQUIPMENT



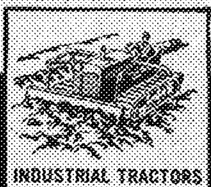
CRUSHING, CEMENT & MINING MACHINERY



BOILER FEED WATER SERVICE



POWER FARMING MACHINERY



INDUSTRIAL TRACTORS & ROAD MACHINERY

ALMERS

OF MAJOR INDUSTRIAL EQUIPMENT

WE WORK FOR VICTORY — WE PLAN FOR PEACE

Not Texts But Treasures

(Continued from Page 89)

the air or the sea, a book must cover very special territory indeed.

The two books by all odds to be placed first here are histories of great raids—the true "basics" which prepare the "finishing process"—a process already, in the case of Africa, accomplished.

One of the first stories of a participant (pilot of the *Ruptured Duck*) in what many students concur in believing the "greatest raid in this war so far," Captain Ted Lawson's *Thirty Seconds Over Tokyo* ($2) commands respect for its factual, systematic, unglamorized quality as well as for its heroism.

"Shortly before midnight on the 2nd of September, 1942, Ober Maat (Chief Mate) Munte . . ."—so begins "The Steel Hand from the Sea" in Hilary S. G. Saunders' *Combined Operations: the Official Story of the Commandos, with a Foreword by Lord Lewis Mountbatten* ($2). The significance of "these small raids" which end with "Reconnaissance in Force: Dieppe" and which include at points Generals Mark Clark and Eisenhower is momentously pointed: "Eighty days later the occupation of French North Africa began." Though we have had nothing yet in poetic quality of allusiveness and unity of conception like Laurence Stalling's and Maxwell Anderson's tremendous photographic *First World War*, still *Combined Operations* approaches it—and it has both interesting text and pictures.

The technical background of the war is apt to include the Incipient Air-Minded—and that includes just about everybody not already a specialist. It is a pretty safe bet that any person so minded would be glad to get either of two absurdly simple and yet astonishing books.

Such is the cultural paradox of our time that, in an era more literate, more highly technical than any other, a college reader who picks up a book dealing with the social applications of the air must find himself only semi-literate. Burnet Hershey's *The Air Future: A Primer of Aeropolitics* $2.75) sparkles with eyeopeners, crackles with statements both technical and social on everything from invention to airpolice bases:

"The facts of American life from now on will center on remembering that Europe is less than five hours away to the East, Asia less than ten hours to the North."

"There's a chorus of agreement . . . there is no limit to the possible size of aircraft."

The record of the impossible with which, less than half a century ago, aviation began, is still with us. The creators of a decisive invention of history still lack an adequate biography. The first and only factual and official life, Fred C. Kelly's *The Wright Brothers* is not a biography but a highly unified history of an idea—the miracle of flight—in two lives. On this account it is an amazing book—and never more so than in the incredible story of authoritative deduction by scientists which rendered reporters unable to write, editors unable to print, readers unable to believe the evidence of their own senses, so that even today the layman is in a bit of a mist on the origin of flight.

Even such a beautiful book as Jeremiah Milbank's *The First Century of Flight in America* (in the Engineering library) is not final but a first account of its subject.

How could De Seversky write his *Victory Through Air Power* in 1921? Those able to believe their eyes may look at an astonishing volume (*Command of the Air*, first published in 1921) possessed by the Engineering library, in which Giulio Drouhet with cool detail of dates and numbers of planes describes the preparation, moral, intellectual and material, of France and Germany and the use of planes in the Battle of France.

There remain to be mentioned John Steinbeck's elementary but official *Bombs Away! The Story of a Bomber Team* (60 photographs), Douglas Coe's *Marconi*, and H. G. Garbedian's *George Westinghouse, Fabulous Inventor*, all in the Engineering library.

Dam That River

(Continued from Page 95)

sloping river bottom to indicate a nine-foot depth at the upper, or shallower, end. Ordinary high water is represented as a sloping line which intersects project pool elevation, falling below it at the lower and deeper end of the pool, extending above it at the upper and shallower end.

This intersection is what the engineers call the "primary control point," and what they use as a pivot to tilt the surface at times of rising water. It is at project pool elevation, so it ensures a nine-foot channel. It is also on the line of ordinary high water, which is within control of the dams. So long as the surface passes through this control point, no matter what the tilt or volume of flow the channel is assured and the flow is under control.

But in time of flood the surface cannot continue indefinitely to pivot about this primary control point. It does so until the lower end of the pool, or headwater of the dam, has been drawn down to the maximum allowed for that dam without endangering navigation depths between the control point and the dam. The elevation corresponding to the maximum drawdown is called the "secondary control elevation."

Upon further increase in flow above ordinary high water, the surface of the pool is pivoted about this secondary control elevation at the dam by continued manipulation of the gates until the water surface in the next pool immediately below the dam rises to within about two-tenths of a foot—the swellhead caused by the piers—of this elevation. Then the gates are withdrawn clear of the water and "open river conditions" prevail. Any higher flood from then on is as nature ordains it.

Thus from the beginning the government has striven, by acquirement of sufficient land and by careful adjustment of pool levels, to protect property owners and to prevent litigation arising from the operation of the dams. And it has had to retain these considerations while carrying out the main purpose for which the dams were built—the maintenance of a nine-foot channel for navigation.

Another consideration that must be observed in the adjustment of pool levels for navigation is the preservation of fish and wild life. Conservation interests and sportsmen's groups have long complained that the fluctuations in pool levels are detrimental to wild life and have requested that they be stabilized for the benefit of hunting and fishing.

It has developed, in discussions on the subject, that the functions of the pools, the purpose and necessity for drawdown at the dams, and the effect of the pools on flood stages in the river are points which are not clearly understood by the general public. That is one reason why this article explaining the operation of the dams and the reasons for surface variations is written.

Last winter, due to a wartime emergency downstream, the pools in the Upper Mississippi River had to be lowered three to four feet. It has been claimed that the lowering of the pools after the ice had formed caused a heavy loss of fish and a high mortality to wild life, especially to muskrats, in the backwaters and sloughs tributary to the river; the ice fell; muskrat houses were exposed; fish were either crushed by the ice or suffocated when the waters became too shallow to contain a sufficient quantity of dissolved oxygen for fish life.

Unfortunately, some of these effects did occur. But the lowering of the pools was not an idle exercise in the operation of the gates. It was a wartime measure carried out through the entire system to maintain navigation requirements in the lower Mississippi below the series of locks and dams, particularly in the vicinity of Chain of Rocks near St. Louis. As the emergency did not arise until January and February, it was necessary to lower the water after the ice cover had formed.

The release of this storage water also provided additional water power at hydroelectric plants in the Mississippi River. This furthered the national war effort since it resulted in a decrease in the amount of power required from steam plants, a large saving of coal, and an appreciable saving in transportation equipment and manpower.

It must always be remembered that the locks and dams in the upper Mississippi were built and are maintained primarily for the purpose of maintaining a nine-foot channel for navigation. They can control flows up to ordinary high water but cannot prevent overflow when flood waters prevail. In the adjustment of pool levels, water surfaces are maintained at as stable a level as flow conditions will permit. Sometimes emergencies occur. In wartime, emergencies are to be expected.


SAFEGUARDING
"HOME FRONT"
LINES!

Allison Engine

(Continued from Page 92)

of the Allison company. The development brought the company enough money so that further research could be done.

Allison died in about 1929, and at about the same time General Motors bought the plant and Gilman was made President and General Manager of the company. It was then that he began to do his own work on liquid-cooled engines. The air-cooled engines had been developed to about 400 horsepower, but Gilman felt all along that the future would be in the liquid-cooled types. He designed especially an engine to be cooled with ethylene glycol rather than the more conventional water. In order to get started he had to get orders for the 700 horsepower engines from the Army and the Navy. After several years of trouble in developing an engine capable of passing the required tests, he decided that General Motors should replace him with an expert in the field of airplane engines. This change was carried out; General Motors sent Ronald Hazen to help Gilman. Inside of six months an engine was developed that passed the required tests. From here the problem was to get this motor into production. This was a long and tedious task.

The man designated to do the job was Otto Kreusser, who had for a time designed cars and had done some instruction work concerning Liberty engines during the First World War. He came to the job in about 1936. The first order was for sixty of the engines, a very small order for a mass production plant that was then being organized. Luckily the government had enough faith in the Allison organization to give them plenty of support, and the Army came through with an order for about 400 of the engines, which was a better number to work on but still not enough. In 1939 the push was on, and large orders were placed. This meant that the plant could at last expand to the desired size to handle the production ahead of them.

The plant set up was very efficient, and every possible precaution was taken in the production to see that the engines were made according to best practice. All the modern plant conveniences were put in to help in production. Such things as fluorescent lighting, no actual windows, good ventilation, and well-constructed test rooms and wind tunnels were all part of the new plant. A great deal of care had to be taken regarding the weight when making the engines. In the automobile engine the weight per horsepower is anywhere from five to ten pounds. The aim of the aircraft engine designers was to obtain a weight per horsepower of one pound. This meant that the cylinder heads had to be extremely thin but strong enough to resist the stresses set up in them. The clearances are so closely set up that even rust spots cannot be sanded off. The latest Allison engine of 24 cylinders weighs exactly one pound per horsepower.

Production in the plants is such that now the work can be set up very quickly and with little difficulty in other General Motors plants. In this way greatly increased production is possible if the need arises. This involves the problem of training skilled men in the many jobs performed on the engines in the new plants. Experienced men were always on hand to instruct the new unskilled men and to get them started in doing the work required. The whole job of setting up such a system was tremendous, but this article shows the original plan and how it developed rapidly into its present important wartime position.

Super-Hurricanes

(Continued from Page 91)

pressures above the critical. The disadvantages of these cycles are the high pressures involved, which are entirely absent in the gas turbine.

One thousand tons more cargo space in each Liberty ship of the U. S. Merchant Marine would mean a shorter war. Installation of gas turbines would give this space, but they use five to six times the air required by steam or Diesel equipment; hence the ship design would have to be radically changed to eliminate the danger from shipping water through intake openings in rough weather.

Aside from the disadvantage of requiring large quantities of air to cool the products of combustion, the gas turbine would be ideal for marine use. Its extraordinary reliability, which is of paramount importance on shipboard, is directly attributable to its simplicity. It has no need for a boiler and accompanying feedwater equipment. Five pounds of water are required for every pound of coal burned, and because makeup must be obtained from salty sea water, the feedwater problem is a large one. Neither has it the many rubbing and tapping parts of the Diesel. The absence of a condenser and other auxiliaries from a gas-turbine installation is another distinct advantage.

Speed control for ship units presents a problem. The gas turbine is inherently a high-speed machine. This necessitates heavy reduction gears or electrical machinery to transform the high turbine shaft speeds to the required propeller speeds of about 300 rpm. Changes in efficiency by controlling turbine-inlet temperatures are possible so that peak efficiency could be maintained throughout the entire speed range.

For naval use the gas turbine has great possibilities. The elimination of boilers and their accompanying protective armor would make room for larger and more powerful gas turbines to drive the ships faster, or provide increased fuel space for greater cruising ranges. Under present conditions forced draft operation gives efficiencies of 14 per cent, and cruising efficiencies vary from 11 to 14 per cent. The gas turbine would prove satisfactory in this respect.

Because of its reliability, economical operation, light weight, and high power the prospects for the gas turbine as a marine engine are very good.

Another glimpse at the future shows high-speed gas turbines of light-weight construction driving the propellers of passenger and cargo planes through reduction gears. This is not a fanciful prediction. A Swiss design for such a turbine was submitted to both Great Britain and Germany before the war. Cooling is the limiting factor in radial airplane engines. The double-row, 14-cylinder, 2000 horsepower air-cooled radial engine is the practical limit of present design. Liquid-cooled engines up to 2300 horsepower are being manufactured, but here the problem is the limit to the number of pistons that can be connected to one crankshaft. Both types of internal-combustion reciprocating engines are confronted with high-compression pressures and complex lubrication systems. In some engines oil consumption runs as high as five per cent of the fuel used. Design of an electric drive between the gas turbine and propeller to permit greater latitude of operation will probably mean much to the advancement of the gas turbine as an airplane engine.

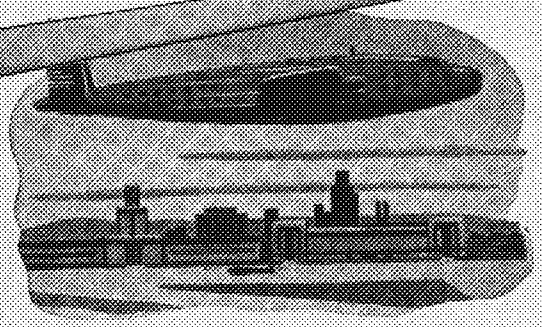
Dr. J. R. Rettaliata, of Allis-Chalmers, and Dr. Moss, of General Electric, are perhaps the most prominent in this country as gas-turbine experts. The DeLaval and Westinghouse companies are also conducting experimental work in its development. In Europe, Brown-Boveri led the development work and are doing a vast amount of research on the gas turbine. Some of the recent progress made involves a burner which permits use of pulverized fuel and use of a primary impulse stage with high-temperature gases confined to stationary nozzles.

Comparison of the steam turbine and the Diesel with the gas turbine reveals that the btu's consumed per kilowatt-hour of energy produced amount to about 14,000 for the steam turbine, 12,000 for the Diesel, and 20,000 for the gas turbine. With the turbine-inlet temperatures raised to 1300° F. the number of btu's drops from 20,000 to 12,000 for the gas turbine, but it must be remembered that the steam turbine derives the same benefit from the increased temperature. Fuel required per kilowatt-hour by the steam and gas turbines is about one pound, and for the Diesel about six-tenths of a pound. Cost per kilowatt-hour for the steam turbine and Diesel is slightly more than four mills, and for the gas turbine about six. Thermal efficiencies for steam turbine and Diesel units reach values as high as 40 per cent, while the gas turbine operating on the closed cycle is capable of 24 per cent efficiency.

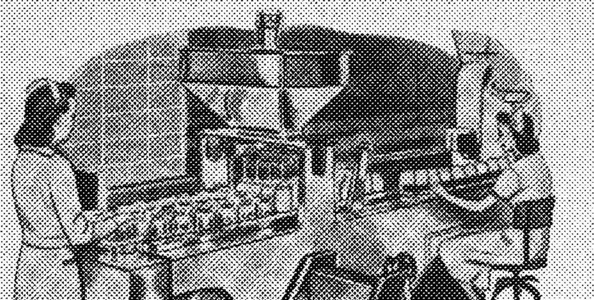
These data are not entirely accurate but do present a rough basis for comparison. The figures for the steam turbine and Diesel are liberal, whereas those for the gas turbine are more conservative. It may be concluded that the Diesel is the most efficient, although all three are fairly close together on that basis.

The steam engine was responsible for the industrial revolution. Then came the steam turbine to take over the task of producing power. When the gasoline engine was invented no one forecast the automobile and the airplane. The Diesel has led an interesting and varied existence. Equally exciting are the possibilities which the future holds for the gas turbine.

Filling Prescriptions with Steel!

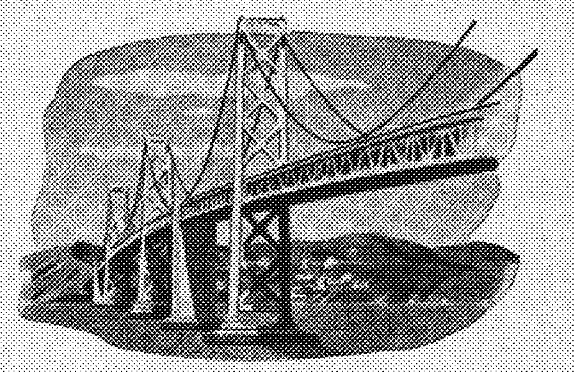


1. BETTER STEELS! This country needs aircraft that fly high and far . . . and hit hard. It needs ships in great numbers. It needs tanks that can take it when the going gets tough. It needs equipment to outperform any on earth. All these things require many special steels. Such steels with needed properties are created through the use of *alloys*. Basic peacetime research by ELECTRO METALLURGICAL COMPANY, a Unit of UCC, has developed many important steels and the alloys to make them, such as chromium, silicon, manganese, vanadium, tungsten, calcium, and columbium . . . all vital today.



2. STAINLESS STEELS! The development of steels of high chromium content gave designers and engineers a whole family of new materials with which to work. Such steels resist rust and corrosion, and are easily kept clean. They are essential in the food industry. Possessing great strength in addition to their corrosion resistance, they save weight in trains and planes. They have brought improvements in the oil, chemical, textile, and other fields...with resultant savings to you. Low-carbon ferrochromium, an Electromet development, is essential in the large-scale production of stainless steels.

3. NEW NATIONAL RESOURCES! Tungsten and vanadium are essential to steelmakers. Long before war clouds loomed, many felt that more of this country's domestic sources of these metals should be developed. Engineering research by UNITED STATES VANADIUM CORPORATION, another UCC Unit, found efficient ways of refining low-grade ores. This enabled U. S. VANADIUM to revitalize old mines with new mills and methods, and make America less dependent on foreign sources for her increased needs of tungsten and vanadium.



4. BUILDING TOWARDS THE FUTURE! Alloy steels offer still greater promise for the future. Bridges and other structures will be made still lighter, stronger, and longer-lasting by wider use of some of the steels with which engineers are already experienced. Trains, trucks, and aircraft will be made lighter, stronger, faster, and safer. Better cars and tractors, homes and home equipment will be made through their use.

Units of UCC do not make steel. They do make ferro-alloys used to purify and give special properties to steel. They also make non-ferrous alloys which, because of their exceptional resistance to wear, heat, and corrosion, are used as cutting tools, hard-facing welding rods, and for other purposes. UCC research and developments mean ever-new and improved alloys for industry . . . and ever-better products for you.

BUY UNITED STATES WAR BONDS AND STAMPS

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York 17, N. Y.

Principal Products and Units in the United States

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INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

AS WE SEE IT

To Seniors Especially

Will you know what is happening on the University of Minnesota campus five years hence? Will you care? If not, you lack the pride and appreciation that go with the privilege of attending this great institution. Another commencement will take place December 16 and close to 750 more seniors will receive degrees. Too many of these graduates will sever all ties with the University and never resume an interest in it.

Had it not been for the activity of the alumni organization the University would not be where it is today. It was largely through their efforts that land was acquired for our present engineering buildings. The alumni also were instrumental in inducing the Northern Pacific Railroad to move its tracks to their present location. These tracks at one time occupied a cut which extended from where the Law School now stands to the Oak Street Laboratories. In addition to cutting the campus in two, passage of trains disturbed instruments in the various departments.

At one time the students of the University could not be assembled except on the football field. Again it was through the combined efforts of the alumni and active University personnel that Northrop Memorial Auditorium could be built. Before the Golden Gophers became nationally known they played before spectators who were forced to sit in wooden bleachers, while at other schools of comparable size the crowds went to permanent stadiums. Our stadium is another of the projects in which the alumni took an active interest. Perhaps most important of all in the activities of the alumni was their part in restoring to the Board of Regents their full powers as controlling body of the University.

But during the past few years the alumni of the Institute have failed to do their part. When Coffman Memorial Union was built tech alumni subscriptions were below expectations. Slightly less than one-fifth of the total funds necessary came from former students. The drive for a new Mechanical-Aeronautical Engineering Building could probably have been successfully completed before the beginning of the war instead of after if tech alums had been active.

The fact that the University is almost entirely a state-supported institution does not mean that its alumni can forget it completely. It is the duty of every alumnus to keep up an interest in and work for the improvement of the University every time he has the opportunity. The time to begin being a good alumnus is the night you receive your diploma. True, it is never too late to begin, but you should endeavor as an undergraduate, to develop the school spirit within yourself and around yourself. If you want to help make Minnesota the best university in the country, it is up to you. Then when you hear the strains of "Minnesota, Hail to Thee," you will feel the pride of being an alumnus that cannot be mistaken.

A Vital Subject

Have the faculty of the Institute overlooked a vital subject? Have they neglected to include a compulsory course in engineering economics in the curriculum? Certainly there has been sufficient emphasis placed on the importance of physical efficiencies as involved in engineering work. Then why not economic efficiency? It is absolutely necessary that such considerations be made in the business world. For example: silver is a much better conductor of electricity than copper. Although its use in electrical machinery or transmission systems would result in increased physical efficiencies it has not been applied. The reasons are obvious. The much larger expenditure for silver than for copper installation has made its use economically unfeasible in normal times or for ordinary purposes. Yet in countless instances the inexperienced fail to detect wherein the importance of efficiency lies. What they do not realize is the significance of the dollars-input to dollars-income ratio.

Economics and engineering are so interdependent that their relationship cannot be ignored. However, most young engineers have not been trained to be cost-conscious. They think too much of only the technical and theoretical aspects of their work; and as a result do not possess the appreciation for the importance of economic factors in engineering problems. Many student engineers are antagonistic or indifferent to the economic considerations but they soon come to realize that such an attitude is definitely out of place. Young engineers should have more regard for the value of economic knowledge which consists of an understanding of production, value, distribution of wealth, and markets.

Engineering training teaches one to deal critically and logically with facts. Men so trained have the ability to apply their knowledge to the solution of the practical problems of the business world. Any engineer who is so short-sighted as to spurn the consideration of economic principles unduly limits his future horizons. Introduction of a compulsory course in economics would be a step towards an improved engineering curriculum. Now is the time to plan such a course that when the war is won a better course of study will be available to the engineering students.

WAR

has exploded the German chemical myth

This is the Chemical Age and many people believe that Germany is *the* chemical nation. Yet history shows that the synthetic organic chemical industry really started in England, got much of its early impetus in France and has reached its greatest development right here in America.

Germany undoubtedly contributed vast research . . . and vast propaganda . . . but she made the mistake of trying to make it a German monopoly, through Government subsidies and control. There is a profound lesson for us in that.

The American chemical industry, operating on private capital, has pulled out of the test tube miraculous new medicines to save life, super-powerful explosives to overthrow dictators, marvelous new materials that Nature never dreamed of. America now has the greatest organic chemical industry in the world.

Koppers is one of the great raw materials sources for the chemical industry. Coal tar chemicals go into the new explosives, into the new wonder-working medicines, into the new plastics, into more productive agriculture.

Koppers is the largest builder of coke ovens, in which coal is processed to yield raw materials for the coal tar chemical industry . . . it is one of the largest producers and distillers of coal tar . . . one of the foremost designers and builders of recovery plants from which come the materials for use in medicines, explosives, plastics, synthetic vitamins, synthetic rubber and other chemical wonders. An affiliate of Koppers is one of the largest independent coal producers in America.—Koppers Company, Koppers Building, Pittsburgh, Pa.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

Tailor-Made

(Continued from Page 93)

ranging from cardboard thickness to tissue thinness with a wide variety of adhesives that will stick to almost anything—glass, paper, cloth, concrete or human skin—with a determined tenacity. Yet all of it, thick or thin, comes off cleanly, leaving no residue.

Most of these tapes were developed to meet a specific need—a peacetime need. But that didn't matter when the war came along. Its demand for speed and still more speed, to send a daily-increasing avalanche of Axis-smothering American war materials into quick action, found "Scotch" tape ready and able to do its part in the nation's war effort.

The same "tailor-made" qualities are present in the wartime "Scotch" tapes. For example, there's the case of the cartridge ejection slots in pursuit plane wings.

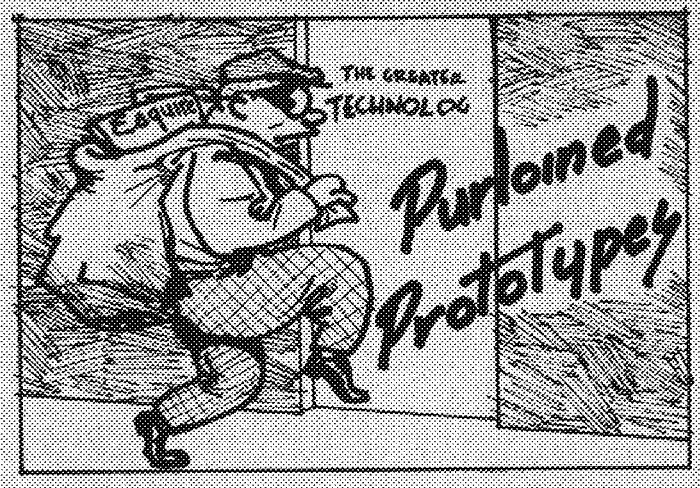
Beneath the wing guns of most American pursuit planes are small slots through which exploded machine gun shells drop. When planes, under combat conditions, had to take off from unfinished fields, the ejection slots often became clagged with sand and dust, causing the gun to jam after a few rounds. Researchers got busy, duplicating a wing ejection slot in their laboratories, sealing it with various types of "Scotch" tape and bouncing empty machine gun cartridges at it from the proper height. Eventually, a tape was developed which would always break at the impact of the first empty cartridges, and yet be just strong enough adequately to protect the slot opening. A similar "Scotch" tape is used to guard airplane wing gun and cannon muzzles from take-off dust, while another "Scotch" tape—the same kind you used to buy at the corner drug store, in fact—snow-and-mud-proofs the gun muzzles of Alaskan ski patrols.

Seals Plasma and Field Rations

Blood plasma cartons and certain types of field rations are sealed with airtight, waterproof and mustard gas-proof "Scotch" tapes, which are applied with high-speed automatic sealing machines. Protection of tanks, trucks, airplane fuselages and other similar material against corrosion from sea spray and fog also is accorded by "Scotch" tapes while the war implements are aboard ship en route to the far-flung battle fronts of World War II. For this purpose, heavy-weight "Scotch" tape is used, and similarly, guns of powerful four-motor bombers making the "water-hop" are rust-proofed with protective paper securely fastened with "Scotch" tape. Another special tape is used between hulls of mile-a-minute PT boats; to hold insulating materials in position between layers of wood. Electric motors, so vital in the war, owe their long life and speedy construction to still another "tailor-made" "Scotch" tape, which holds units in place during assembly and acts as an insulator on leads and windings during the life of the appliance.

And so, on and on, numbering into the hundreds, go the wartime, production-speeding uses of this handy-andy product, just as they did in peacetime. Only now this product, instead of making things handier for Americans, is making things tougher and tougher for America's enemies, by helping get the materials of war to the battle fronts faster and faster.

Together with four other concerns, this St. Paul organization is furnishing management for direction of operations of a government-owned synthetic rubber plant in Kentucky. In one of its own plants, oleum, or 109 per cent fuming sulphuric acid, is being made for use in the manufacturing of explosives. One of its newer products, "Scotchlite," a material for reflecting light back to the source of light, used on highway and commercial signs prior to the war, now is being used in the war for making airport runways, backs of explosives trucks and lifeboat paddles. Combination of two of its products, abrasive cloth and cements, created a safety walk used extensively on airplane wing walks and the decks of ships to keep the fighting men from slipping.



BY BILL SANFORD, M.E., AND HERB ROCHEN, A.E., '44

Don't you ever look at anything besides the jokes?

* * *

The marriage course put on here at the University certainly ended with a bang. At the end of the lecture questions were written down on slips of paper and turned in to be answered. The one which undoubtedly took first prize was:

"A soldier and a girl are about to have a baby. The soldier is about to go overseas. Should they get married?"

The reply: "They'd better."

* * *

"What engines shall we use in this boat?"

"Oh, Diesel do."

* * *

You can tell a roadhog even in the theater. He always takes the arms of both seats.

* * *

"So you're a young man with both feet on the ground, eh? What do you do for a living?"

"I take orders from a man with both feet on a desk."

* * *

Second (to boxer)—"Well, old man, I'm afraid you're licked now."

Boxer (gazing dizzily across to opposite corner)—"Yeah, I should have got him in the first round when he was alone."

* * *

A wedding carriage was seen driving through the city streets the other morning. Inscribed in chalk on the back were these words: "Result of Careless Talk."

* * *

Mary has a little swing,
It isn't hard to find,
And everywhere that Mary goes
The swing is just behind.

* * *

—and to all the graduating seniors, let me say that college is just like a laundry—you get out of it just what you put into it—but you'd never recognize it.

Ed. It's a dirty lie. We don't get anything out.

* * *

A young lady with a touch of hay fever took with her to a dinner party two handkerchiefs, one of which she stuck in her bosom. At dinner she began rummaging to the right and to the left in her bosom for the fresh handkerchief. Engrossed in her search, she suddenly realized that conversation had ceased and people were watching her, fascinated.

In confusion she murmured, "I know I had two when I came."

* * *

Al Hesby—"I gave my girl a wonderful present last night."

R. A. Johnson—"I gave my girl a wonderful past last night."

* * *

She—"Love me always, sweet."

He—"Sure, babe. Which way do you want me to try first?"

Exercise kills germs, but we haven't found out how to get the darn things to exercise.

* * *

Joe—"What kind of dress did Eleanor wear last night?"

Blow—"I don't recall all the details, but I do know that it was checked."

Joe—"Boy! That must have been some party."

* * *

"Now," said the college man to his dad at the football game, "you'll have more excitement for two dollars than you ever had before."

"I don't know," replied the old gent, "That's what my marriage license cost me."

* * *

A dainty foot, a lovely torso
Can make a friendly feeling more so.

* * *

And the old maid said, "Don't put 'Miss' on my tombstone when I am gone, for I haven't missed as much as you think I have."

* * *

He: "Where can I get a hold of Janie?"

2nd He: "Well, I don't know. She's awfully ticklish."

* * *

"Between you and me, what do you think of Mary?"

"Between you and me, nothing, but alone—OH, BOY!"

* * *

It was a cold night, and the soldier standing on guard tried vainly to keep warm. Suddenly some one approached.

"Halt! Who goes there?" said the sentry.

"Friend with a bottle," was the answer.

"Pass, friend; halt, bottle," promptly commanded the sentry.

* * *

We never were able to find Grandma's glasses, but now she leaves them just where she empties them.

* * *

Q: "Do you know why the little bee buzzes?"

R: "You'd buzz too, if somebody stole your honey and nectar."

* * *

While sleeping in his hotel room one night a traveling salesman was awakened by the clerk at the desk who phoned that he had a telegram.

The salesman asked him to read it over the phone. The telegram read as follows:

AM NOT GETTING ANY BETTER STOP COME HOME QUICK LOVE
WIFE

The salesman thought for a time and then spoke to the clerk, "That's funny, my wife wasn't sick when I left her."

He thought again, then bellowed over the phone, "You read it wrong."

* * *

Of all the things that get in your teeth the only thing that toothpaste can't remove is the dentist.

* * *

Pretty Girl: "What do you mean by saying that date with you was like a string of pearls?

Private: "Necklace, honey, neckless."

* * *

He gave up liquor, wine and food
He never went to bed;
He swore off smokes and women, too,
He had to—he was dead!

* * *

He: "You love me."
Gal: "Say you love me—say it! Say it!"

* * *

His wife was a WAVE
And he waved at a WAC
The WAC was in front
But his WAVE was in back
Instead of a wave from the WAC
Be it said
He got a wack from the WAVE
He had wed.

* * *

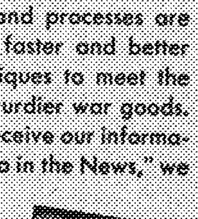
The rest of the magazine is good too.

IT'S MAN-MADE from metal and no bigger than a thimble, but at 30,000 feet this tiny mechanism means life to our pilots.

On stratosphere flights it is this vital part of the Airco regulator which automatically controls the proper flow of life-sustaining oxygen. As flight altitude increases, it instantly increases the oxygen ratio. Like the supercharger, it has helped to push up the effective ceiling at which our war-planes may operate . . . making war-planes more deadly . . . air transports faster and safer.

This high altitude oxygen regulator is just one of many Airco products which—in addition to Airco welding and cutting torches and Airco and Wilson arc welding equipment—are contributing to the advancement of American aviation.

Similarly in every major industry—from shipbuilding to food packing—Air Reduction products and processes are helping to establish faster and better manufacturing techniques to meet the need for more and sturdier war goods. If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd St., New York 17, N. Y.



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"THIS YEAR, LET'S PAY THE BONUS
IN WAR BONDS

THE ? MARK

SLIPSTICK PHILOSOPHY BY MELVIN MARK, M.E., '44

As it must to all men, a 1-A classification has come this bright December morn to M. Mark; and therefore, as is the fate of all good (?) things, this column is about to be buried. (Heaven only knows how many times this has been tried before.)—But before dying, the column and its author present, as a final gesture, something which has never before been attempted in TECHNOLOG history—something which could only be made possible by a war-weary world—a clean joke column!! It may not be funny (but then why change now?), but we (the column and I), defy anyone to find one single word or phrase that might blemish this attempt. (Any resemblance between any joke herein printed and a dirty story is purely coincidental and a figment of the reader's mind, if there is any.)

• • •

Wolf—one who takes out a sweater girl and tries to pull the wool over her eyes.

• • •

Well, I tried anyway.

• • •

Horse sense is something a horse has that keeps him from betting on people.

• • •

Policeman: "How did the accident happen?"
Motorist: "My wife fell asleep in the back seat."

I believe there should be a better substitute than rayon for nylon stockings. Most men and women do not like the feel of rayons.

• • •

SHORT STORY OF THE MONTH

Two farmers met on a country road and pulled up their teams.

"Si," said Josh, "I've got a mule with distemper. What did you give that one of yours when he had it?"

"Turpentine. Giddap!"

A week later they met again.

"Say, Si, I gave my mule turpentine and it killed him."

"Killed mine, too. Giddap!"

• • •

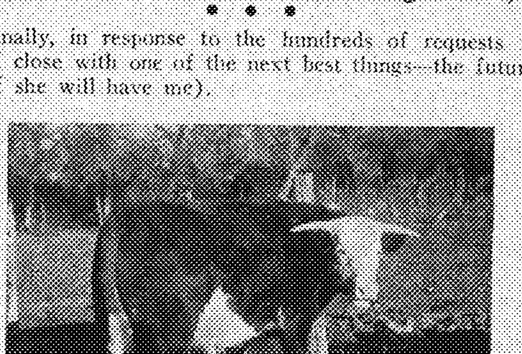
Instructor: "Why are you late this morning, Mr. Rapko?"

Rapko: "I squeezed out too much toothpaste and had a hard time getting it back in the tube."

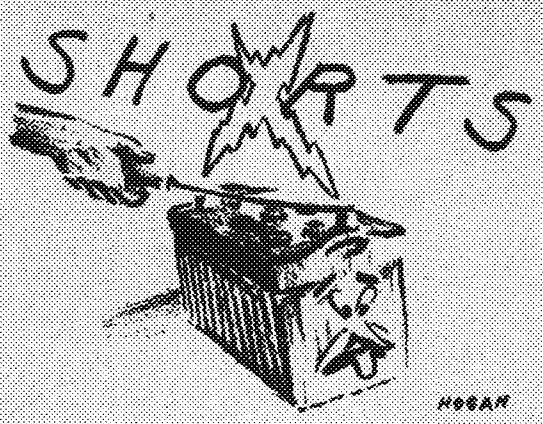
(But we know better—since when has he got teeth.)

• • •

And finally, in response to the hundreds of requests for my picture, I close with one of the next best things—the future Mrs. Mark (if she will have me).



Why buy a cow with milk so cheap?



The time has come for us to clean out our desk and make room for the new editor. Eugene Andrews, more commonly known as Andy around the office, will take over until he receives his commission from the Navy in March. Andy prepared for the position by taking over the duties of managing editor for this issue, but that is beside the point. The last time we saw him before we wrote this he was suffering from a slight touch of *mal de mer* which was contracted after a voyage around the lagoon in Loring Park. However, this did not dampen his ardor for the sea. One heartbreaking incident in his recent experiences was the sale of his dearly beloved Model A. Mr. Andrews was widely sought after for his driving ability but we won't say by whom. And if you should ever see a PT boat or a destroyer in the swamp behind Old McGinty's farm you will know that Andrews is in command.

Harry Brenner was chosen to carry on after Andrews leaves in March. Aside from his ability to do a good job on the magazine, Harry is widely known as an authority on feminine pulchritude. We believe this because when he was taking a course in surveying last summer he let us look through the telescope of his transit which was trained on an excellent view. And as a fisherman Harry is unexcelled. He told us so himself. Fresh from New York when he entered the University he came into the Log office to get acquainted. We think he is now judging from the number of phone calls he gets and from the crowds of people that come in to see him.

• • •

Now that the football season is part of the dim dark past we would like to tell about a little incident concerning some of the engineers on the team. It seems that a couple of them have girl friends who are very loyal. We got a little note one morning calling our attention to the fact that these engineers were among the mainstays of the team, and that the TECHNOLOG should give them the proper recognition. Well, we were touched by this note and decided to do something about it. This short paragraph is it and we hope that everyone has been sufficiently awake to realize that without men like Mitch and Hard Rock Mike and Chuck and Hank on the starting lineup things would have been considerably tougher this season.

• • •

As must come to all persons so came the realization to the *Skum* editors that the TECHNOLOG is a red-hot publication. We wish to thank them for that 75-or-so dollar's worth of free advertising which they so graciously gave us in their last issue. It was truly appreciated.

• • •

During Convocation hour on December 8 of this year, several members of MAPE, commonly known as the Minnesota Association of Professional Engineers, will talk to the senior engineers in Room 166 of the Physics Building. It has been rumored that any senior engineers who do not attend the meeting might not get their goatskins come December 16. Could it be? We recommend going just in case there is any truth in the rumor.

• • •

We might mention at this point that the TECHNOLOG does not consist only of a few columns of jokes and maybe a humorous article. There have been known to be cases of students actually reading and enjoying some of the other articles. In this issue we can guarantee that you will find something worthwhile if you look hard enough.

• • •

The Wright Field Electronics cadettes, who by the way are no way related to the Curtiss-Wright cadettes, are working hard in the EE building and also over in the Oak Street Laboratories. At the present time they are working with the sheet metal radio chassis which will be the foundation for the sets they will build. Because the girls do not live on the campus and because they are extremely busy we have not seen much of them. We are convinced, however, that it would be very worth while to become acquainted with some of them.

• • •

The seniors who are graduating December 16 are very fortunate. It seems that they are going to get a 75, or maybe 85 cent dinner for 50 cents the night of commencement. After the practice session in the afternoon they will meet in the Union cafeteria. Then after they have eaten there will be some kind of doings. Maybe even some singing. So now you can see that it pays to graduate. You save at least 25 cents on a dinner in the Union cafeteria. Let this be a lesson to you lower classmen.

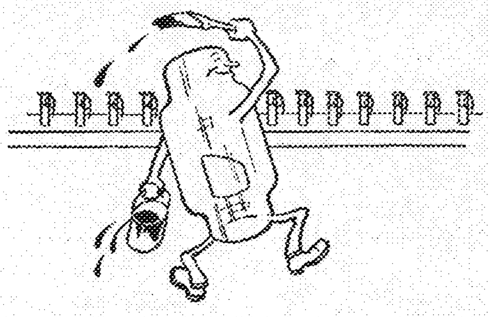
• • •

And now to express our thanks to Engdahl who had to put up with us for these past several issues. What with deadlines that were always supposed to have been met yesterday and making a mess of the office before the magazine was finished, he must have had a tough time. So long Dickie-boid.

G. V.

G-E Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

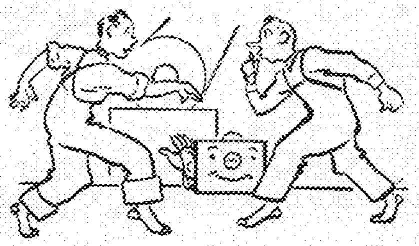


PAINTING THE FUSE RED

WHEN General Electric's automatic X-ray machine, developed to check the proper amount of powder in hand grenade fuses, "sees red" there's too little powder in the fuse, and the grenade might explode as soon as the soldier released his grip on its handle.

For checking, the fuses are set upright on a movable belt that passes through the machine. The perpendicular beam of a 100,000-volt X ray penetrates each fuse and produces a glow on a fluorescent screen, above which is a phototube or "electric eye." As long as this glow remains constant, the fuse passes through untouched. But when a fuse with a light powder charge passes over the X-ray beam, the phototube detects the change in the glow, automatically rings a bell, flashes a red light, places a dab of red paint on the top of the fuse, and records the dud on a chart. This four-way check makes it impossible for a bad fuse to get by without detection.

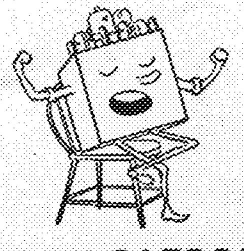
This machine, the first of its kind in the country, will automatically check 4000 fuses an hour.



SH—H—H

TO help make "all quiet" on the factory front—at least as much as possible—General Electric has developed a new sound-level meter that gives a quantitative measurement of sound.

Because man's nervous system is severely agitated if he is subjected to a sound above 120 decibels, the efficiency of factory workers is often lowered considerably by machinery noise. Highly sensitive, the instrument's range of 24 to 120 decibels covers the normal range of man's hearing and warns when the noise is harmful. Thus proper steps can be taken to reduce the sound.



YAWN PATROL

ON guard against over-fatigue of metals is the new electronic machine developed in our General Engineering Laboratory.

For metals, like human beings, get "tired" after a certain amount of work. One of the most important metallurgical tests is determining how much stress and strain certain metals can take under continuous vibration.

Energized by especially powerful electronic equipment, the new machine can vibrate a sample of metal back and forth about 10 million times in five hours—or in one-fourth to one-tenth the time previously required.

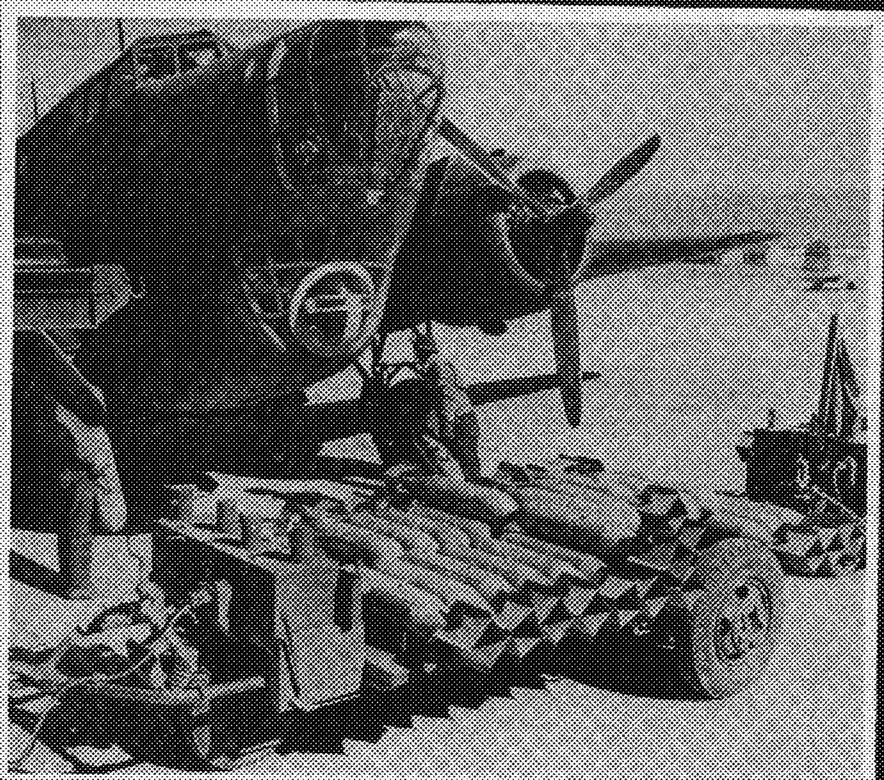
Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

965-14-211

192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.

TECHNOLOG



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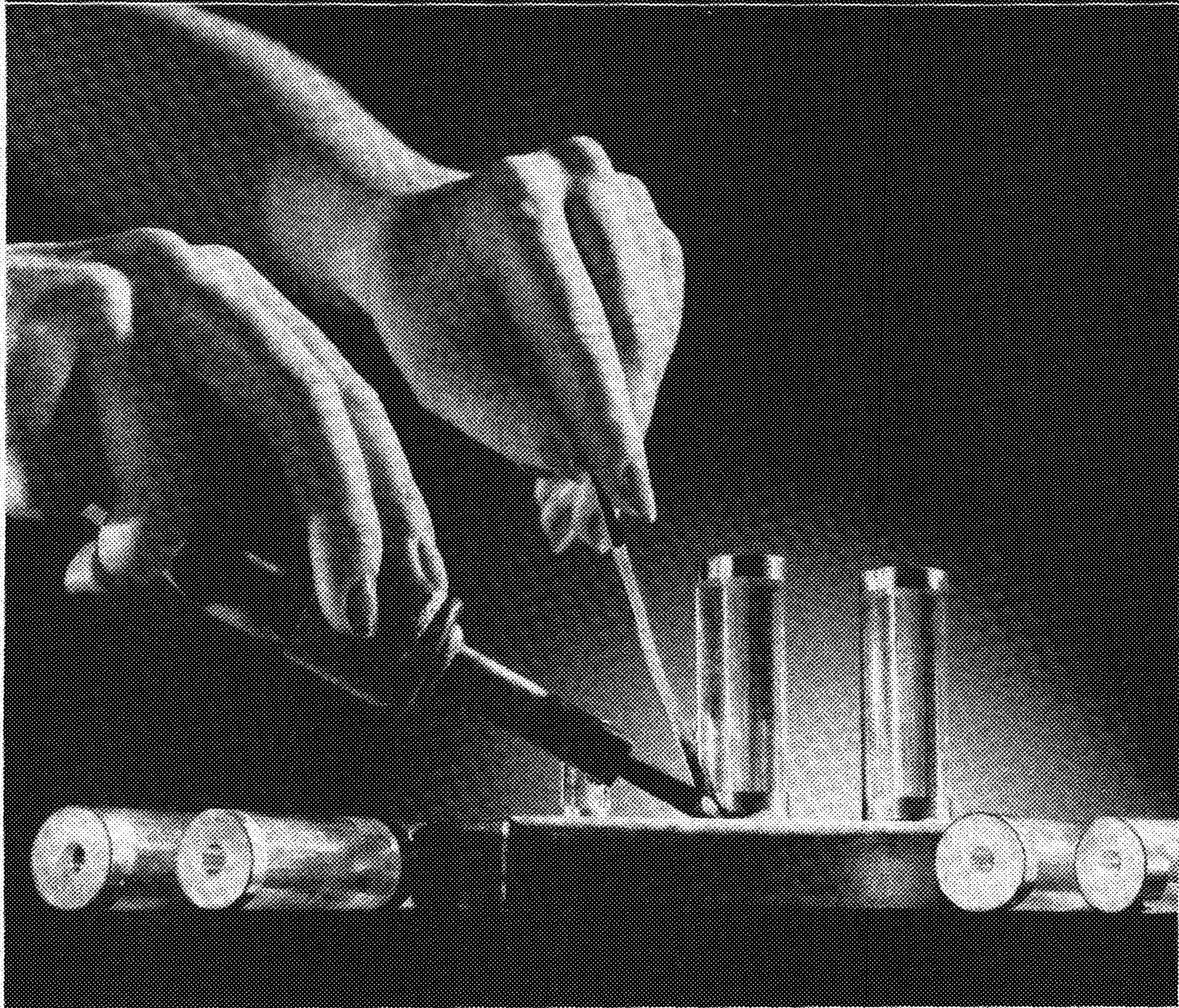
MINNESOTA

Imagine soldering metal to Glass!



HERE'S one for the book! The young lady is soldering metal to glass to make an important piece of electrical war equipment, and she doesn't have to be fussy about it either. She just solders!

The reason this can be done today is that some time ago Corning developed a method of firmly attaching a thin film of metal to glass, as a base for the solder. It was just one of many glass-metal problems that were once called "impossible."

Being ready with ideas has been the glass industry's greatest contribution to our war effort. That, and the ability to mass produce essential glass without delay.

Take Corning for instance. Here research found ways to mass produce essential optical ware. Insulators, aerial and naval navigation lenses, bulbs for electronic tubes, these and countless other war needed items are being turned out in vast quantities.

On the civilian front, Corning right now is supplying glass piping, and valves, nuts and bolts that resist chemical attack. Glass springs that apparently never wear out. Glass acid pumps that replace scarce metal alloys and give longer service in the bargain!

Glass isn't taking a back seat now, or after victory. Too many people are finding out something about its unusual qualities to ever let this happen.

They are discovering that glass is versatile. It has astounding strength. It can be shaped with great accuracy. It resists corrosion and abrasive wear. And they're finding out, too, that Corning knows glass, not only as a producer but as a developer of glass ideas.

In engineering, too, glass is a material with a brilliant future . . . In the years to come, keep your eye on glass! Corning Glass Works, Corning, N. Y.

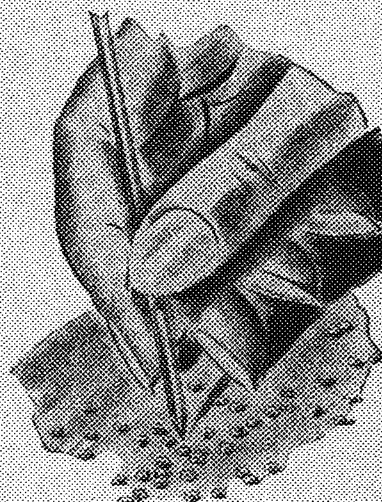
CORNING

means

Research in Glass

The synthetic sapphire that becomes a precious jewel...

1. High over Berlin on the instrument board of a bomber, these synthetic sapphires become the most precious jewels in the world. They're man-made jewels for instrument bearings. Without them, no bomber could drop its load with accuracy, no warship could navigate. Before Pearl Harbor most of these synthetic jewels came from abroad. But today industry is mass producing its own with the help of diamond blades and polishing compounds such as made by Carborundum.



2. Man-made sapphires are created by fusing aluminum oxide. To turn the rough boule into a bearing requires more than 100 precision operations, including cutting, grinding and polishing. No tolerance over 0.0003 in. is permissible. One of the best abrasives for producing a sapphire bearing is the diamond. So diamond grinding compounds by Carborundum are widely utilized.

3. War has given enormous impetus to the art of grinding. In industry, you may find operations which might be done better with abrasives. Carborundum engineers will be glad to consult with you on any such problem. The Carborundum Company, Niagara Falls, New York.

CARBORUNDUM
ABRASIVE PRODUCTS

this month

W. E. Peik is the author of the second of a series of "Postwar" articles which will appear from time to time in this magazine. The Dean of the College of Education has a great interest in plans for advancement of educational facilities after this war, and has presented his ideas in the article entitled *Learning Leans Forward.*

After receiving his Bachelor's degree at the University of Minnesota he went to Columbia for his Master's and then returned to his home state, Minnesota, for his Doctor's degree. He has held various positions in secondary grade schools and colleges. Dean Peik is particularly interested in "curriculum" and teacher training programs and has spent some of his time conducting surveys which have dealt with the problems of higher education. These have furnished some of the material for the research he is doing on educational problems.

Although he is one of the University's "Who's Who" men, he still finds time to enjoy his Minnesota. Whenever there is an opportunity he likes to spend it in the out-of-doors fishing or just relaxing by the shore of one of the lakes in Northern Minnesota.

Forest Grimm, a product of South high school, is on the list of future graduates from the University. In June, he will be the proud holder of a mechanical engineering degree. And what will he do after graduation? He says he'll just wait and see which way the wind will blow.

Forest hasn't had much time for extracurricular activities because he has devoted his spare moments to his favorite hobby, music. His favorite musical instruments are the banjo and guitar, and whenever he has a chance, he is either playing or giving lessons on these instruments. He was a prize winner at the National American Guild contests held in Providence, Rhode Island in 1939 and at Cincinnati in 1940.

Silver at War written for his seminar course is his first article published by the TECHNOLOG.

He doesn't go with any one girl, but gives them all a chance, blondes having a small edge over the others. After all, he says, this is leap year.

Another Minnesotan who really gets a bang out of life is Mr. Earl Savage. An unexpected or perfectly planned canoe trip or sailing party suits him to a Tee, and it's just one of those things that gives him those extra thrills.

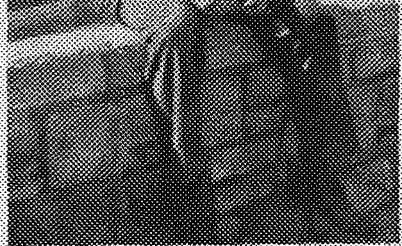
Mr. Savage attended Princeton University and majored in English. Upon completion of his training he returned to Minneapolis, accepted a position with General Mills, and has been associated with them for the last six years. He is now in the research and public relations department. Mr. Savage has prepared the article, *Naval Ordnance*, another in the series of articles on Minnesota Industries at War.

He is a Captain in the Minnesota State Guard, but he points out, that doesn't mean much when your draft papers come and you report for orders.

One of the more notable members of the TECHNOLOG staff is Richard Emanuel Engdahl, who is the holder of the official title, TECHNOLOG business manager. Counting the pennies, nickels and dimes is his main job, and then he has to find where they come from and where they have gone. Dick is the kind of a fellow who spreads his equipment all over the desk and then proceeds to make himself at home. As a master of the telephone conversation he is tops, and he keeps his lady friends dangling on his every word. A very serious fellow, despite words to the contrary, he's always there if there's work to be done.

Dick's home has always been in Minneapolis, and he is a senior at this University. He says he expects to get his degree in Mechanical Engineering in 1944, and so he can be found many a night bent over his books at a desk in 17 Murphy Hall. Dick is a member of the Minnesota Foundation and he is very active in church work. At present, he is the vice president of the Minnesota State Luther League and he is planning the big winter conference at Iduhapi. This fall, Bob Giantvalley, past editor, and Dick attended the ECMA conference at Milwaukee, Wisconsin, and took a side trip to Chicago. We've heard lots of rumors about this trip, and especially about the dining, wining, and women in Chicago.

Howard Langpap is the up and coming author of the article *Design for Riding* and he really knows what he is talking about. Right now, Howie is majoring in mechanical engineering under the auspices of the United States Navy. He is a senior in the Naval V-12 program and hopes to graduate sometime in the near future. Before coming to the University, he attended Junior College in his home town, Tracy.



Howie likes to indulge in some hunting and athletics, but mostly athletics. He was out for football, and was a main cog in the Hauser team. Howie played a little basketball for Tracy Junior College.

When we asked him if he had a picture of himself, he replied that we could secure one from his girl friend. It is through the courtesy of this young lady that we were able to obtain the picture which appears on this page.

MINNESOTA TECHNOLOG

The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is twofold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

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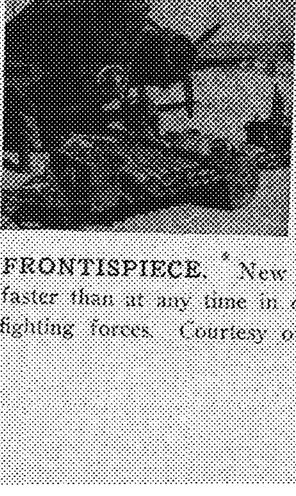
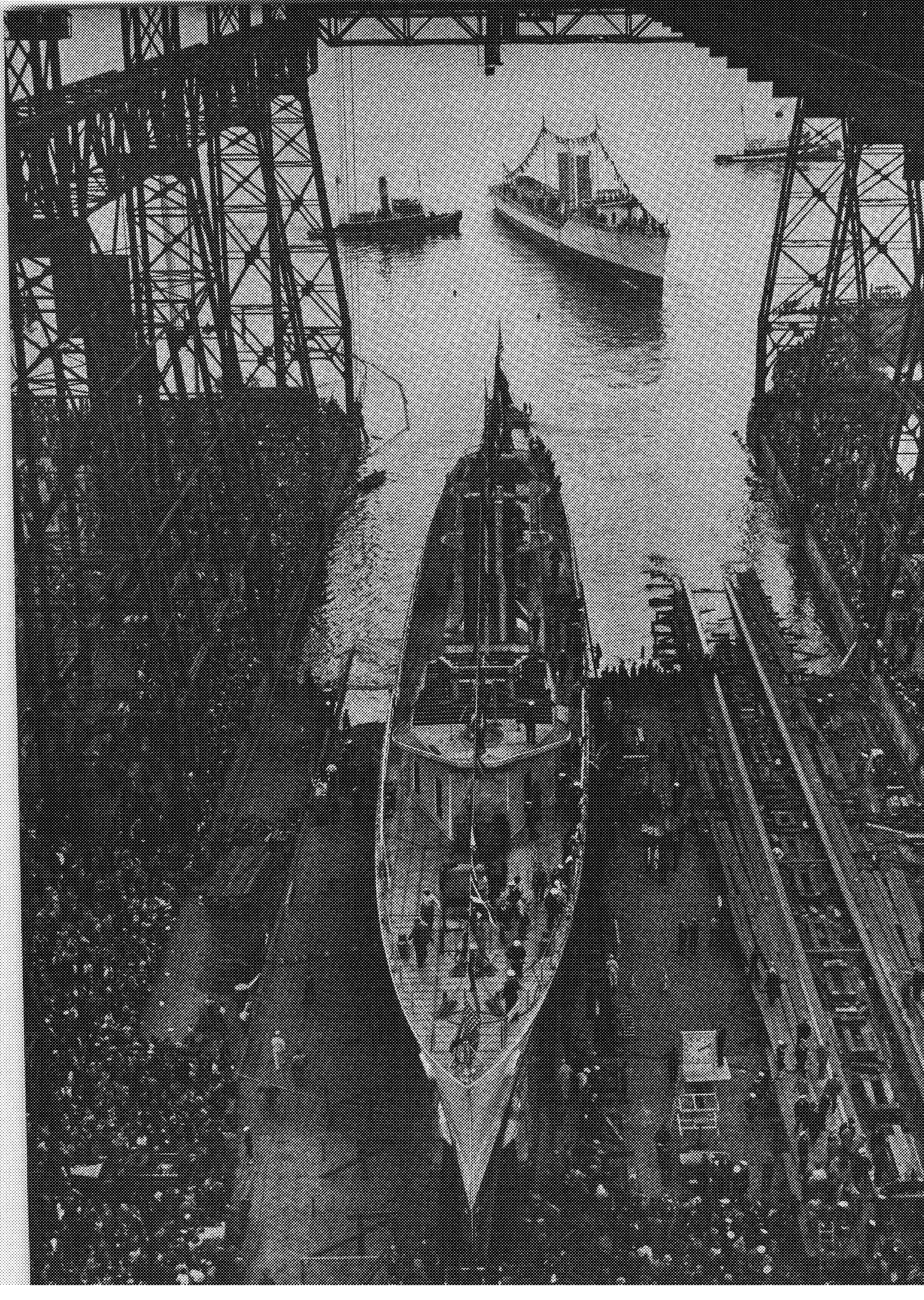


THE COVER. Bombs are loaded into a B-18 as the plane is prepared for a future raid. Official U. S. Army Air Force photo. Courtesy of Westinghouse Electric and Mfg. Co.

FRONTISPIECE. New ships are now being launched faster than at any time in our history to bring supplies to our fighting forces. Courtesy of Allis-Chalmers Electrical Review.



Your Future

1-A OR 2-A

BY S. C. LIND
DEAN OF THE INSTITUTE OF TECHNOLOGY

COURTESY OF THE '44 GOPHER

IN a mechanized war such as the world has, fortunately, never seen before, one would expect the Engineer to be a "necessary man" and that the supply of graduates with engineering training should be maintained. This was the original intention of the Selective Service System. Engineers were quite early declared by Selective Service to be essential and Local Boards responded readily to requests for the deferment not only of engineers already in industries having war contracts but also of student engineers in training in technical schools.

Up to 1942 the situation was, on the whole, satisfactory. Some technical schools had an actual increase of enrollment in the summer and fall of 1942; others had dropped only a few per cent. This situation probably lulled into complacency the industries dependent on engineers and scientists as well as the educators who train them. Some few foresaw the result of the 18-year-old draft and the policy of Selective Service to defer only those students of engineering and science who can complete their courses in 24 calendar months.

But the full impact of this policy is now making itself felt. Enrollment in the Engineering Colleges of the country has dropped to about one-third of normal. Anomalously the present Senior class is the largest of the four classes now in the Institute of Technology. Most of these Senior engineers are being permitted to enter essential war industries. But recently several Local Boards have insisted that immediately upon graduation graduates be inducted. This is, of course, not only illogical but contrary to Selective Service principles and to the purpose of their previous deferment.

The enrollment of graduate students both in science and engineering has already been reduced to zero except for graduate assistants who are either carrying on war research sponsored by some Government agency or who are giving instruction in an essential field. It is very necessary that the requisite number of men should be retained in both of these activities and that new graduates may be deferred in sufficient number to provide replacements. The instruction of Army and Navy students is highly essential. An adequate staff for laboratory work could not possibly be maintained without graduate assistants. This has been a particular point of contention with a few Local Boards; it is to be hoped that Selective Service in Washington and the offices of State Directors will not lose sight of its importance.

The finishing blow will be the policy now proposed to defer no one under 22 years of age except those exempted by law, such as medical students, candidates for the ministry, et cetera. If this proposal is put into effect there will be no male freshmen except those who enter while 17, who would also be drafted when they reach 18.

Of all the hobbles with which democracy impedes itself in prosecuting this war, the manpower policy has been and continues to be the most crippling. No other nation in the war has so ruthlessly emasculated its source of engineers and scientists. England and Canada conserve most of their students of science, Germany and Russia retain perhaps half. But the United States gambles on a short war and a perilous future by planning to discard science education for the duration.

In December 1939 the total enrollment of Engineering Colleges in the United States was about 105,000 (including evening students). At present it is not more than one-third of this and is rapidly falling toward zero.

Hitherto engineering has stood midway between medicine or dentistry where deferment of all passing students is assured, and Law, Arts Colleges and other fields where little or no deferment has been possible. Engineering students have been individually deferred on their merits upon recommendation of their colleges and at the discretion of their Local Boards. This system worked satisfactorily until recently when the "save the fathers" sentiment became so strong.

Some of the agencies which should have helped to avoid this unfortunate situation have done nothing. Industries which will suffer most have raised no concerted voice of warning or protest. This can be better understood when one realizes that industry is better organized for competition than for coöperation, and that individual industries have hesitated to protest for fear of being accused of selfish or unpatriotic motives.

One might hold it to be the obligation of the Society for the Promotion of Engineering Education to defend the position of engineers in training. It seems to me that both engineering students and their prospective employers with war contracts could rightfully expect that this Society should take the lead in a matter so important to production of war materials. I regret to say it has not done so. Industry is not well informed as to the approaching debacle and will continue to look to the engineering colleges, as it always has, for a supply of trained men competent to help carry on the program of essential production. They will not be available.

The present outlook for a logical and factual approach to the problem is very discouraging. Rumors are filling the country as to future policies of Selective Service. The Service has just been restored to ultimate authority by Congress and is apparently sending up some trial balloons on further restrictions of deferment, particularly below 22 years of age. Some Local Boards are already anticipating such policies by putting them into effect at once.

The question must arise as to whether all previous policies including our recommendations for deferment have been wrong. Certainly a drop to one-third of normal enrollment in Engineering with the prospect that it will go much lower, is alarming. The question must be seriously considered as to what effect such a dearth of trained men in science and engineering will have upon war production and maintenance and especially upon postwar reconstruction. Personally I feel unwilling to endorse the long gamble that is involved. Somewhere, sometime, a more realistic policy must be adopted for the preservation of some essential minimum of Engineering Education. May it not be too little and too late.

Cars of the future

DESIGN FOR RIDING

BY HOWARD LANGPAP M.E. '44

THE future automobile always offers much speculation, especially today when one has to realize that until victory is won the family automobile cannot be replaced. As we all know, the automotive industry is geared for war, turning out implements of destruction for the armed forces. Nevertheless, the automobile in America is really a national institution, and the public is keenly interested in its future. With this in mind the automotive engineers are looking ahead and making at least visual plans. It will be the first time that the design and construction can be approached on an entirely new basis. The old assembly lines are gone. Manufacturers have converted about two-thirds of the equipment to war production and the rest of the machines are rusting outside the factories or have been scrapped. The postwar car that first rolls from the assembly line will embody not only all the improvements of the past that have been held back because of old machines and methods but also all the improvements brought about during the war period.

Smaller Engines

The present automotive engine weighs five times as much per horsepower as an aircraft engine and is capable of developing only one half the power per cubic inch of displacement. With the principles of the aircraft engine it would be possible to eliminate as much as two hundred and fifty pounds of the now average six hundred pounds automotive engine weight. The tremendous increase in production of one hundred octane gasoline brought about by the war will mean that perhaps its superior qualities will be offered to the public in the future. This gasoline is capable of developing fifty per cent more horsepower from a given piston displacement.

In many parts of the world the present war has brought about an awakened interest in automotive steam power plants. No high speed steam engine for road transportation has been developed up to the present. The traditional steam valve gears prevent this possibility. It is possible that modern achievements in the power stations, and the heat efficiencies they have attained will lead to steam engine development for automotive use. Gasoline efficiency, contrary to general belief, is now considerably lower than that of steam. The difference amounts to approximately ten per cent. The production of high octane fuels even on our mass production basis is an expensive process. With steam power, octane has no value whatsoever. The cheapest hydrocarbon can be used in a steam generator.

It is almost impossible to make an exacting engine speculation. Each year as the war progresses toward victory the engineers' dreams will turn to working models and then turn and be incorporated in the engines of our army of destruction. But, some day all the improvements will be found in the engine of our automobile. Perhaps we can look forward to a completely sealed engine with our present form of liquid cooling disappearing, fuel injection replacing the carburetor or perhaps even steam power replacing our internal combustion engines.

The appearance of the automobile is of primary importance to the buyer. The public is willing to buy a beautiful car in preference to a better but less handsome one. In the future as always in the past the engineer must accommodate the working parts to the stylist's dreams.

In the car of the future you'll no longer drive along the road half blinded and befuddled by the post down the center of the windshield, the two bulky corner posts and a rear window set at an acute angle and which is usually blacked out entirely every time it snows during the winter. The Dartmouth Eye Institute which is the leading visual laboratory in the country has found from tests that curved transparent plastics offer no visual distortion. The results of this test will probably mean that the future windshields will form an integral part of the automotive body. There will be no metal obstructing vision and a polarized windshield will prevent glare. Sides slanting inward toward the top will cut dangerous reflections and give one more privacy by reflecting the sky and making it hard to see in.

Mechanical Distortions

The wrenching of machinery to fit the stylist's shapes has almost reached its limit. The passion for getting the body close to the ground has caused many mechanical distortions and our smaller wheels have made braking almost impossible. In the pre-war car hoods were drawn out to exaggerated lengths concealing engines that appeared relatively tiny when exposed. In short the body design was approaching the dinosaur stage. Whether the car of the future will be shaped as a teardrop, an egg or a beetle is impossible to forecast. It will be designed so that the airflow rather than the weight holds it to the ground. Let us hope that out of this design will come a functional beauty not hampering the important working parts.

Reasonable revisions will include a greater emphasis on the elimination of individual fenders. Front fenders will blend gracefully into the body and the rear fenders will be eliminated through a widening of the body to absorb them. This will make for fewer individual stampings, smoother exterior stream lining, and the generous smooth surfaces can be reshaped more easily after accidental denting.

Whether the body will be made of all plastics, aluminum, magnesium, or steel is not known. The tensile strength of our finest new steels is 100,000 pounds per square inch, but there is a new plastic, a substance made from the same kind of material from which glass is made, whose tensile strength is 1,000,000 pounds per square inch. Plastics are capable of absorbing ten times more impact energy than metals and can be designed to within 90% of their strength properties. This is due to the fact that the ever-present discontinuities present in metals are not found in plastics. Henry Ford has already used plastics in his cars to a limited extent, but perhaps after the war the automobile will be grown on the farm.

Perhaps springs will be replaced by rubber or hydraulic controlled stabilization, or maybe gyroscopic couples will help turn the roughest roads to paths of silk. But the biggest changes of all are likely to come from the coöperation of the plane and automobile industry in war production. Automobile engineers have to work on planes now and plane designers are discovering a great deal about automobile manufacture. The aircraft industry has been greatly expanded during the war and will find when the war is over aircraft production demands will drop off tremendously. The aircraft industry could easily be converted to turn out automobiles on a mass production basis. This new competition should prove to be an important factor in our postwar car.

A series of huge industries have been built up on the automobile; the manufacture of the car itself, tires, petroleum, automotive transport, and road building. In 1940, at a time of widespread unemployment, the automobile was responsible for an employment of six million people. It is easy to see that the automobile has become an important factor of our economy system and its importance will continue after the war. The economics and politics of the postwar era will largely determine whether we shall get the car that the engineers are now able to make.

Burning the Midnight Oil

LEARNING LEANS FORWARD

by W. E. PEIK

DEAN OF THE COLLEGE OF EDUCATION

ONCE this war is over, higher and secondary education will change in many sundry ways. The reasons are obvious. More young men and women will go to school and they will attend school longer. More and better education will be desired by those who have noted the advantages and priorities which education, specialization, and competency have given to men for promotion in the military services. It will be more than ever essential to have higher intelligence and better informed leadership, because society is growing more complex in organization. The problems to be solved are becoming more involved. Many of them are industrial and technical in origin. There is also a worldwide tendency in democratic countries for the rank and file of people to insist even more upon their own participation and to profit from a higher standard of living. Education has increased their wants and needs.

In addition there will be the returning soldier and the war worker to re-educate for the occupation of peace. One-tenth of them have indicated a desire to continue education after demobilization.

Finally, adult education of many sorts at the secondary and college levels will grow in volume and scope in cooperation with secondary schools, the radio, the cinema, women's clubs, libraries, various institutes, labor unions, civic and commerce associations, industrial plants and the like. The need for social progress and the expansion of knowledge is accelerated so fast these days that the formal learning of youth in schools will not suffice for a lifetime. The informal learning through books, the press, or the radio will not keep up that more intensive knowledge needed by leaders and experts as well as by laymen.

There will be widespread increases in the number and size of junior colleges, with terminal vocational outlets for those who cannot go on. Extension services will prosper; so will all technical colleges. More than by any other modern war, the widespread American passion for more, for higher, and for a more functional education will be stepped up by this one.

These trends for more education for more people will call for inevitable changes of subject matter, courses, and curricula in the direction of a more functional general education, more guidance, and much more thorough adjustment of curricula and courses to the abilities of normal persons. These normal persons are distributed from low to high verbal intelligence, pretty well according to the so-called normal curve. We shall have to plan continued education through the 14th year of school for all those who are normal and yet not able to take secondary and higher education according to the standards necessary for the learned professions and the highly technical occupations. Not to do so will mean inconsistency with the democratic concept of life which gives to each person as his birthright educational opportunities to develop his capacities according to his endowments if he desires to do so. Success of the democratic way of life, too, demands it.

POSTWAR EDUCATION for future peacetime occupations must be provided for those who desire education after demobilization. Many, who formerly would have little desire for education, are receiving training which will create a demand for it.

Future Changes

Realistic changes must be planned to make such instruction personally and socially meaningful and valuable. In an industrial society based upon technology, which in turn is superimposed upon a basic technical agriculture, naturally much technical education in science and related mathematics is demanded. It is not only a matter of technical specialization for a larger professional and sub-professional group of engineers, chemists, mechanics, doctors, scientists, or agriculturists. This era calls for some technical orientation for all persons who are to find their way about effectively and to understand life sufficiently to perform their duties and to pass intelligent judgements. International collaboration, defense, unemployment, security, health, conservation of resources, labor and management are examples of a few of the social problems whose roots lie within technology and science, which become a necessary part of general education. Not to be forgotten are the everyday contacts of all with motors, tractors, autos, airplanes, refrigerators, or radios. It is easily seen how the importance of technical education for all has therefore grown with acceleration through recent decades.

It is therefore essential that we examine the problem of what changes and adjustments are needed in secondary and junior college education to give proper emphasis to technical content (1) in the pre-professional preparation of those who will enter the technical professions which require full curricula of collegiate level and very high standards; (2) of those who should have sub-professional specialization for technological jobs in vocational and terminal curricula of sub-professional level either in the high school or in the junior college; (3) of all who want general education and can go on to senior college for more education; and (4) of those not so able with whom high school or junior college education has to be terminal general education.

Here are large and important educational groups, for whom an optimum pattern of education to include technical education has to be planned to fit individual differences of ability, to fit differing vocational destinies, to make good citizens who will function better as citizens as well as vocationally because of more years of education of the right sort. Obviously it is a joint problem of secondary and college educators, who should coöperate in planning for all instead of accusing each other of sins of commission and omission which are loudly proclaimed at large but never discussed with each other. May I make suggestions which I believe are possibilities.

As the pre-professional education for the technical, learned professions which require difficult and advanced college or university work, there should be a rigorous selection as early as possible of students of ability. This will be promoted by an improving system of secondary school guidance and personnel work. There are still very many of the abler students who do not go to college. They constitute a social waste which society will learn to salvage for all of the learned professions even if it takes an extension of scholarship plans at state expense to do so. The brains of men are still the greatest resource in a nation, more important in war and peace than iron, rubber, oil, food and power. The technical group needs a pre-professional high school and junior college education which includes rigorous mastery of arithmetic of much more than ordinary difficulty—algebra, geometry, trigonometry, freshman mathematics—followed by other more advanced junior college mathematics. It also needs rigorous high school and junior college courses in the physical and biological sciences. The average high school student is not able to master in the time allowed the content of these subjects at standards required of the professions. He should not be expected to do so.

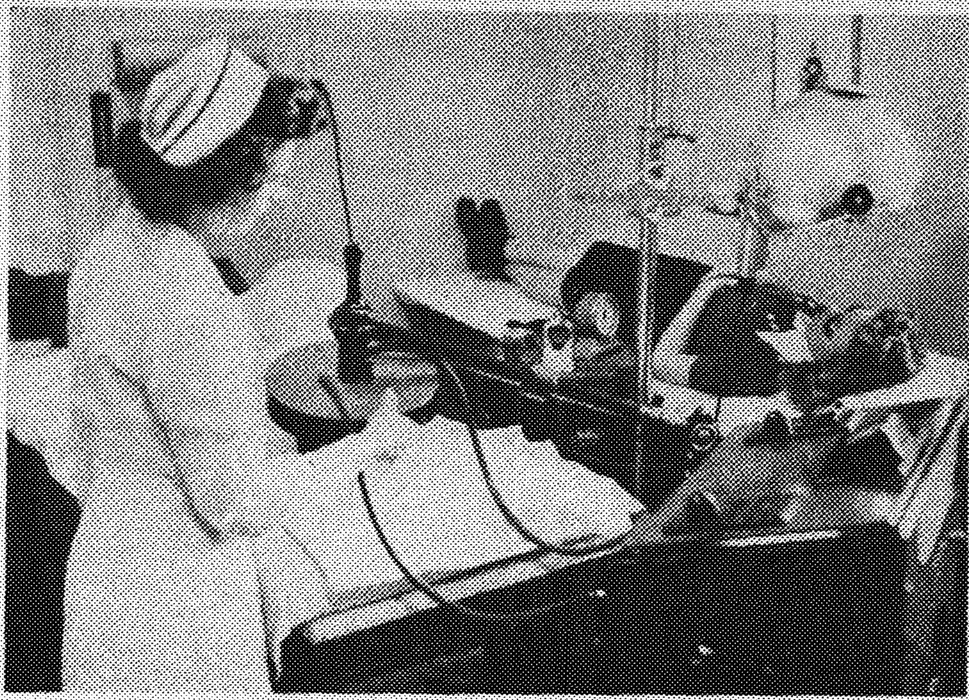


PHOTO COURTESY OF KANSAS STATE ENGINEER

NURSES AND TECHNICIANS will begin their training at secondary schools and complete it at specialized centers. High schools must present to the students the scientific curriculum required by an industrial society based upon technology requirements.

A Broad General Education

I want to make a plea for as much broad cultural training for this technologist as possible even if it takes a year or so longer to bring this about. A good example of the principle here involved is the lawyer in another sector of education. He might follow a strictly pre-legal and legal curriculum so far as making money through the legal profession is concerned. However, 40 per cent of our legislators are lawyers. In their capacity as legislators, they must not only know law but they must also have social vision and insight of the highest type for a complex industrial society, which only come out of a liberal, general, functional education of college level. For the lawyer, this calls for education in science. In a similar way the engineer must first of all be a citizen of social, nationwide, and worldwide vision with liberal training to play his optimum role in an industrialized society as a citizen, expert, and prophet. Some past studies of engineering education support this idea.

There is, next, a group of persons, from which come skilled mechanics, pilots, industrial foremen, and the like, of less native scholastic ability, who yet are able to take for a year or two a general education together with specific technical training of a substantial but not so rigorous sort. The high schools and junior colleges must and will provide more terminal vocational courses for them after the war. The university, too, has obligations; at any rate the state university has them. For this group the educator will consider vocational education to be important and basic, but general education for wholesome living and good citizenship even more important. As much general education as possible with the delay of all vocational training as long as possible should be the aim. These people are not able to do the science and mathematics at the rigorous standards required for the professions. They must have science and elementary mathematics of the applied sort, gauged to their ability.

An insight into the basic principles and applications of technical knowledge to industrial life, agriculture, the medical profession, the technical professions, health, sanitation, and the home becomes a necessary part of the general education of the layman who goes to high school or college. It must be a principal part of everyone's secondary and higher education. Science for general culture has been winning its way for a hundred years against other vested cultural interests where only the humanities were classified as cultural. The war is hastening this process. Even the professor of college literature who interprets life through literature cannot afford any longer to omit education in science for his own culture and effectiveness if he is really to understand something about this age of industry and technology through literature in contrast to literary periods when science played a less significant role. He must interpret life as it is to others through literature.

The abuse of free and restricted elective privileges has prevented many college graduates from receiving a proper orientation in science and related mathematics. The curriculum trend in general education now is definitely in the direction of more specific requirements and fewer electives. These prescriptions include more and more functional science for the layman.

We do not yet have the necessary courses in most higher institutions. The use of the same introductory course of a department in science or of mathematics which is planned for the future major in a science or a technical curriculum by those who merely want to get an insight into science as a part of general education is not justified. There isn't time to make the rounds of all the scientific departments basic to life to get what the general student wants. He will get involved knowledge of a technical sort which he will not use, and in accordance to the principles of learning and forgetting he will promptly forget it even if he has learned it. He can be introduced to but one or two such departments at best because each department usually assigns many credits to its first courses.

Planned Sequences to the Students

We need to plan required sequences of one or two years, not more than 15 to 30 quarter credits, in which the general student's needs are emphasized. There is no more time or credit than that available at the undergraduate level since language and literature, oral and written expression in English, history and the social studies, health, recreation, and physical education, the fine and applied arts, and some specialization in one or two areas simply will not permit more time or credits to be devoted to science as such. All specialized college departments must come to see the absurdity of not doing this for the general student and of insisting on too much and

A PROPOSED UNIFIED PLAN OF GENERAL EDUCATION

In Secondary Schools and Junior Colleges to Meet Certain Deficiencies of Contemporary Practices

I. Functional life areas to be recognized more, to be itemized into statements of needs and these assigned to appropriate divisions in II.	II. Cultural, General Needs. Divisional areas for the basic organization of all general education into a curriculum required of all to secure continuous development and articulation through eight years of secondary and junior college education. (approx. ¾ of time.)	III. Vocational Needs. Choice of one area for terminal vocational or preprofessional emphasis as desired. (approx. ¼ of time.)
	Divisions	
Individual relationships.	1. Oral and Written Expressions in English. Speech correction.	1. Agriculture.
	2. Literature and language (English, American, World literature in translation).	2. Clerical Occupations.
	3. Social studies (history, more geography and all other social sciences included).	3. Distributive Occupations.
Home and family relationships.	4. Sciences—all biological and physical sciences included. More human biology.	4. Trades and Industry.
	5. Applied arithmetic and elementary mathematics for everybody.	5. Homemaking.
	6. Health education, physical education and recreation.	6. Advanced unit courses for special talent in music, art, writing, speech, and dramatics, etc.
Social and civic relationships.	7. Fine and applied arts.	7. College Preparatory. More rigorous courses. Mathematics. Modern or Classical languages. Science.
	8. Extracurricular opportunities — informal. Clubs, organizations, athletics.	8. Others.

the wrong content for all in order that their major student group may be served. It has been difficult for each of some twenty to forty college and university departments to see this problem because of vested interests.

It is my belief that a fifteen-quarter credit course in the biological area, including human biology, and one fifteen-credit sequence in the physical sciences is the maximum that can be required in the sciences for the general student above the high school level. Properly planned and functionally selected, that content should then be required of all. It will be difficult to secure even that much. If it is to be done well, science departments should coöperate to determine a functional content that includes the basic principles and reveals the scientific methods while illustrating very liberally the applications to life.

The content of these sequences should cover each important area of science subject matter for all and must then be adapted to various levels of abilities because we are going to have to educate all normal youth and keep them in school until age 20, as has been pointed out, to prevent the unemployment problems and to safeguard our democratic way of life. There is something for all to learn. We can be quite technical and rigorous with the superior general student who does not specialize in a technical profession, but we need not be as technical and mathematical even with him as with the one who is specializing for a specific technical vocation. One of the major future efforts of higher education is required on this problem, for after the college man's first effort to adjust to a lower level of content, he will find that he is still talking over the heads and beyond the capacities of most normal youth; because the college professor is one of the most highly selected individuals intellectually. He has consistently failed to realize that his personal standards of learning are above those of over 95 per cent of the normal population.

These difficult problems of high school and college science and mathematics instruction need to be attacked in two stages through several decades. The first effort must concentrate upon the junior college level so long as the preparation of high school entrants in science and mathematics continues to be as it is. The second, more desirable stage can occur only after the high school and college have learned to work together to establish a complete high school and higher education sequences in science and mathematics well articulated in development through eight years of general education. These should begin in the seventh grade and terminate in the fourteenth or sophomore year. This is only possible and practical if high school curricula follow a broad divisional rather than departmental organization in the chief sectors of knowledge, including science.

Diagram I will illustrate what I have in mind. This program calls for eight years of high school and college science, for more required advanced mathematics of those who plan to enter college and for more mathematics and science than most people get now of those who do not go. At present many get none of either or very little, if any.

The junior college also needs to make one more adjustment for those of ability who finally choose to enter a technical profession at the time when they enter college but who have not yet had the mathematics courses of the high school for college preparation. There should exist the possibility to take all algebra, geometry, and trigonometry during the first year of college with college credit, just as we can do in the case of practically every other high school subject if high school preparation has not occurred. There will be some loss of time to be sure. It is the price to pay for a late vocation decision by a student; but the total situation does not warrant prescribing such mathematics to all at the high school level whether they plan to go to college or not and whether they can master it or not. If this adjustment is made, then other college students who have omitted high school mathematics under present plans can still include it for their general education. It will mean much more to many if taken later. It will be done better, too.

You will note that the diagram does outline a divisional sequence in applied arithmetic and elementary mathematics for everyone who is enrolled in high school. That includes a needed shift of upper grade business arithmetic and a more complete mastery of the processes with short cuts to a later time when it is more meaningful and much closer to the time of use in life or in science courses. It should include some elementary algebra, such as is involved in the use of formulas, also geometry and trigonometry as applied to life problems.

In conclusion may I state that conferences among the college departments of science and mathematics, the public school science and mathematics teachers, high school principals and superintendents, state departments of education, schools of education, and the technical professions are necessary to improve the present situation. One or two-day institutes to exchange ideas frankly may be useful. Much committee work and discussion is needed. Experimentation is in order. The adjustment will involve compromises.

Minneapolis, the home of

NAVAL ORDNANCE

BY ERLE B. SAVAGE, JR.

GENERAL MILLS, INC.

This is the second in a series of articles in which the TECHNOLOG is presenting some of Minnesota' Industries at war. The purpose of these articles shall be to familiarize the University students with Minnesota concerns and the work that is being accomplished in our state.

SINCE 1852, the year when Austin Sperry and George Lyon built their first mill at Stockton, California, General Mills and its predecessor companies, including the Washburn-Crosby Co. of Minneapolis, have been manufacturing flour. Today its primary business is still the milling of wheat to provide food for the American people and for the armed forces and lend-lease.

It is not unusual for a food company to make special Army rations nor to prepare food products for our allies, but it is somewhat unusual to think of a milling company making naval ordnance. Unusual or not, as part of its war effort, General Mills undertook to produce torpedo directors, gunsights, and ammunition hoists for the ships of the United States Navy.

The evolution into a precision ordnance began in 1926 with work on flour-packaging machinery. Over the years, more and more equipment for processing the company's products—flour, Wheaties, Kix, Cheerioats, and many others—was designed and manufactured in a small machine shop in the Minneapolis mill. This machine shop had grown from six employes in 1926 to seventy-five in 1940. The first contract for the production of naval ordnance was started in the shop. In February, 1941, the former Northern Pump plant on Central Avenue was purchased and a number of contracts undertaken. This building with a floor space of 300,000 square feet and an adjoining building later purchased with 51,000 square feet today make up the Ordnance Plant.

The number of employes has increased from 75 to 1,500, and the plant was recently awarded the Army-Navy "E" for excellence in production.

This plant is operated as the Mechanical Division of General Mills under the direction of Mr. A. D. Hyde, Vice President in Charge of Research. Shop engineers, artisans, draftsmen, and experts in various mechanical lines have been brought together in a modern efficient production unit.

On December 7, 1941, that day which will "live in infamy," the General Mills Mechanical Division employed nearly 400 men. The company was working on what were then called "defense contracts." This day found them ready to take on some of the most intricate technical production jobs the Navy had to offer.

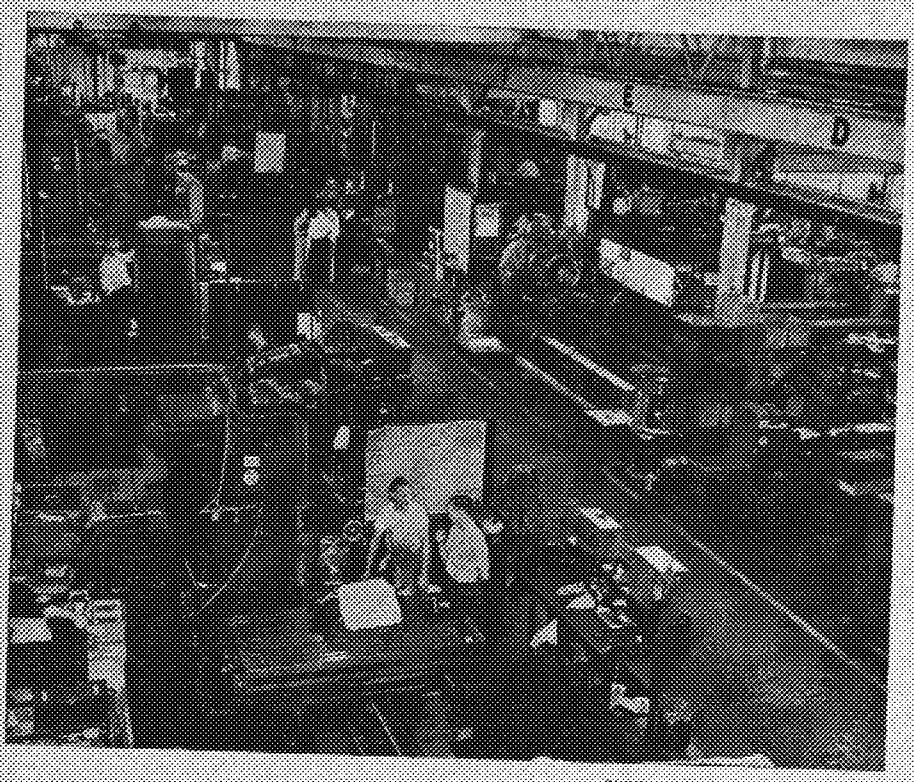
Torpedo Directors

The first of these was the torpedo director and indicator. This instrument consists of two parts: One usually located on the bridge of the ship into which are put its course and speed, the course and speed of the target, and an imaginary point at which it is judged the target will be at a given time. The machine instantly makes the necessary calculations which are electrically relayed down to the indicator mounted at the torpedo tube station giving the necessary computation to aim the tubes and set the course of the torpedo. This almost unbelievable performance makes it possible to use torpedos that can be set to follow unusual patterns of trajectory.

High Precision Work

They may be fired directly at the Point "X" or at a right angle from it or even shot from the opposite side of the ship in the opposite direction and made to turn around and arrive at the point "X" at the correct time. To make possible such super-accurate timing requires the delicate precision instruments with practically no margin of error allowed. In the computation of such calculations, the wheels and gears, unlike a watch which only goes in one direction, have to be so set that they can reverse and can go the opposite direction with complete freedom and without any slack in either direction. To get gear cutting of this extremely high calibre was at first left to the laws of

MACHINES OF MODERN WARFARE are born on paper. To the layman these blueprints are uncomprehendable, but to the expert draftsman, one glance will unfold the entire meaning. The finished prints go from the draftsman to the millwright for fabrication where the parts are rushed to completion for active service.



THE CROWDED CORRIDOR, through which flow tooled parts to the assembly room, is bustling with activity twenty-four hours each day, seven days a week. You will notice the censor's brush which covers the machinery which is confidential.

chance, and by trial and error we would try gears until we found one that was perfect. This was slow and expensive. After much research and training of personnel, the company perfected these operations so that gears were cut to the fineness of ten thousands of an inch. Here was a delicate instrument, finely balanced and yet that had to be made sturdy enough to withstand the shock of battle conditions on a fighting craft, and to withstand severest weather conditions.

The torpedo directors are being turned out on an assembly line basis, something which company officials say is not being done elsewhere in this country. These directors have already reached battle fronts, one of them sharing in the credit for destruction of a Japanese cruiser in the South Pacific, on October 12, 1942, by sending a torpedo on its lethal way from an American destroyer.

8-inch Gunsight

As intricate and difficult and complicated as the torpedo director was it was nothing compared to the 8-inch gunsight. Almost a hundred companies were asked to bid on this instrument. General Mills was the only one willing to tackle the job. We know now why no one wanted this contract. Not only was it complicated requiring extremely high precision, but it was an almost insurmountable problem to put it into mass production. It was one of those jobs that at times looked absolutely impossible. The whole cruiser program depended upon solving the production difficulties and turning out the stuff. Engineers, draftsmen, everyone, went through many trying hours of overtime, nights, holidays, working the bugs out of the production problems.

To make the job still more difficult, designs were changed at various times which would make it practically necessary to start all over again. The men and women of the Mechanical Division persevered until they had licked all the problems and had developed a mass production line. To check the accuracy of the instruments, the inside of a gun-turret which handles the 8-inch rifles was duplicated to test the accuracy of the production line. These gunsights weigh about two tons each. Such sights consist of around 800 parts, stand about 20 feet high and 30 feet wide. They train guns of three-gun turrets—each independently or simultaneously as to both elevation and azimuth.

Actual combat experience has shown that use of this 8-inch gunsight has increased the fire power and also the accuracy of that fire power.

In August of 1942, the Mechanical Division of General Mills took on a contract from the British Navy to produce a specialized piece of fire control apparatus known as the roll corrector. We have also from time to time rebuilt other fire control apparatus requiring high technical skill for units of the British fleet that have put in at our ports for repairs.

That, briefly, is the history of the food manufacturer at war. To bring this closer to home and to increase the realization that even here in the center of the great plains area of the Northwest we are close to the war front, we are quoting a story related by A. D. Hyde, President of the Mechanical Division:

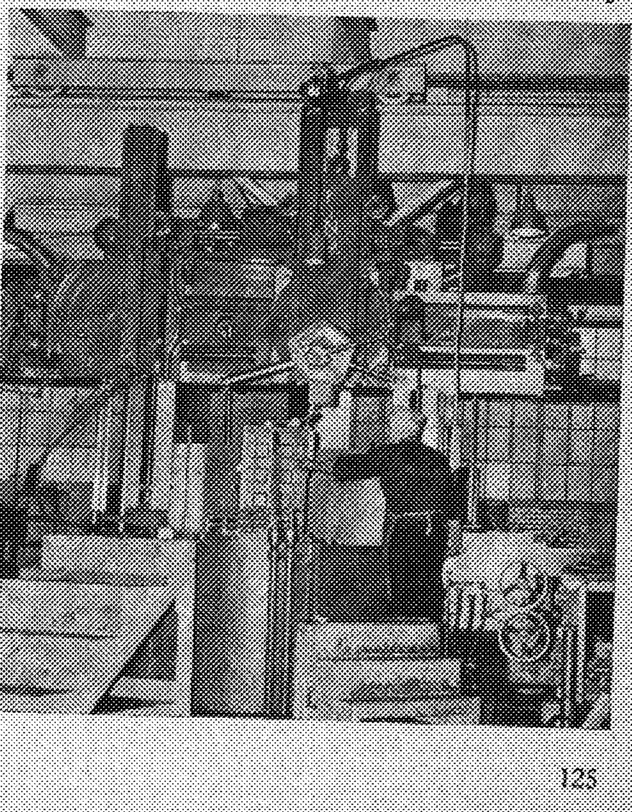
"A destroyer-escort vessel snakes its way into a dock in the Canal Zone. Immediately an urgent message is radioed to Washington in code. In the Navy Department the message is decoded and a long distance call is put in to Lt. R. W. Hannam, Resident Naval Inspector of Ordnance at the Mechanical Manufacturing Division of General Mills, Inc., in Minneapolis.

"The message is repeated to Lt. Hannam: The ship waiting in the Canal Zone must have immediately a replacement for one of its fire control instruments damaged in battle.

"The call reached General Mills at 10 a.m. on a Tuesday morning. At 2 p.m. the vitally needed instrument has been inspected, greased, packed and put on a plane, and it has been given necessary priorities. Traveling the 3,000 miles by plane, the unit reached the Canal Zone, was installed in the ship, and the ship was under way by 6 a.m. Thursday morning—less than 48 hours from the time the message reached the war plant.

"This incident—and it's not unusual in time of war—is sufficient to illustrate how very close General Mills, and the men and women who work for General Mills, are to the fighting fronts. That ship, 3,000 miles from Minneapolis, could not go to sea until the part that General Mills was manufacturing in its war plant could be sent to it—and it was done in less than two days."

THE KING MACHINE, which reaches nearly to the ceiling weights over forty tons and can handle with extreme accuracy the high precision work required in heavier tooling.



Many Uses for

SILVER AT WAR

BY FORREST R. GRIMM M. E. '44

SILVER is serving the ends of Victory in two ways; first, as a replacement for tin, copper, and other critical materials, and, second, in its own rightful use for mechanical and electrical parts where silver or its alloys function best. Actually, in certain of the "substitute" applications, silver alloys are turning out to be superior and will someday present a serious challenge to the metals they now replace providing the value of silver remains favorable.

A typical "for the duration" application of silver is its new use as bus-bars in aluminum and magnesium reduction plants. The bus-bars are heavy-gage bars of pure metal that conducts the electric current from the power-supply substations to the electrolytic refining cells. They are normally constructed of pure copper or aluminum. When silver is employed without redesigning the system the weight of the conductor is heavier than with copper for silver's density is about eighteen per cent higher. The two metals have similar conductivities on a volume basis.

The silver for this purpose is lent by the Treasury Department to the Defense Plant Corporation, who may use it only in government owned or operated plants. Every ounce of this silver must be returned within five years. One of the most recent silver bus-bar installations is at one of the Dow Magnesium Corporation's plants, where nine hundred tons of it, worth over eighteen million dollars at the Treasury's price of 71.11 cents per ounce, must be kept constantly under armed guard. One understands immediately why silver for bus-bars is an emergency use only. The use of silver in the new silver nickels will almost certainly end with the war's termination.

Silver Bearings

Silver is employed in bearings by two different methods: it may be in the form of silver-clad or silver-plated steel or silver-based alloys; or as a constituent of lead-based alloys developed to replace bearing metals containing large amounts of tin.

Fine-silver is used in the main bearings and connecting-rod bearings of several types of aircraft engines because of its superior performance and engineering economics. A thickness of about twenty-five thousandths of an inch of silver or a silver-lead alloy is joined to a steel backing. This combination provides the mechanical strength in thin sections beloved of aircraft designers, along with the property of absorbing grit instead of being scored by it plus the corrosion-resistance and the "oiliness" of silver. The friction properties of silver are similar to those of lead, tin, and cadmium. In addition it has a higher melting point than any of these and is unusually good in fatigue resistance.

Pure silver is not the "oiliest" bearing material available for on ground shafts it has some tendency to seize. However the addition of a few per cent of lead seems to improve its bearing qualities considerably although the bond between silver-lead and steel is weaker than that between fine silver and steel. Pure silver bearings run ideally against a polished shaft.

Silver bearings in aircraft engines are electroplated, cast, or rolled on to a steel backing. Although the cost of silver bearings might be expected to be high, actually they often cost little more than comparable bearings of other types especially if the silver coating is produced by electroplating. The cost of the silver in a bearing is only a small proportion of the total material plus the production cost of the part.

A substitution use for silver in the bearing field is its presence as an essential constituent in a class of lead-based babbit metals being offered in place of the conventional tin-based babbits containing up to eighty-five per cent tin. Lead babbits have widely replaced tin, since tin is relatively much scarcer. Lead babbits with two to five per cent silver approach the properties of the tin-based babbits more closely than other substitutes that have been used.

Tin Conservation

The tin conservation performance of silver in the solder field can be summarized in the statement that two and a half per cent silver can replace thirty per cent tin. The favorite substitute solder today is one containing ninety-seven and a half per cent lead and two and a half per cent silver, which are now being used to replace lead-tin solders containing more than thirty per cent tin. Now that the technique of using it has been mastered, the substitute solder is developing a strong preference among many users and may be the solder of commerce in years to come.

The reasons for this are interesting. The solder must be applied at a higher tem-

(*Continued on Page 134*)

POURING MOLTEN SILVER into crucibles in the preparation for making wire bars. Silver is now being used in many of our vital wartime industries in the conservation of the scarce metals. In many instances, this substitution has given a much superior alloy.

COURTESY OF SCIENTIFIC AMERICAN AND HANDY AND HARMON

Famous Scientists Are

HARNESSING THE SUN

by Experimental Technique

BY DR. R. S. LIVINGSTON

PHOTOSYNTHESIS is the greatest energy conversion and chemical manufacturing process in the world, but not an engineer or a chemist has a hand in it. The old saying, "All flesh is grass," reminds us that we and all other animals either eat plants like sheep, or like wolves live upon grass-eating animals.

According to Dr. Lionel S. Marks, retired professor of mechanical engineering at Harvard University, the photosynthetic process is the most efficient natural point for converting solar energy into work. He points out that in certain tropical areas, under favorable conditions, it would be possible to harness a continuous supply of work at the rate of 5 kilowatts per acre. Solar energy is the only important source of power. It is the cause of winds, rain and plant growth; in earlier times it was stored in coal and petroleum, and that of recent times is stored in vegetable and animal matter. It is also stored in water which rain has carried to lakes and reservoirs. Of the solar energy which arrives at the earth's atmosphere, man will be able to control only the 43 per cent which reaches the earth's surface. If all the petroleum, making allowance for future discoveries, were burned, it would be about equal to the solar energy arriving at the earth's crust in half a day.

Both plants and animals obtain their vital energy from the controlled combustion of sugars and other organic compounds under their "internal boilers." The typical chemical equation for such a process is

$$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + 673{,}000 \text{ calories}$$

Only plants have the ability to reverse this process, and to build up their organic tissues from the inorganic compounds present on the earth's surface. They convert carbon dioxde and water into sugar or starch, utilizing the light energy from the sun. The chemical equation for this process, which is called photosynthesis, is

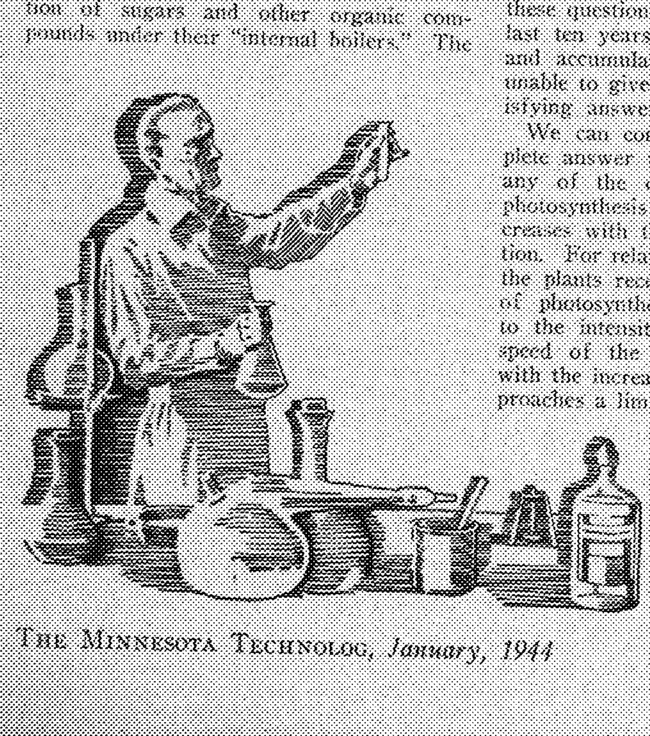
$$nh\nu + 6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$$

where $nh\nu$ represents the energy contained in n quanta of visible light which are absorbed by the plant. All the myriads of other organic compounds which make up living tissue are derived from this beginning.

Puzzled Scientists

How is photosynthesis affected by external conditions? What parts and chemical constituents of the plant are essential to it? What are the detailed steps which make up this complex reaction? How is its occurrence related to the origin and evolution of life? Is it possible so to arrange conditions that photosynthesis will occur in a "test tube" without the aid of plants? These and similar questions have fascinated philosophers and physiologists, chemists and physicists for hundreds of years. Several thousand scientific papers dealing with these questions have been published in the last ten years. In spite of all this study and accumulated information we are still unable to give a complete or altogether satisfying answer to any of these questions.

We can come nearer to giving a complete answer to the first question than to any of the others. The rate at which photosynthesis occurs in ordinary air increases with the intensity of the illumination. For relatively low intensities, such as the plants receive on dark days, the speed of photosynthesis is directly proportional to the intensity. For brighter lights the speed of the reaction does not keep up with the increasing intensity but instead approaches a limiting value. At this limiting speed, the whole reaction depends upon the rate at which carbon dioxide can be taken from the air, and the speed is said to be "CO_2-limited." When the concentration is low (equal to or less than that of ordinary; i.e., about 0.04%) the limiting rate is directly proportional to the concentration of carbon dioxide, but at higher concentrations the rate approaches a new limit, which cannot be exceeded at any concentration or intensity. In this respect a green plant is like an aluminum refinery. When there is a power shortage, the output of the refinery is limited by the amount of electrical energy supplied to it; when bouxite is scarce, the output is determined by the rate at which this raw material is delivered; but if both are present in unlimited amount, the output of the refinery is limited by its size and efficiency.



The amount of money that a man puts away in a year is influenced as much by what he spends as it is by his income. Similarly the rate at which plants store sugar or starch is determined by their speed of respiration a swell as by their speed of photosynthesis. Some of our fastest growing plants are distinguished more by a low rate of respiration than by a rapid rate of photosynthesis. In some green-house experiments it has proved possible to speed the growth of plants by illuminating them at night, when they would otherwise be expending their stored up carbohydrates, and by increasing the carbon dioxide content of the air during the day when the light intensity is highest. However, up to the present this type of treatment has not proved economically sound.

Molecular Construction

Plants are much harder to study than are simple chemicals, electrical circuits, or internal combustion engines. All living material, even single-celled algæ, is complex both in structure and in chemical constitution. Many of the chemical components which plants contain and which are essential to their existence have never been identified or isolated in the pure state. The pigment chlorophyll is a notable exception. This substance, which gives plants their green color and which is responsible for the light absorbing steps of the photosynthetic reaction, has not only been isolated but its structure has been determined. It has the empirical formula: $C_{55}H_{72}O_5N_4Mg$. As you might guess, the proof of this structure was very difficult and required the cooperative work of many skilled organic chemists extending over a period of years. While the greater part of this work was done in the laboratory of Professor Hans Fischer at Munich, Dr. Conant, who is now

(*Continued on Page 132*)

Tau Beta Pi Essays

WHAT'S YOUR IDEA?

Future of Aviation

"As a goad to action, the instinct of self-preservation is stronger than the lure of profit or any human urge. That is why science in general makes more progress in a year of war than in a decade of peace." These words were written recently by Major Alexander de Seversky, well known aviator, author and inventor.

World War I showed a technical advance in the airplane that would have required perhaps a quarter of a century of peacetime puttering to accomplish. There is every reason to believe that World War II is proving a similar stimulant to the science of flight.

New ideas in the principles of flight, new construction materials and fuels, and increased efficiency of operation have been indicated in the first three years of this war. Each of these things holds potentialities for the days of peace that must follow.

Aside from the technical advancements of the airplane in this war, there is also the psychological advance. For every one of the hundred thousand licensed pilots in this country before the war, there will be twenty or thirty qualified to be licensed when they return from the battle fronts.

The Office of War Information made a statement substantiating this when it said:

"An additional factor bearing upon the future of American air transport is the number of persons who will be air-minded after the war, including probably the majority of over three million men, who will be in the air forces by the end of this year, trained as pilots, navigators, radio men, airport engineers and the like."

These factors taken together will have a tremendous effect upon aviation after the war. It is not hard to foresee the results. Add the technical knowledge and enthusiasm for the airplane developed by this war to the highly trained professional organization of our prewar air transport system and the result is obvious immediately. This does not mean that the automobile, the train, and the steamer will not play an important part in our postwar transport system since it is hard to imagine a world without them.

Before the war, the airlines operated regularly in the face of adverse weather. Today military aviation virtually ignores the weather, far beyond our peacetime scheduled flights. This triumph of science over nature has been accomplished by extraordinary improvements in instruments, equipment and other essentials. Radar, "automatic pilots," and hundreds of other inventions most of which are the outgrowth of military needs, will take many of the hazards out of flight, not to mention innumerable structural improvements in the design of both aircraft and engines. Discoveries such as uses of magnesium in aircraft construction are also the direct outgrowth of this war.

On the matter of private planes, it is hard to see "backyard airports as common as garages" or "family flivvers as common as automobiles" as some writers do. However, the postwar demand for airplanes will be tremendous compared to that of a few years back even though civilian aviation was taking great steps in providing the public with efficient, and practically foolproof light airplanes at that time. The supply of these airplanes after this war will be exhausted. To fill the immediate demand, 1942 models improved in such ways as better streamlining, retractable landing gear, flaps, and better engines will be available.

A relatively new type of air transport, and one whose general acceptance had to wait until the war proved its worth, is the helicopter. The helicopter combines increased safety along with light airplane cost and performance in the matter of speed and efficiency. Add to this the fact that they can hop straight up from lawns and streets, should make them ideal for public use.

In conclusion it can be said, the advancement of the science of flight, like most other sciences, is obtaining a powerful impulse from the demands of war. These advances will be used by a public which has been made air-minded by the war, for purposes of commerce and culture once the fighting has ceased.

OWEN REFLING

Phy Ed for All

PHYSICAL education, that is, body training through more or less systematic exercises or games, has been practiced in some manner by almost all races and nations. Very early physical education as carried on by the Romans and Spartans emphasized training of warriors for military purposes, while the Greeks placed emphasis on gymnastics and music with a love for competition and esthetic beauty. From the eleventh to the sixteenth centuries the main athletics were those carried on in connection with knighthood. In about the middle of the eighteenth century physical education through gymnastics and games, as we knew it nowadays, began to develop.

Physical education is now considered a very important part of general educational programs of all schools. A good physical education program serves many purposes.

Among these purposes is the satisfying of the natural desire for play in the form of games, running, exercise, and other outdoor activities. Physical education in the form of dancing, drama, et cetera, gives yield to the expression of feelings and ideas. There is also the pleasure which is received from the desire to win a fairly fought contest and the development of sportsmanship which it involves. In the case of team sports, leadership, how to take orders, and teamwork are developed. These physical activities also serve to better the endurance, strength, timing, skill, and quickness of the individual. The above is one of the most highly thought of reasons for participation in athletics by most people because it is a natural desire to show noticeable improvement in the direction of being the best performer in any game or sport.

Besides the physical benefits there are mental benefits, which I believe are the most important reasons for engaging in competitive athletics. The best performers don't win on their athletic skill alone, they must also have the determination to win in their minds. That is, there must be concentration of effort, initiative, coördination of action, and the will to win. All of these are developed by competitive sports such as football, baseball, basketball, hockey, tennis, swimming, golf, track, and others.

The activities covered by a good program in physical education are the following: First, there are the natural activities such as hiking, swimming, climbing, et cetera. One very good example of this class of activities is camping, which provides natural environment in place of the artificial conditions we are used to.

Another class, which is one of the most important, is that of athletics and sport. This includes baseball, football, tennis, basketball and the other competitive sports.

Then there are the individual exercises and noncompetitive gymnastics which are corrective and also find much use as conditioning exercises for the competitive sports.

Also there is a class of activities which may be called recreational. This means the taking part in sports of adults as a change from their usual activities. This group will include all the above activities but will have as its chief purpose diversion and not body building.

I think that at the present time it is especially desirable for all army and navy trainees to carry on a well-rounded schedule of physical education, especially the games consisting of bodily contact. Not only will these games serve as body builders but the sports will bring out leadership, courage, sportsmanship, and a real fighting spirit.

CHARLES L. SWANSON

TECH NEWS

EDITED BY CHARLES AMANN, AERO. E., '44

Will Engineers Have E-Day?

Each spring for the past 41 years Minnesota's engineering students have participated in their own special celebration, Engineers' Day. This year, however, there are so few civilian students in I. T. that the Tech Commission, the organization behind the planning, is raising the question of whether E-Day can be made a successful affair. Because of the small enrollment such a project would require the loyal support of every Institute student.

The festivities got underway last year when Saint Patrick and his queen were crowned, the seniors were knighted, and every engineer and his girl went to the big E-Day Sunlite. There were exhibits by local manufacturing concerns, and tournaments in bowling, pocket billiards, and basketball, not to mention the obstacle race, which provided laughs for all. The celebration was brought to a close on Saturday night with the Engineers' Day Brawl at the Radisson.

Festivities such as these remain as one of the few traditions in the Institute, and we cannot fail those who have done their share toward it in the past by discontinuing it this year. But before anything can be done the Tech Commission must be assured of sufficient support. If you think there should be an E-Day this year, say so on paper, and give your reason for feeling that way. Add your name, class, and P. O. number and address your letter to E. L. Proszek. Send or bring it to the TECHNOLOG office, Room 17, Murphy Hall, as quickly as possible, for plans should have been well along by now. You need not write an essay; a note will do. It is up to each individual to put E-Day across, so do your part today.

Essay Contest Has Big Prizes

The Pabst Brewing Company has announced a series of seventeen awards totaling $50,000 in their Postwar Employment Essay Contest. These awards will be given to those entries that, in the opinion of the judges, have presented the best solution to the postwar reemployment problem.

Each plan must be legibly handwritten, or preferably typewritten, in 2,000 words or less, and only one side of the paper may be used. Additional information about the contest may be secured in the TECHNOLOG office.

ASME Elects New Officers

The American Society of Mechanical Engineers met Tuesday, November 30, for a dinner and business meeting at which officers for the coming period were nominated. Professor Rowley, head of the mechanical engineering department, spoke briefly on what is in store for M.E. students after the war.

The election of officers took place on the following Friday, and Harry Foehringer was elected new president. Dan Greenwald will serve as vice president, Neil Griebenow will keep the minutes, and the cash box will be managed by Verne Peck.

Men from MAPE Address Students

Four representatives of the Minnesota Association of Professional Engineers addressed a good representation of junior and senior engineering students during convocation hour on December 19. Their purpose was to urge graduating engineers to join state and national engineering organizations.

Dean Lind introduced Walter H. Wheeler, private consulting engineer of Minneapolis, who in turn presented R. R. Herman, president of the MAPE, H. C. McWethee, evaluation engineer for the Street Railway Company, and E. F. Jones of the Saint Paul city engineer's office.

Architect Grads Aid War Effort

Sixty-six of the 143 men graduated from the School of Architecture with degrees in architecture from 1935 to 1943 are now in the armed forces, and 46 are engaged in civilian activities, according to the report of Prof. Roy Childs Jones, head of the School of Architecture. There are no available records of the remaining 31 men. All but 6 of those in military service have been commissioned officers, and 14 of the 46 in civilian occupations are government employes.

Lind Explains Fate of Frosh

A few weeks back quite an uproar was caused among civilian engineering freshmen by an article appearing in the *Daily*. This item seemed to leave its readers with the impression that so many first-year engineers were entering the armed forces that by the time that the remaining freshmen became sophomores there would not be enough of them left to hold classes. With the idea in mind that there would be no sophomore class, freshmen began to lose whatever faint hopes they had of securing educational deferments. Those who left high school before graduating, planning to be well into their second college year before becoming eighteen, were particularly perturbed.

To this worried group Dean Lind says that the article creating the disturbance has been misunderstood. If the sophomore class is so small that specialized courses such as are now being offered are impractical, it may become necessary to continue with the various types of engineering all offering the same courses in combined classes just like in the freshman year. Perhaps each school in the Institute will have its own standard course. This would mean that all students in the School of Engineering would meet in the same classes, those in Mines would have their own course, and so forth. At any rate the University does not intend to close I.T. as long as there are students to enroll in it.

Tech Alumnotes

Harley B. Lindeman, E.E. '43, has joined the Westinghouse Electric and Manufacturing Company as a member of their graduate student course. He is one of 259 young men selected by Westinghouse from the nation's universities and colleges to receive this special instruction designed to bridge the gap between school and actual participation in industry.

Harry H. Nessel, E.E. '40, is now with the Bendix Aviation Corporation in Towson, Maryland.

Roy V. Wright, M.E. '98, was awarded an honorary membership in the ASME at that society's annual dinner in New York City on December 1. Mr. Wright is a national authority on railroad engineering.

AS WE SEE IT

Instructors, Please Note!

Wartime education is of necessity both practical and narrow. The postwar period must preserve the practicality but not the narrowness. Breadth of education is considered by many to be furnished by a liberal arts course. In view of this we can mention that the battle between culture and education is still in progress. The meaning of culture has been greatly abused. For the purpose of this editorial let it be defined as "enlightenment, discipline, and refinement, obtained by mental and moral training."

Now we come to the question of method. Consider the statement made by Philip Swain, editor of *Power* magazine: The professor stands up there and talks, and the students, like sponges under a dripping faucet, are supposed to swell up gradually with the moisture of knowledge. This is exactly the procedure in too many of our classes. The instructor lectures from the text without including any other material, and most important without student participation—no recitation. Good teaching keeps the student active. Education not accompanied by effort doesn't stick. Too many of our instructors come to class unprepared except for what they may remember; they have no plan whatsoever for presenting the material, and as a result they put the students to sleep with their unorganized ramblings. Some of the best classes attended by the majority of Institute upperclassmen are the junior math courses. Here the students go to the blackboard and learn by doing. And the classes are interesting because the instructor makes them so.

Important in education are books, which, although better than the majority of lecturers, are not above criticism. The texts which go into long and detailed derivations ofttimes neglect items that are far more important. Especially aggravating are books in which reference is continually made to illustrations or tables which are several pages distant from the type matter. If a little more time and effort were expended in their preparations, if the authors would use shorter words and a little more humility, far better books would result.

The methods of conducting and preparing tests and examinations seems to be far from what they might be. Uniformity as to frequency and content would not only help the student but would enable the instructor to assign grades in a more intelligent manner than is now possible.

A fact that is noticeable to students in the Institute is the lack of instructors and professors who have had formal training in educational procedures. It would not be amiss to change this in the future. If grade schools and high schools require degrees of their teachers it would seem that much more important for the University to set standards for those engaged in instructing its students.

Let's Go To College

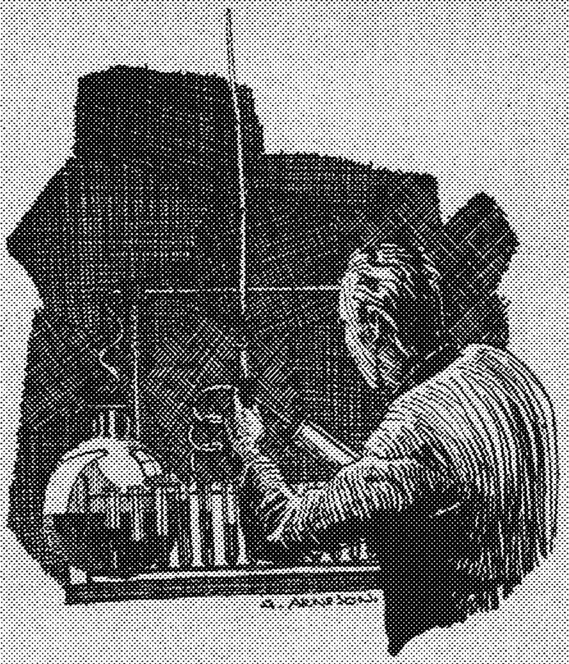
The war has changed our campus in many ways. Some of these changes, such as the arrival of the fine young men of the armed services, have been quite pleasant, but there are few of us who have welcomed the decline that has taken place in the extracurricular activities. During the last several semesters, almost all of the student organizations have found it difficult to continue.

There are probably many people anxious to hear the death knell of extracurricular activities because they have the mistaken idea that all student organizations are a peacetime luxury—an unpleasant hangover from the giddy raccoon coat and hip flask college days. If this were the case, extracurricular activities would certainly have no place on the wartime campus—or on any other campus, for that matter.

The idea that extracurricular activities are frivolous and a waste of valuable time could not be further from the truth. A college composed solely of books and classes would be of little real value. Its graduates would be a fine collection of timid, lazy, self-centered individuals. It is the function of extracurricular activities to prevent this unhealthy condition. By participation in the various campus organizations, the student acquires confidence and initiative, learns to shoulder responsibilities and perhaps most important, learns to meet and *coöperate* with his fellow man. In short, the student "goes to college."

The question should now be asked, "What are we going to do to insure the survival of student organizations?" We think that the most sensible plan is for every student in the university to adopt the attitude held by the United States Navy. The navy has stated that its men are permitted to participate in student activities so long as their school work is satisfactory. If student organizations are to continue, it behooves each student to adopt the same policy. Naturally, there are many students who because of heavy class or work schedules will not have time to participate but to those who have the ability and the time to spare, we say "Let's go to college."

Ed.—The above editorial is reprinted with permission of The Michigan Technic. Many students are new to the Minnesota campus and do not realize the opportunities for them in extracurricular activities. Because of this unfamiliarity many worthwhile organizations are barely able to exist and others have been discontinued. Those interested in participating in University activities may secure pamphlets about them from the information desk in the Coffman Memorial Union. Information about organizations within the Institute of Technology may be received from the TECHNOLOG *office located in Murphy Hall.*



(*Continued from Page 127*)

president of Harvard, also made important contributions to this study.

Although the detailed chemical steps by which plants transform six molecules of carbon dioxide and of water into a molecule of glucose are still a matter for conjecture, our understanding of this problem has advanced greatly in the last few years. The old ideas which were based upon the assumption that formaldehyde and hydrogen peroxide were intermediate compounds in this reaction have been definitely discarded. Probably the most satisfactory scheme which has been suggested is the one which was proposed in 1941 by Professor James Franck of the University of Chicago and Professor Herzfeld of the Catholic University of America. Their scheme postulates that there are at least one hundred and twenty distinct chemical reactions involved in the formation of one molecule of glucose and, that in addition to chlorophyll, at least three different enzymatic catalysts take an essential part in the process. This set of postulates is consistent with a vast amount of experimental evidence, but we have no assurance that future experiments may not reveal faults in it.

Experimental Work

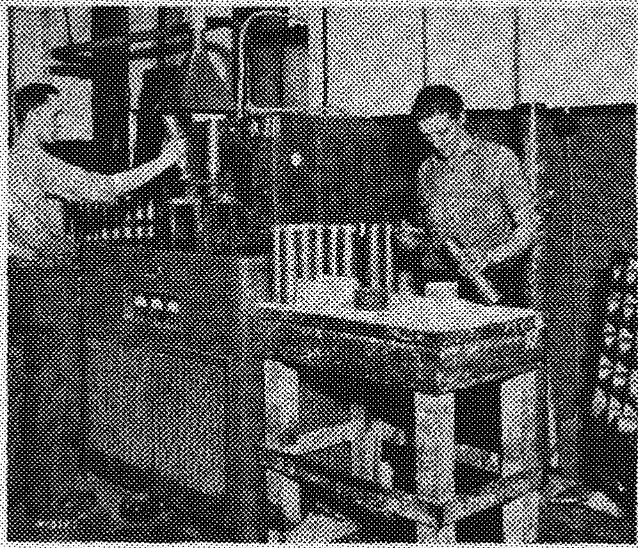
It is interesting to note that one thing which delayed the development of a rational scheme or "explanation" of photosynthesis was the misinterpretation of some of the older experimental results. In 1922 the famous German physiologist, Professor Warburg, published the results of some experiments which he interpreted to mean that plants require only twenty-four light quanta to convert six molecules of carbon dioxide into one of glucose. Due to his personal prestige and the fact that twenty-four quanta is about the minimum number which would satisfy the energy requirements, his claim was practically unquestioned for fifteen years. Finally, a group of scientists, working at the University of Wisconsin, had the courage to publish the results of experiments which indicated that more than fifty quanta were required. After several years of controversy, which at times took on the character of a political argument rather than a scientific discussion, the issue was settled by the careful work of Professor Emerson of California, which revealed the source of error that was present in Warburg's experiment. The new theory of Franck and Herzfeld is based upon the assumption that forty-eight quanta are required to form one given molecule.

In the last few years many new experimental methods have been applied to this problem. The radioactive isotope of carbon has been used as a tracer element by Dr. Ruben at the University of California. In the University of Minnesota, Professors Armstrong, Burr, and Nier are applying the stable heavy isotope of carbon in a similar way, making use of the mass spectrograph as an analytical tool. At the Smithsonian Institute in Washington, Dr. McAlister has developed a special method of studying the rate of photosynthesis by measuring the absorpation of infrared light due to the carbon dioxide in the air which is in contact with the plant. The photosynthesis of aquatic plants has been followed by measuring the concentration of carbon dioxide in the water with a glass electrode, and of dissolved oxygen with a polarograph. The red fluorescence of chlorophyll in living plants has been studied. Investigation has been made of the photochemistry and spectroscopy of chlorophyll and of related pigments. The photosynthetic activity of plants has been studied under a variety of controlled artificial conditions; including intermittent illumination, the absence of oxygen, the presence of high concentrations of carbon dioxide, and the addition of various special poisons and narcotics. It is possible to get some understanding of the difficulty of devising a mechanism of photosynthesis, like that proposed by Franck and Herzfeld, when it is remembered that the scheme must be consistent not only with all of the special experiments but also with the general principles of physics, chemistry, and physiology.

Whether photosynthesis can occur in the "test tube," without the aid of plants, is still in dispute. The English physiologist Professor Hill, has demonstrated that under certain conditions chloroplasts, isolated from plant cells, are able to evolve oxygen when illuminated. However, it must be admitted that this only shows that part of a plant is capable of performing one of its functions even if it is separated from the rest of the organism. A few scientists, notably Professor Bailey of England, and Professor Dahr of India, have claimed to be able to produce organic compounds by illuminating aqueous solutions of carbon dioxide in the presence of suitable light absorbing substances. These results have not been generally confirmed and are viewed with some skepticism by most workers in this field. Whether such studies will eventually lead to results which will influence our daily lives, no one can predict. It is not inconceivable that the forerunner of life upon our planet was the chance assembly in the sunlight of chemicals similar to those which Professor Bailey mixed in his test tubes. It is not beyond the bounds of possibility that the engineers and chemists of the future may, by a skillful combination of light absorbers (sensitizers) and catalysts, establish factories which will supplement or even supplant beets and cane as sources of sugar or potatoes and corn as sources of starch. But at present, such speculations are better suited to dreamers than to hard-headed engineers.

COURTESY OF BOEING NEWS

"Now what other secret weapons does your government have, Fraulein Schmidt?"



COURTESY OF THE WELDING JOURNAL

BRAZING SHELLS with a Tocco induction heating machine. Such brazed parts are used in torpedoes, ship pipings joined by silver alloy rings, 20-mm and 40-mm guns and for parts of bombsights.

(Continued from Page 126)

perature than the ordinary standard solders and requires a more active flux. The solder also can produce stronger joints than the lead-tin solders and are no more costly.

The major uses for solder in normal years were for dip-soldering automobile radiators, for electrical connections, and for soldering tin cans. In wartime the latter use emerged as one of the toughest substitution nuts to crack, but the can-makers have been extremely coöperative. They are now employing the lead-silver solders even with their automatic soldering machinery that was designed for the standard solder which used a lower application temperature and wider freezing range. The lead-silver solders go from the liquid to the solid state quite rapidly without pasty period. Some can-makers prefer the lead-silver solder on can bodies that have been made from the new electrolytic tinplate because the side-seam strength is higher. This is significant because the use of electrolytic plate is expected to surpass that of hot-dipped plate in the postwar period.

The War Metallurgy Committeee's investigation leads to the conclusion that the lead-silver solder for food cans involves no health hazard and is entirely safe ever for evaporated milk which is so widely used for infant feeding.

Lead-silver solders containing twenty-five hundredths per cent copper have long been used in the electrical field. Solders with four to five per cent silver were and are standard for automobile radiator dip-soldering due to the better strength encountered at their elevated operating temperatures.

The war has brought a sharp increase in the use of silver in electrical contacts. The contacts take the form of switch points, flat springs, nibs, screws, and many other parts. Some contacts are pure metals while others are alloys and bimetallic strips. Other types are pressed from the powder to yield a duplex structure.

Engineers are generally agreed that an ideal material to be used for contacts would be one with the electrical conductivity, heat conductivity, low arc-resistance, workability and resistance to oxidation of silver; along with the low material-transfer during arcing and the hardness of tungsten. Approaches to this ideal are available in silver-tungsten powder. The finished structure possesses the individual properties of the two metals.

Silver molybdenum contacts made by powder metallurgy are employed where the utmost resistance to oxidation is not required. The molybdenum is used to correct the tendency of silver to evaporate at high currents.

Silver contacts of various types are used in aircraft control devices, communications equipment, circuit breakers, relays, and temperature control systems for a variety of purposes. Recently considerable research has been done with laminated or bimetallic contacts which consist of two-layer strips of silver on a copper backing or of sintered silver-nickel, silver molybdenum, or silver-tungsten on copper.

The phenomenal expansion in the use of silver brazing in the last decade, and particularly since war production began on a large scale, has reflected a positive interest in this joining method as a faster, less expensive means of fabrication. According to Handy and Harmon, New York silver bullion dealers, since the start of the war tons of this material have been used where merely ounces were required in peacetime.

Silver-brazing alloys are basically alloys of silver, copper, and zinc that contain ten to fifty per cent silver and melt at temperatures as low as 1175 degrees Fahrenheit. The brazed joints are made by bringing the parts to be joined closely together with a rod, strip, disk, ring, or powder of the brazing alloy at the joint. The joint area is heated slightly greater than the melting temperature of the brazing alloy by torch, induction heating, or incandescent carbon.

Properly designed silver-brazed joints usually have the strength of the solid metal and give the added advantage of being made at a low temperature. This means either faster production or lower heating costs, or both. This often permits the brazing of parts or tools that cannot be heated to temperatures above 1300 degrees Fahrenheit without destroying their useful properties.

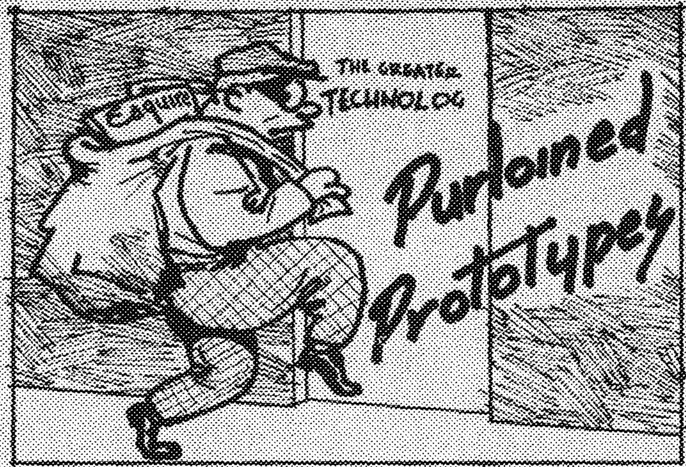
A modern airplane has over four hundred silver alloy brazed parts while every torpedo has several hundred brazed joints. A large ship contains over eight miles of piping that is joined with silver alloy rings. One of the greatest single war uses of silver-brazing alloys is in the manufacture of bombs and shells. Sections of the 20-mm and 40-mm guns, the waterjacket of the Bofor gun, and even parts for the latest bombsights are silver-brazen.

Repairing Steel Tools

A vital contribution of silver-brazing to war production is its wide use for repairing hardened high-speed steel tools for they cannot be used if during repair they are heated to a temperature over 1300 degrees Fahrenheit. Yet they are still useful and would be costly and time-consuming to replace with new tools. Tungsten-carbide and high-speed steel tool tips are also being applied to ordinary steel shanks by silver brazing, therefore saving tons of critical too alloys by confining their usage just to the tips of the tools.

The use of silver for brazing has grown the fastest of all silver applications during the war and will continue to expand in the postwar period along with the use of silver-bearings and solders. These are all applications of silver involving more than just replacement of scarce materials for they represent applications in which engineers are discovering that silver and its alloys have superior qualities of their own. Silver can complete economically and technically with the more familiar industrial materials.

Other applications of silver that have postwar as well as wartime importance is especially its use as a surface layer for corrosion-resistant chemical process vessels and piping. It is also used for certain types of food or drug containers, for surfacing of permanent electrical connections to avoid oxidation, and for use as a reflecting surface on head lamps, search lights, and flashlights.



A sparrow sat in a tree in Berlin. His beak was high in the air, and his feathers were puffed up proudly.

"What makes you so pleased with yourself?" asked his mate.

"I got Hitler today," proclaimed the bird.

• • •

First soldier: "Here's a wire from my wife saying that I'm the father of twins."

Second soldier: "Well, I guess congratulations are in order."

First soldier: "No, but I think an investigation is."

• • •

The queen bee is a busy soul.
She has no time for birth control.
And so it is times like these
You meet so many sons of bees.

• • •

A couple were sitting on the River Bank admiring the scenic beauties.

"Some moon out tonight," said he.

"Some stars," said she.

"Some dew on the grass," said he.

"Hell, no, not me," said she—and left.

• • •

"How are you getting along at home while your wife's away?"

"Fine. I've reached the height of efficiency. I can put on my socks from either end."

• • •

When the flood was over and Noah had freed all the animals, he returned to the ark to make sure that all had left.

He found two snakes in the corner weeping.

"What's the matter?" Noah asked.

The snakes replied, "You told us to go forth and multiply upon the earth, and we are both adders."

• • •

"Here's one Luther Burbank didn't try," said the coed as she crossed her legs.

• • •

POEM

A tree toad loved a she toad
That lived up in a tree;
She was a three-toed tree toad,
But a two-toed toad was he.
The two-toed tree toad tried to win
The she-toad's friendly nod;
For the two-toed tree toad loved the ground
That the three-toed tree toad trod.
But vainly the two-toed tree toad tried—
He couldn't please her whim;
In her tree toad bower with her veto power,
The she toad vetoed him.

• • •

"What's the matter with your finger?"

"Oh, I was downtown getting some cigarettes yesterday and some clumsy fool stepped on my hand."

• • •

Drill Sergeant: "You've been training for six weeks now, and what have you learned?"

Recruit: "I've learned why soldiers aren't afraid to die."

Host: "When I was a young man I always said I'd never be satisfied till I'd smothered my wife in diamonds."

Guest: "Most laudable. But why in diamonds?"

• • •

"Pappy ain't you gonna shoot that city slicker who didn't do right by me yistiddy?"

"Shore, datter, but don't be so ternation hurrified . . . just give me a chanct to shoot the one who didn't do right by you day before yistiddy."

• • •

I suppose you've heard about the bowlegged herdsman's daughter who had trouble keeping her calves together.

• • •

Fiddler: "The leading lady seems to have a break in her enunciation."

Orchestra leader: "Keep your eyes on your music."

• • •

An insurance salesman tells about a valuable wardrobe that his firm insured for a client during a European trip. Upon reaching London she wired: "Gown lifted in London." After due deliberation he sent this reply: "What do you think our policy covers?"

• • •

Proud parent on meeting the new first-grade teacher: "I am very happy to know you, Miss Smith. I am the father of the twins you are going to have next year.

• • •

"Oh, John," sobbed the terrified wife, "when I was taking my bath, a ghost came out of the closet."

"It did!" gasped the husband, "how did it look?"

"As hard as it could," she answered.

• • •

"I can't marry him, mother, he's an atheist and doesn't believe there is a hell."

"Marry him, my dear, and between us, we'll convince him that he's wrong."

• • •

Wolf: "Your husband looks like a brilliant man—I suppose he knows everything."

Wife: "Don't fool yourself; he doesn't even suspect anything."

• • •

Did you hear about Minnie, the moron, who when asked what rank her boy friend was in the Navy, answered, "Chief Petting Officer."

• • •

"What engines shall we use in this boat?"

"Oh, Diesel do."

• • •

Eskimo lover: "What would you say if I told you that I had come a hundred miles through ice and snow with my dog team just to tell you I love you?"

Eskimo sweetie: "I'd say that's a lot of mush."

• • •

"Hows' your new girl?"

"Not so good."

"You always were lucky."

• • •

"Mother, papa wouldn't murder anybody, would he?"

"Certainly not, my child! What makes you ask that?"

"Well, I just heard him down in the cellar saying, "Let's kill these other two, George."

• • •

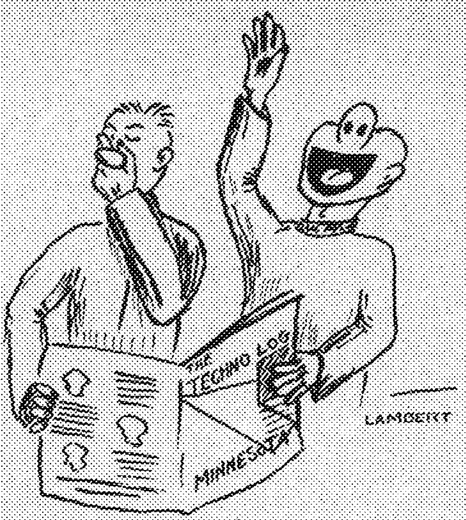
A Scot was engaged in an argument with a conductor as to whether the fare was 25 cents or 30 cents. Finally the disgusted conductor picked up the Scot's suitcase and tossed it off the train just as it passed over a bridge.

"Mon!" screamed the Scot. "It isn't enough to try to overcharge me, but now you try to drown my little boy!"

• • •

A reporter sent to cover a mine disaster, was so impressed by all that he saw that he tried to indicate all the emotion and heroism around him in that vast panorama of death. In a telegram which he sent his editor, he began: "God sits tonight on a little hill overlooking the scene of disaster—"

His editor wired back: "Never mind the disaster. Interview God. Get picture if possible."



Joke Column

The Pre-med Student turned to the young Engineer who was showing him through a locomotive plant, and, pointing, asked, "What's that big thing over there?"

That's the locomotive boiler," the young Engineer replied. The Pre-med Student scratched his head, as Pre-med Student usually do, "And what do they boil locomotives for?"

"To make the locomotive tender," said the young Engineer, without batting an eyelash.

• • • • • •

I used to love my garden
But now my love is dead
For I've found a Bachelor Button
In Blackeyed Susan's bed.

• • • • • •

"Why have you painted one side of your car red and the other side blue?"

"It's a swell idea. You should hear the witnesses contradict each other."

• • • • • •

"What did she say when you told her you knew practically nothing about kissing?"

"Turn out the lights and let this be a lesson to you!"

• • • • • •

There was a little dachshund once,
So long he had no notion
How long it took to notify
His tail of his emotion,
And so it was that while his eyes
Were filled with woe and sadness,
His little tail kept wagging on
Because of previous gladness.

• • • • • •

A grave digger, absorbed in his thoughts, dug the grave so deep he couldn't get out.

Came nightfall and the evening chill, his predicament became more uncomfortable. He shouted for help and at last attracted the attention of a drunk.

"Get me out of here," he shouted, "I'm cold."

The drunk looked into the grave, and finally distinguished the form of the uncomfortable grave digger.

"No wonder you're cold," he said, "You haven't any dirt on you."

• • • • • •

Kelley and Cohen were having dinner together. Cohen helped himself to the larger fish and Kelly said:

"Fine manners ye have, Cohen. If I had reached out first I'd have taken the smaller fish."

Cohen: "Vell, you've got it havent you?"

• • • • • •

"Do you know what the stream said to the elephants?"

"No, what?"

"I'll be damned if you lie down in me."

• • • • • •

"What is the difference between an accountant and an engineer?"

"An engineer is a damn fool running around with a slide rule whereas an accountant doesn't own a slide rule."

Fire Arts Professor: "I was terribly disappointed in that gentleman you introduced me to last night."

Liberal ditto: "Indeed! How so?"

F.A.P.: "Why, you spoke of him as a bridge expert, and he turned out to be nothing but a famous engineer."

• • • • • •

A man was discovered by his wife one night standing over his baby's crib. Silently she watched him. As he stood looking down at the sleeping infant, she saw in his face a mixture of emotions—rapture, doubt, admiration, despair, ecstasy, incredulity. Touched and wondering alike at this unusual paternal attitude and the conflicting emotions the wife with eyes glistening arose and slipped her arms around him.

"A penny for your thoughts," she said, in a tremulous voice.

He blurted them out: "For the life of me, I can't see how anybody can make a crib like that for three forty-nine."

• • • • • •

Private: "Why don't you like girls?"

Sergeant: "Because they're too biased."

Private: "Biased?"

Sergeant: "Yes, every time I go out with them it's bias this, bias that, bias something else, until I'm plumb broke."

• • • • • •

A Chinese visitor says: "Funny people you Americans. You take a glass—you put in sugar to make it sweet and lemon to make it sour; you put in gin to warm you up and ice to keep you cool—you say, "Here's to you and then you drink it yourself."

• • • • • •

Filling out one of those unnumerable government questionnaires, a retailer was asked to list his "fastest-moving item." Without hesitation, he wrote: "Personnel."

• • • • • •

In a crowded bus: "Step to the rear. The backs of our buses go your way too."

• • • • • •

She: "Do you know what they're saying about me?"

Engineer: "Why do you suppose I came over to see you?"

• • • • • •

Her name was "checkers" because she jumped every time you made the wrong move.

• • • • • •

I wish I were a kangaroo
Despite his funny stances.
Then I'd have a place for all the junk
My girl friend brings to dances.

• • • • • •

Did you hear about the moron who:

Was feeling low and got his face slapped.

Kissed the streetcar goodbye and went to work on his wife.

Went to the show with two other morons. Two paid admission but the third wouldn't, saying,

"My name is Crime, and Crime doesn't pay."

Took a dose of buckshot so he could pass the ammunition.

Thought a football coach had four wheels.

Was running behind a streetcar to town and the second moron asked him why and he said, "To save a nickel." The second moron said, "Why not run behind a taxi, and save thirty-five cents?"

• • • • • •

If brevity is the soul of wit, then my girl's dress is funny as hell, and I can see right through the joke.

• • • • • •

"I'll bet you think twice before leaving that wife of yours alone in the evenings."

"I'll say! First I have to think up an excuse for going out and then a reason why she can't come with me."

• • • • • •

"You look all in today, Bill. What's the trouble?"

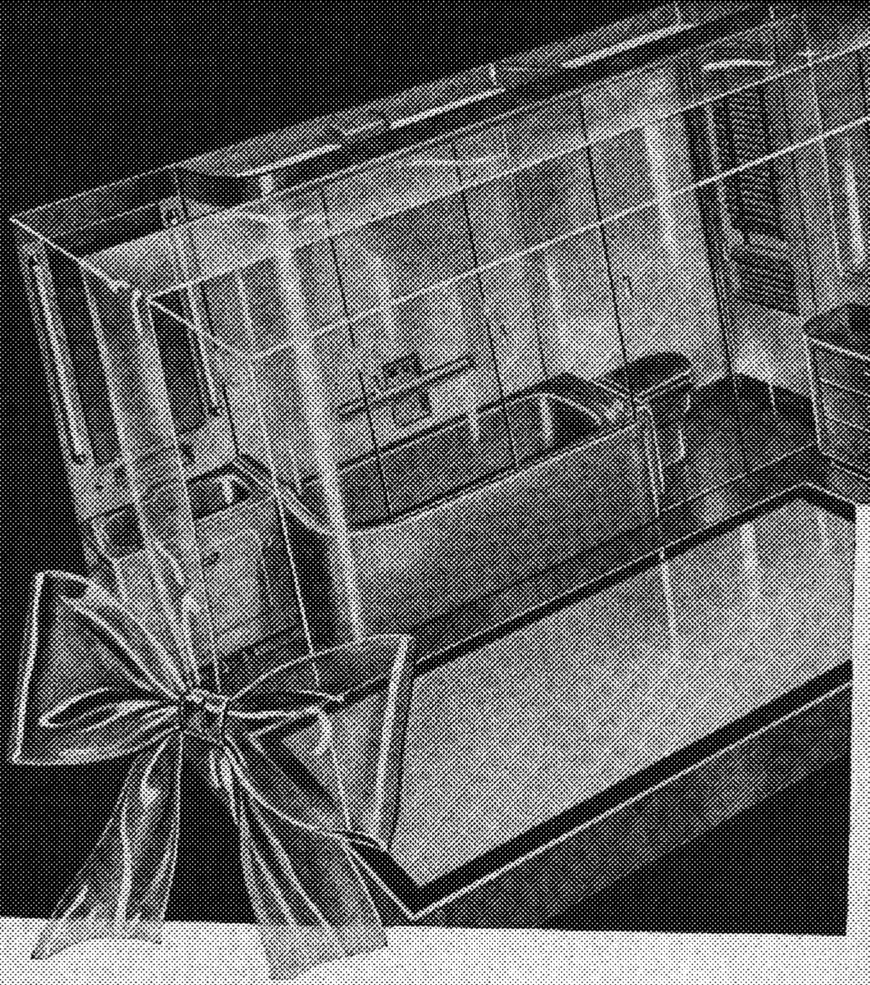
"Well, I didn't get home until after daylight, and I was just undressing when my wife woke up and said, "Aren't you getting up pretty early?" In order to save an argument, I put on my clothes and came down to the plant."

• • • • • •

On her way out of a cafeteria, a smartly dressed girl handed the cashier a slip of paper on which appeared the number 1004180. The cashier glanced at it and let the girl pass without paying.

When the proprietor appeared, the cashier handed him the note. He studied the number frowningly, then demanded to know its meaning.

"You see," said the cashier, "it reads, 'I owe nothing for I ate nothing.'"



Plastics Will Mean Better Homes

. . . and more of them!

EVEN TODAY, plastics men can vision a bathroom with practically everything in it made of plastics or containing plastics in some form. Imagine such a bathroom, costing less to manufacture, to ship, and to install, delivered *as a unit* to your home!

The raw materials to make better homes with more bathrooms and finer kitchens come true are *in existence today* . . . in VINYLITE and BAKELITE resins, and plastics made from them.

BAKELITE resin-bonded plywood, like that from which planes and torpedo boats are made, can be used to make floors, walls, ceilings, and furniture.

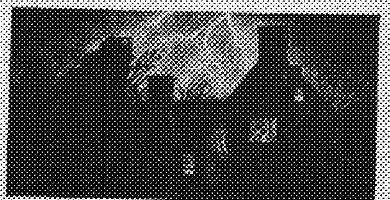
The type of plastic film used in waterproof, chemical-resistant food bags and rifle covers can be fabricated into mildew-proof shower curtains. VINYLITE resins can also be made into rot-resistant floor coverings that can be walked on millions of times *without showing appreciable wear!*

Our engineers know from the record of VINYLITE plastic-coated life raft sails, sleeping bags, and life preservers, that VINYLITE plastics and compounds can be used in the future to bring you wall coverings, window curtains, and furniture finishes that will outlast anything now available.

Under heat and pressure, VINYLITE and BAKELITE plastics can be molded into numberless useful forms. Experience gained in molding war equipment will help to bring you such things as molded plastic furniture which will be lighter, easier to move, easier to keep clean!

Spun plastics made from vinyl resins are resistant to rot. Right now, such plastics are used for making jungle hammock ropes and vital chemical filters. They also can be fashioned into draperies, upholstery, stockings, and other articles of clothing ...sun-proof, water-proof, and moth-proof!

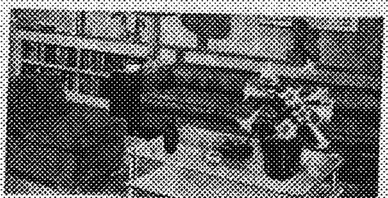
VINYLITE and BAKELITE resins and plastics, and many new techniques for using them, are peacetime research achievements of CARBIDE AND CARBON CHEMICALS CORPORATION and BAKELITE CORPORATION, both Units of UCC. Fabricators converting these raw materials into finished articles are making them mean more and more to you.



GREATER SAFETY! Improved electrical wiring insulation that *will not support flame* can be made from several VINYLITE plastic compounds. Such wiring, now employed in vital circuits of warships, will some day provide greater safety in the home.

MORE BEAUTY! New *washable* water paints based on BAKELITE resins, will bring new beauty to homes. These paints are inexpensive . . . and *easy to apply!*

LESS EXPENSE! Use of BAKELITE molding plastics in making washing machines, refrigerators, and many other household devices and fixtures can mean lower-priced, longer-lasting equipment for you.



LESS WORK! Easier cleaning of plastic-treated walls, ceilings, and floors. Plastic furniture and upholstery that are easier to keep clean. Yours in the future!

BUY UNITED STATES WAR BONDS AND STAMPS

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THE TECHNOLOG, as always, is the Institute of Technology's student publication. However, to really make the magazine serve as an instrument of the students we must have many of you working on the staff of the magazine. The staff at its best represents only a small minority of the student body; therefore, we must hear from you. What types of articles interest you? What kinds of editorials do you prefer? What suggestions do you have for the Institute to better serve the student body?

The TECHNOLOG should also be used by the professional societies and fraternities for creating greater interest in their organizations. This may be done by publicizing your future meetings and reviewing the proceedings of your latest meetings in the magazine. Let's help get the Tech Commission back on its feet. Above all, let's show the rest of the University that although the students of the Institute are few in number, we're on our toes and accomplishing great things.

We would like to extend an invitation to the servicemen on this campus to take an active part on the TECHNOLOG staff. Certainly many of you must have talents valuable to a staff, perhaps some of you have a gist for writing or making cartoons, or then again you might be interested in some other branch of our publication. Do come in and lend us your talents.

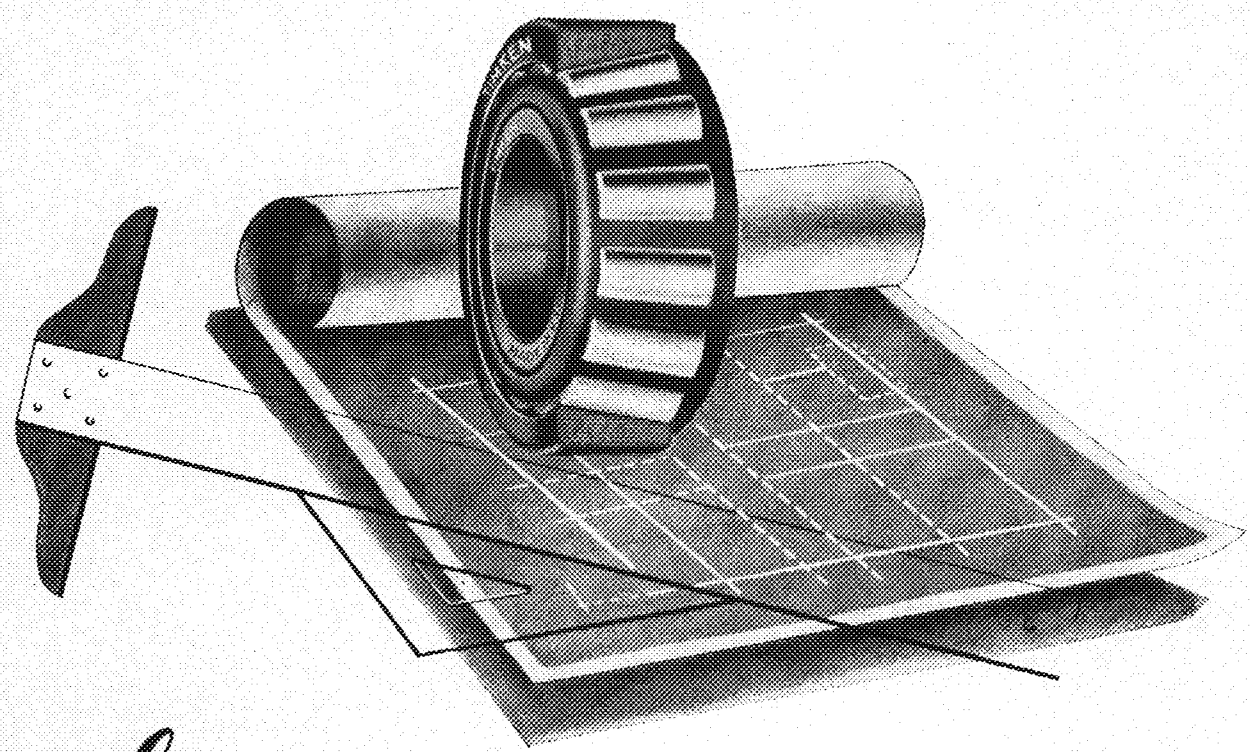
We notice that the *Ski-U-Mah* staff is keeping up its customary high standards and reputation as champion wolves of the campus. They are running up against a distinct disadvantage resulting from the shortage of manpower on the campus, and they are attempting to remedy this situation. To entice unwary beings into the den of the *Ski-U-Mah*, they have resorted to unscrupulous methods. While the engineers are generally known as being tops in this field, they use only fair methods of attack to conquer the unruly. These people are desperate! They find it necessary to resort to bear traps set at the entrance of the office! Although this seems a very brutal method to accomplish such work, we are wondering if it is getting results.

During the Christmas vacation a few members of the staff had a skating party followed by refreshments at the Engdahl residence. That afternoon Dick's younger brother was cracking walnuts for the annual Yule fruit cake. Most of the nuts were splitting into perfect halves, so he glued the shells back together with airplane glue. Upon cracking the walnuts we found empty shells or candy instead of the nuts we had expected.

There is a time in a person's life when one feels that he wants an opportunity to give credit where credit is due. That's the position I'm in now. So, thank you, Bob Giantvalley, for the grand job you did as editor of the TECHNOLOG. Although he worked almost alone many times, he always succeeded in getting out a good magazine. He's helped to get this year's small staff organized and straightened around so that they know what's what. Bob has been sworn into Uncle Sam's Navy, and he is waiting for his call to report. Good luck to you on your Navy career, Bob.

For those of you who might be interested, Flotsam and Jetsam are two words taken from the Knight's Modern Seamanship. Flotsam means floating wreckage or goods while jetsam means goods which sink when thrown overboard at sea. This seems to me to be quite an appropriate title for this column. You can either let the words of wisdom in this column be the goods which float away and are lost, or they can be the kind that sink in, take root, and really get you started someplace.

—E. R. A.



for post-war success

LEARN TO KNOW YOUR BEARINGS NOW

YOU may not get into this war, but there will be another tough struggle awaiting you when Victory has been won and the job of reconstruction begins. You probably will graduate right into the midst of the most severe competitive situation our country ever has known.

Then, as a full-fledged engineer, you will have the responsibility of keeping your company's products ahead of those of competitors by giving them greater speed, precision and endurance; lower operating and maintenance costs.

That's where your specialized knowledge of Timken Bearing design and application will pay dividends; for you will be in position to meet any and every bearing condition with complete protection against friction; radial, thrust and combined loads; and misalignment of moving parts.

Begin to acquire that knowledge now—while there still is time. Timken engineers will be glad to help you. The Timken Roller Bearing Company, Canton, Ohio.

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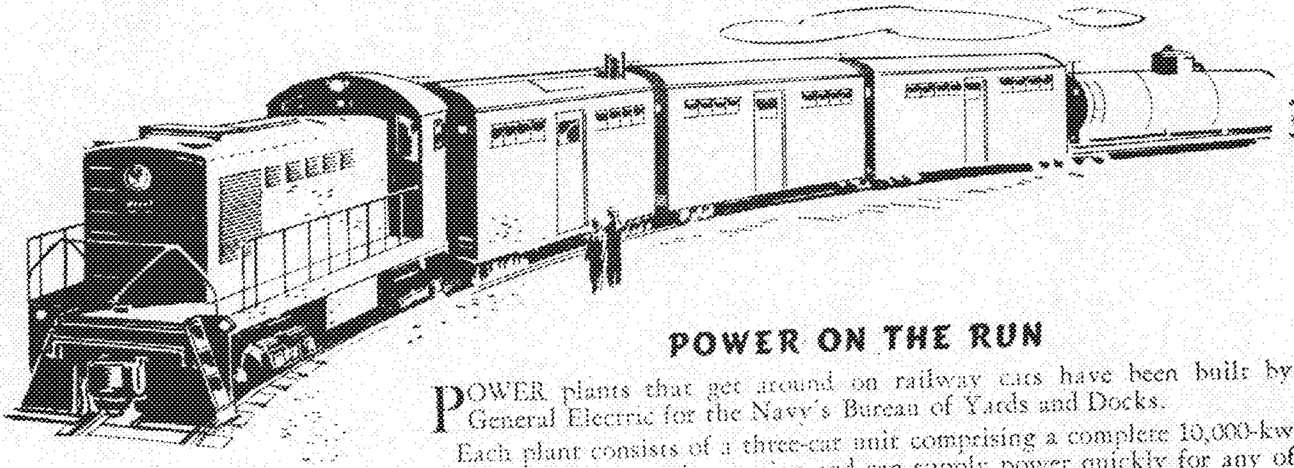
TAPERED ROLLER BEARINGS

Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD



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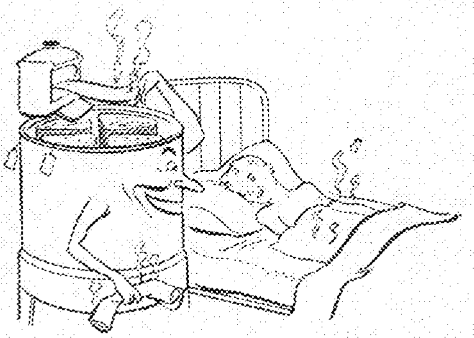
POWER ON THE RUN

POWER plants that get around on railway cars have been built by General Electric for the Navy's Bureau of Yards and Docks.

Each plant consists of a three-car unit comprising a complete 10,000-kw steam-electric generating station and can supply power quickly for any of the Bureau's many projects. Engineers estimate that these power plants can be "put on the line" within 24 hours after they are shunted on to a siding.

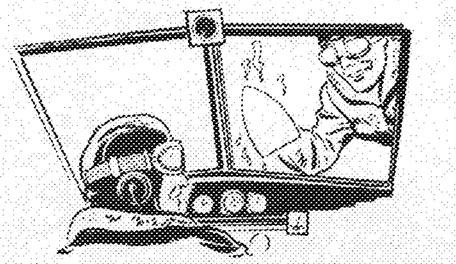
Although the units in themselves are unique, the apparatus involved is of the same type used in regular central station and industrial power plant installations throughout the country.

MACHINE OF MERCY



A HYBRID electric washer and water heater, devised by G-E workers, speeds and improves the Sister Kenny treatment of infantile paralysis. This treatment employs the application of hot damp packs to the patient to relieve pain and reduce muscular spasms, and the washer provides an improved way of heating and wringing the heavy woolen cloths used.

In the bottom of the tub, which does not have an agitator, is a Calrod immersion heating unit that can bring the water to a boiling point, permitting the use of the machine for contagious cases.



TEMP-TURB

A G-E engineer has ironed out the problem of temperature control and windshield defrosting in planes. His solution is an ingenious application of the bimetallic thermosensitive element used in automatic household irons.

This device, called the Temp-Turb, which regulates air temperatures for cabin warming and windshield defrosting, is now being installed in Havoc A-20 bombers.

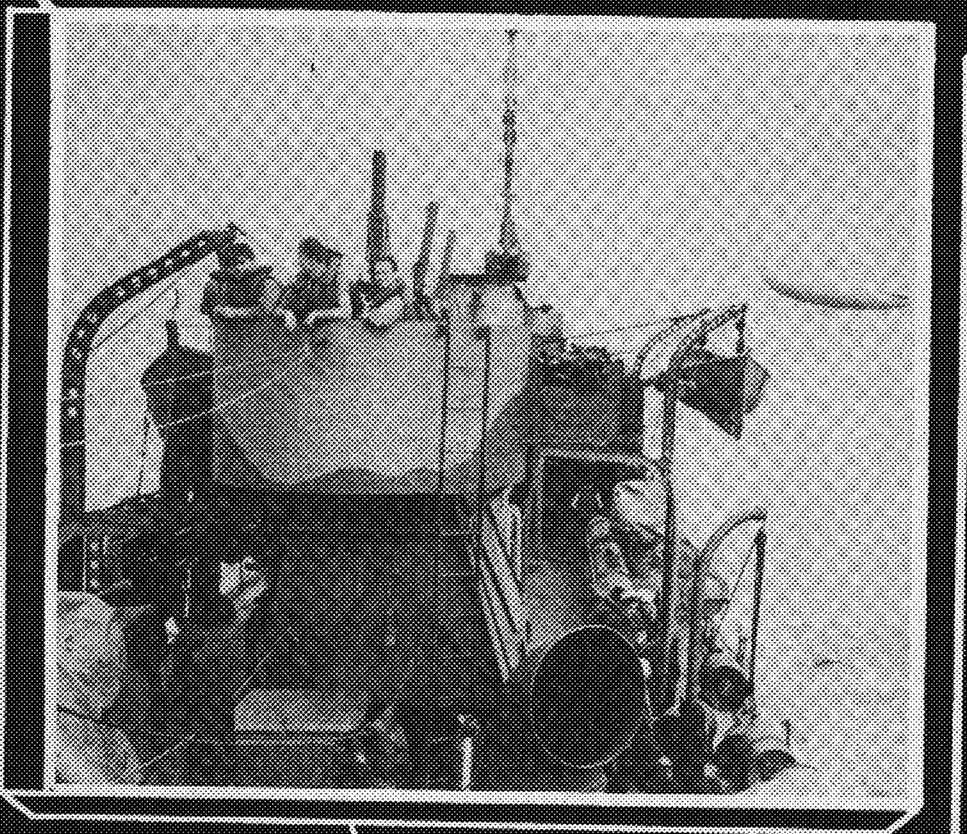
The operation of the Temp-Turb requires no external source of power other than that obtained from the velocity of air flowing through it, on the windmill principle.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.

TECHNOLOG



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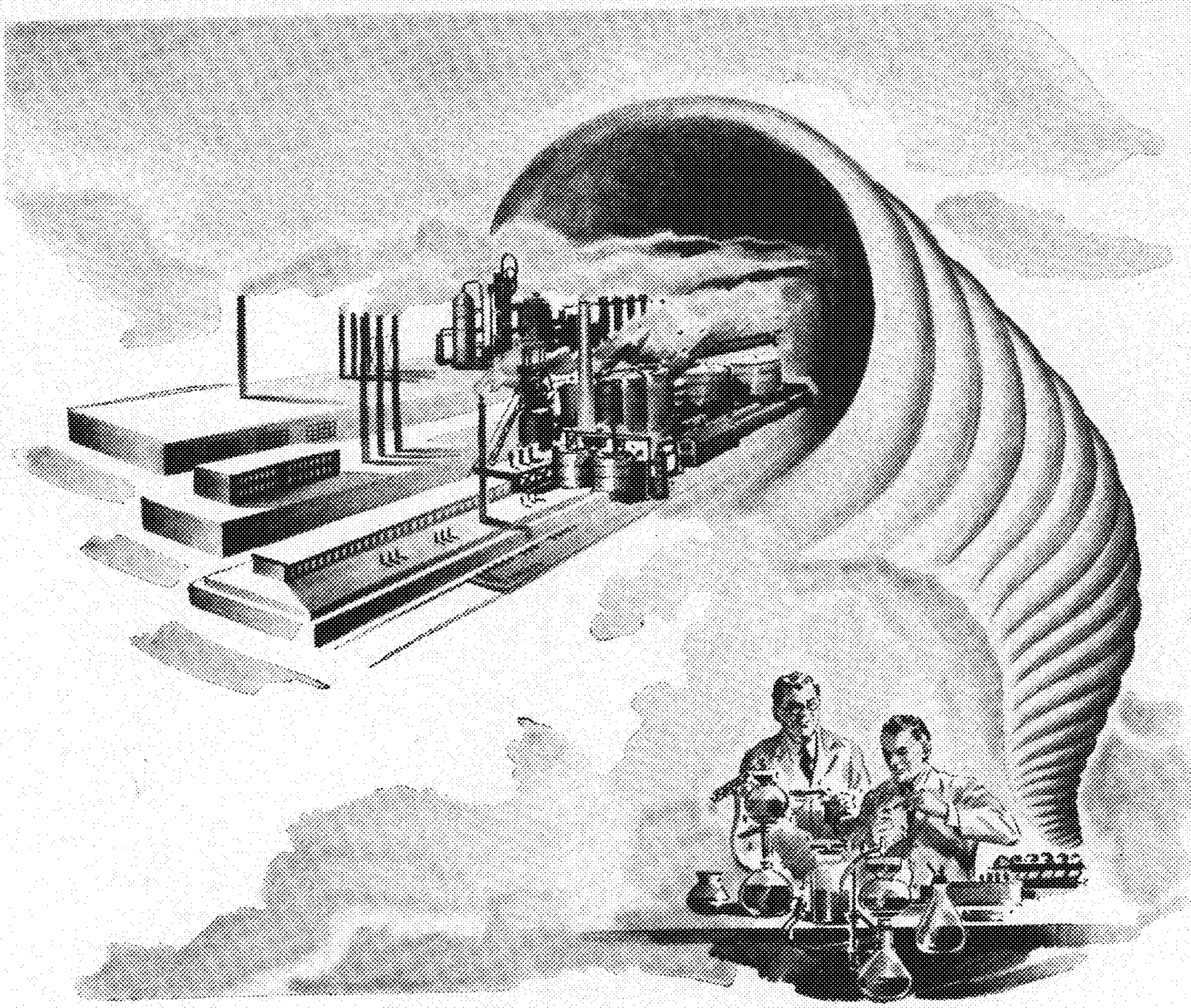
MINNESOTA



this month

BY HELEN HELLAND

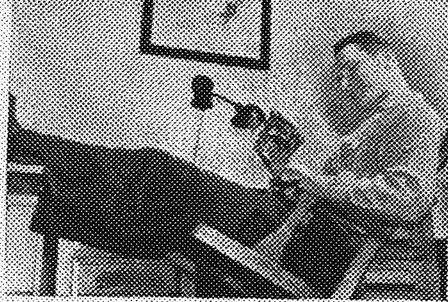
After eighteen years at Minnesota, and nine years as the head of the Institute of Technology, Dean Samuel C. Lind should be well qualified to write about *Your Professional Status*.

Dean Lind graduated from Washington and Lee University and later studied at Massachusetts Institute of Technology, and in Leipzig, Paris and Vienna. He invented the Lind interchangeable electroscope for radium measurements and originated the ionization theory of chemical effects of radium rays.

Back in 1915, a fellow chemist succeeded in interesting Dean Lind in trout fishing and since then it has been his favorite sport. Roughing it in the open and casting a fly for the wary trout are his idea for a perfect vacation. Golf and bowling also interest him. He claims to be no expert, however, and as he terms it, he has trouble with the figure 100, keeping above it in bowling and below it in golf.

Jerry Schwab spent many long hours in research before he discovered the interesting "little known facts about pyramids" he writes about in this month's TECHNOLOG. It seems these hollow triangular structures, in spite of their old age, can tell a lot of humorous stories.

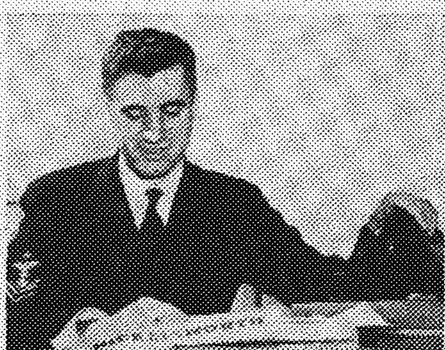
"Babe" graduated from Cretin High in St. Paul, and attended St. Thomas Academy for two years before he came to the "U." He belongs to Theta Tau, is the membership chairman of ASME, and still finds time to work in the power plant laboratory, and to correct engineering reports.



Jerry says he is just a "plain guy" who likes to play at all sports, and loves to sleep. We think that he is modest, but Babe insists that he is a bachelor by women's choice because he likes them all.

An editor and an author both this month is Eugene R. Andrews who has written the story on the amplidyne. Andy is a senior in the NROTC and one of his extra curricular activities is the TECHNOLOG.

Before he was elected editor of the TECHNOLOG, Andy was make-up and managing editor and an amateur photographer on the staff. He is a member of Sigma Alpha Epsilon and Anchor and Chain fraternities.



Andy likes skating, skiing, and especially eating; the last one particularly when he goes on a combination skiing trip and steak fry. One of his favorite places to spend a vacation is on the desert. He acquired the yen for the desert camping while he was attending Riverside Junior College, located in Riverside, California. His favorite hobby was his well-known Model A until a few months ago when he sold it to an unsuspecting staff member. It was said to have been a third cousin to Jack Benny's equally famous Maxwell.

Professor Downs, assistant professor of German at the University, has a fascinating hobby. He collects slang like other people collect stamps or bugs. He discusses the effects he thinks the many new expressions initiated in this war will have on us in *G. I. Jive*.

Mr. Downs suggested his interest in slan may have started in World War I, whe he served overseas in the Army Field A tillery for twelve months.

When he isn't working on his new sla guage or teaching, Professor Downs e joys reading and all spectator sports.

He earned his B.A. and Master Arts at Cornell University. Profes Downs likes his subject and his studen even those who don't take their work seriously. "I'm a teacher because I enj it," said Mr. Downs.

MINNESOTA TECHNOLOG

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The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is twofold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

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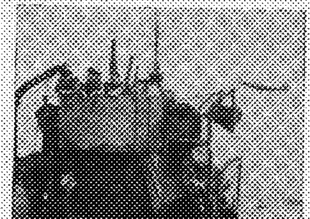
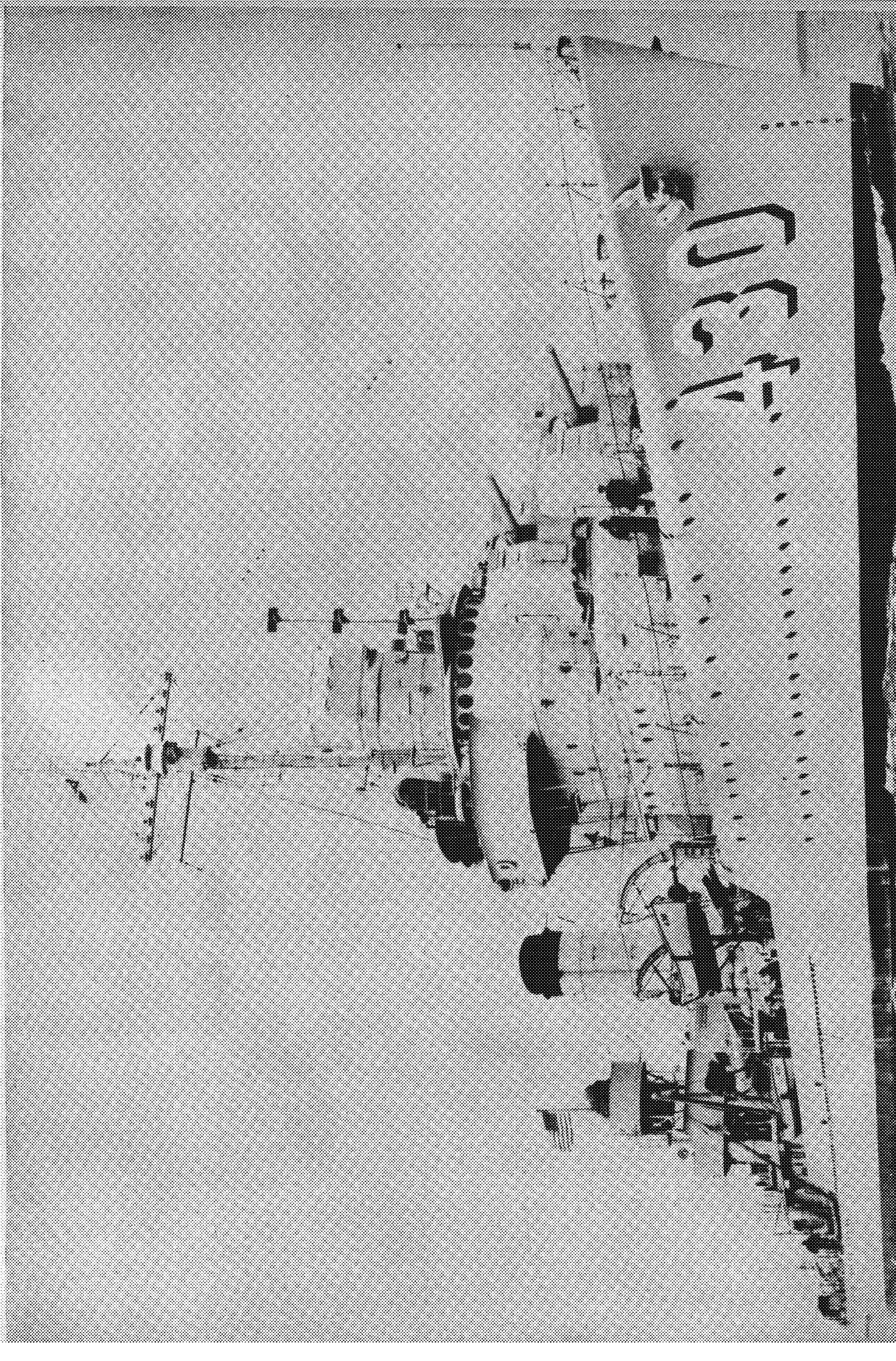


THE COVER. On the masts of fighting ships appear a new kind of light by which signals can be interchanged without risk of interception. (Official U. S. Navy photo. Courtesy of Westinghouse Electric and Mfg. Co.)

FRONTISPIECE. One of the new destroyers equipped with the most modern technical equipment. (Official U. S. Navy photo. Courtesy of General Electric.)



A Future Consideration

YOUR PROFESSIONAL STATUS

BY SAMUEL C. LIND
DEAN OF THE INSTITUTE OF TECHNOLOGY

THIS is an old but always an important question—more so than ever in this present changing world. In the prewar days the average engineer looked forward to employment in his profession, probably by one of the large industrial companies or by a public utility or some government, state, or municipal agency. He thought of becoming, if lucky, an executive or administrator.

But what of the engineer in the postwar world? Will his services be needed? Will there be enough jobs to go around? Will he be able to stay in his profession? Or if not, what will his status be? These are all questions that demand careful consideration by the student approaching graduation or even by the new student choosing his professional field.

I have never worried about the engineering graduate who fails to be employed in his profession. He has had a good education which will stand him in good stead in many other occupations. If he has devoted only four years to his undergraduate work, he goes out on an equal footing with graduates from other colleges in the University and with a training that does not confine him to such a narrow field of specialization as if he had completed a longer course in Medicine, Dentistry, or Law.

Union Affiliations

At the beginning of his career he may be assigned to plant production or development work. In this capacity the young engineer or scientist may be brought into close association with nonprofessional employes or even be put into a postion where he will have to decide whether he will join a labor union. He may even be forced to do so in order to hold his job. On the other hand he may find it to his immediate advantage to join a Union or at least to give it serious consideration.

With the growth of industrial unions the question has become more pressing as to what course a young engineer should plan to follow. The professional engineering societies have generally opposed the forced inclusion of their members into labor unions on the ground that men engaged in a profession do not properly belong in a labor union and should not be compelled or encouraged to join one. In accord with this view, members of certain professions including Medicine, Law, and Dentistry were excluded from the application of the Wages and Hours Act. Accordingly if a member of one of these professions is employed by an industrial company, he is under no obligation to join a union even if his company has a closed shop contract.

The engineering profession, however, and the other applied sciences have not yet been able to define their status in a sufficiently definite way to avoid possible inclusion under the Wages and Hours Act. Consequently the professional societies are now faced with the problem of either trying to get an all-inclusive definition which would bring them the same professional status and exemption from the Wages and Hours Act as the professions of Medicine and Law; or of trying to organize their own unions to operate under the provisions of the Act.

The American Society of Civil Engineers has recently decided on the latter course and offers to become the official "collective bargaining" agency not only for Civil Engineers but also for other members of the engineering profession.

Opposition Arises

There has been some opposition to this procedure both on the grounds of policy and constitutionality under the laws of the Society. It has also been pointed out that it would be preferable to have some agency represent all the engineering professions in matters of professional status affecting all the branches of engineering alike, leaving the separate engineering societies free to devote their funds and energies to the more scientific aspects of their fields, for example, publications, meetings, and such activities.

The National Society of Professional Engineers (N.S.P.E.) is organized for the purpose of promoting and safeguarding professional status and standards in all the branches of engineering. It is well equipped to accomplish those ends effectively. So far as the N.S.P.E. has expressed itself, it appears that it will favor amendment of the Wages and Hours Act to exempt engineers rather than the function of unions for professional engineers. Its affiliate in this state is the Minnesota Association of Professional Engineers.

I have devoted so much space to the subject of affiliation with unions because it is at present a very live issue with which future graduates of engineering are likely to be confronted and to which they may well give some thought. There may be considerable objection to the idea of having to belong to two professional organizations instead of one. But we may as well accustom ourselves to the fact that society is steadily becoming more highly organized to meet the increasingly complicated problems of the modern world. The man who can get along with only two memberships will be lucky.

Postwar Positions

The difficulty which engineering graduates now encounter is not being allowed by Selective Service to enter some branch of war production for which they have been prepared was pointed out in the January issue. The difficulty is becoming greater as the number of graduates become smaller. This anomalous situation makes it hard for engineering graduates to become employed in industry at the present time in spite of the great demand for them. The great reduction in the number of graduates during the war and immediately afterwards will enable engineering graduates returning from the war to find ready employment.

But whether the engineer has taken part in the war in the armed forces or in the production of war materials, or has rendered other essential service, society will need to employ his training and experience where they will be of the greatest use in the postwar period. Problems of reconstruction and rehabilitation will bring him new responsibilities. The engineer will play an even greater role in the postwar world than he has in the past. It is more important than ever that he maintain his professional position on a high plane of public service. He must be prepared not only to serve but to advise and administer. He must have the highest ethical standards. He must be prepared not only to serve but to advise and administer. He must be able not only to plan and construct, but to write and speak in a way that will put his ideas into effective operation.

The value of the engineer to society can not be questioned but he has not yet taken his rightful and well merited place in the world of affairs nor even in the professional realm. It is the new generation of graduates, the postwar engineers, that must bring this about. It is the challenge of the future to every young graduate of engineering or of applied science.

Rush Up the Canvas for

WINTER CONSTRUCTION

BY PAUL M. ANDRESEN

WALTER BUTLER SHIPBUILDERS, INC.

LIKE enormous cigars, their steel hulls wrapped and swaddled in canvas, the two half-finished victory cargo ships rested on their keel blocks beside the ice covered slip at Walter Butler Shipbuilders, Inc. Steam from the scows and cranes in the shipyard rose in great billowing clouds into air that seemed to crackle in the bitter cold of 20 degrees below zero.

Inside the ships' cargo holds, fuel tanks and forepeaks, grimy-faced workers peered at each other through the gathering smoke that came from stoves placed in every room in the vessels. The spatter of smoking welding rods could be heard during the intervals when the chipping guns quieted. Shipfitters' hammers and sledges pounded on steel. In spite of the low temperature, the victory ships were under construction.

All the available canvas in the yard had been gathered. Canvas had been ordered from all over the central midwest, and great bundles of it had arrived at the shipyard in rush deliveries. The ships had been wrapped in it so that it hung down over the steel sides and scaffolding. The open hatches were covered with canvas. The dark interiors of the partially completed cargo holds were lighted by strings of light bulbs that sometimes became dull blobs in the smoke. On the tiers of scaffolding that ringed the vessels like the ruffles on a dress, workmen walked as though through semi-darkened tunnels.

The fire-fighting equipment of the yard stood by, while the stoves, hastily built of scrap iron by the men, were placed at intervals under the vessels, their stacks poking out incongruously through slits in the canvas.

Welding, perhaps the most perfect mechanical process conceived by man, is ordinarily never used in temperatures below zero. A standard rule in the shipyard for the past two winters has been to permit production welding only at temperatures higher than ten above, and tack-welding at zero and above. However, with the use of stoves and canvas, the temperature of the steel in the ships was brought up to and then above the requirements of the U. S. Maritime Commission for production welding.

Through the ingenuity and perseverance of the men, the two vessels were being built in weather so cold that only a few months ago the construction of ships under similar conditions was thought to be impossible.

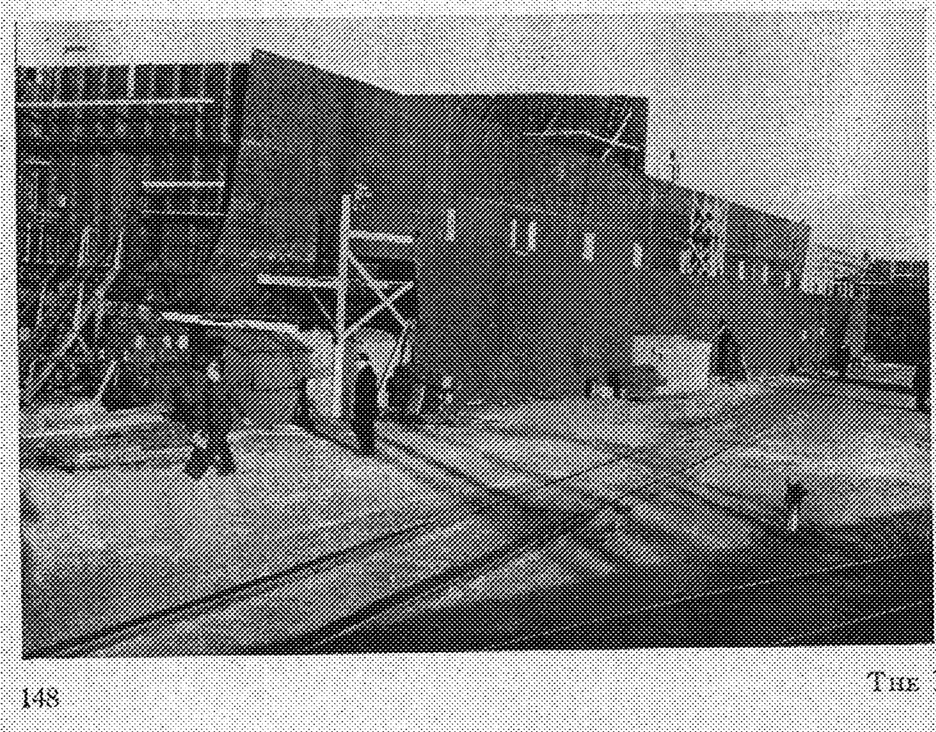
But the cold had brought the flu with it, and where 15 to 18 per cent of the men had previously been home sick, now almost 40 per cent were down with it.

The hull of one of the ships, the SS *Frank Dale*, had been half completed in almost two weeks' time before the advent of the cold weather. Its foremen were aiming at a construction record. With the canvas and stoves and a complete reorganization of the depleted crews, the building of the vessel went on.

Water that was pumped into the inner bottoms to test them for leakage began to freeze and steam was piped in to prevent the forming of ice.

Not only was the hull finished, but it was launched in only 23 working days after its keel had been laid, a record for hull construction on the Great Lakes. It must be remembered that the *Dale* was not a completely prefabricated ship of the type built at the Kaiser yards, but was welded together plate by plate and section by section.

CANVAS IS HUNG over the lower scaffolding on the hull to keep the warmth in and the wind out. By using this canvas covering and stoves, it is possible to maintain a sufficiently high temperature so that welding may be done even in this northern climate.



Launching with Ice

In order to launch the vessel, the ice in the slip was cracked, broken and pushed to one side by the company tug, and when the ship thudded into the slip a great ten-foot wave of water and ice cascaded over the adjoining pier.

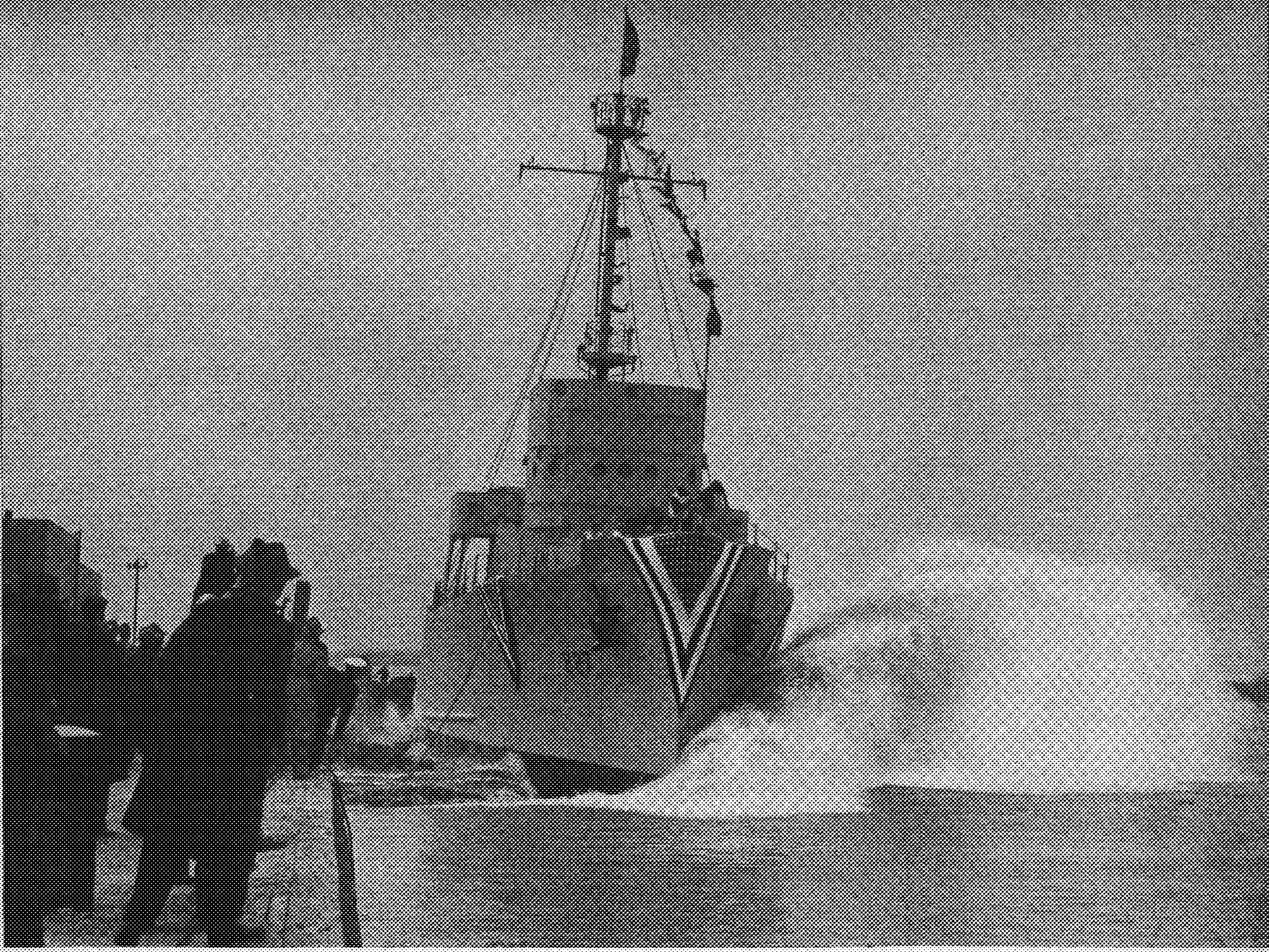
Ed Rogers of the Maritime Commission had this to say, "The *Frank Dale*, built under the most adverse conditions imaginable, is one of the best constructed hulls to come from this yard."

Winter blizzards were taken into consideration in determining launching dates shortly after the shipyard was in production, but in two years of winter construction only three days have been lost because of snow storms. Several hundred men with shovels can clean out seven-foot drifts between open bulkheads in a morning's time.

Ice in the slips has even facilitated the building of vessels in one respect. A scow that rides on top of the ice like a giant sled, its great steel boom placing bulkheads and plates onto the hulls, is employed in the yard and has been found to be more maneuverable than one that floats in the water.

The men who build the victory ships at both the Superior and Riverside yards of Walter Butler Shipbuilders, Inc., have come from factories, farms and stores. The great majority had never seen the inside of a boat until they came to work in the shipyard, but their ability and willingness to learn has given the shipbuilding industry some of the finest craftsmen in the country.

The complete installation of the engine-room floors, catwalks, stairways and rail-



COURTESY OF ALLIS-CHALMERS ELECTRIC REVIEW

ings in the largest ocean-going tankers ever built on the Great Lakes—tankers built at the Riverside yard—took a crew of eight men six weeks on the first ship, three on the second and nine days on each of the remaining five.

Rushing to complete the ships and get them into service before the lakes froze, sometimes sixty to seventy men would work in the engine rooms, installing the hundreds of feet of steel, copper and brass pipes, the engines, boilers, electric motors, wiring, insulation and the many smaller necessary fixtures.

Wearing dark goggles to protect their eyes from the blinding glare of the welders' arcs, the men worked beside one another. With the air hazy from welding smoke, the pipefitters, chippers, shipfitters, burners, spray painters, boiler men, machinists, carpenters, erectors and outfitters worked together as a team. Within three months the seven great tankers passed through the locks at the Soo on their way to ocean ports.

During the last war, ships were built almost entirely by riveting. There was some welding, but it was used more or less experimentally. Today this process has almost reversed itself. In the shipyards at the head of the lakes riveting is rarely used. Welding has taken its place.

Yet, even now welding is not fully understood. No man, whatever his experience, can predict the exact amount of stress and strain that will be locked in two plates after they have been welded together. One set of plates may react one way after welding, while another set of the same size and welded by the same man may react in quite another way.

Welding Process

The butts of two plates that are to be joined together by welding are first beveled either by burning or chipping. An open seam of from one-eighth to three-sixteenths of an inch is usually allowed between the plates before the welder begins. Should the welder start at one end of the seam and work toward the other end, the plates irrespective of their positions on the ship, would have a tendency to pull together at the further end before the welder had gone half way. For this reason a welder will usually lay a series of two to three inch welds from one end of the seam to the other before starting production work. In most cases the shipfitter will have strongbacks, strips of steel from one to five feet in length and three to seven inches thick, tack-welded across the seam at right angles to it in order to hold the plates level and to prevent them from drawing together.

In squaring off a bracket that is to be set upright on a plate, the shipfitter may, if the bracket after being tackwelded leans a little to one side, have his welder tack the other side of the bracket where it is in contact with the plate, until it is drawn upright by the pull of the weld. The pull exerted on steel by the expansion caused by welding will close a large gap in two thin twenty-foot plates when they are welded together.

There is a limit to the number of welders who can be used at one time on one section of a ship. Uncoördinated, they might lock a tremendous strain in the steel that may never be discovered until the vessel later runs into a heavy sea or receives some unforseen shock. As a result the ship might possibly show a crack in any seam or across plates.

An experienced welder can reasonably gauge the pull his weld will exert on the steel, and lines up his work accordingly. An inexperienced man may cause a great deal of trouble. For that reason, every welder employed at Walter Butlers, as well as any yard doing government work, must first pass the American Bureau of Shipping welding test.

In taking the test the prospective welder welds together two small steel plates. His weld is then planed down and scrutinized with minute and painstaking care. The test plate is bent and sometimes drawn apart to determine the number of pounds of pull it may withstand.

Welding pipes together is a job for a first-class man. However, not all first-class welders are able to work on pipes simply because they can't lay a good weld from a difficult position. To pass a pipe-welding test, a man must take an examination under conditions as similar as possible to those he will actually meet on the ships. His weld is inspected in much the same way as it was in his regular test.

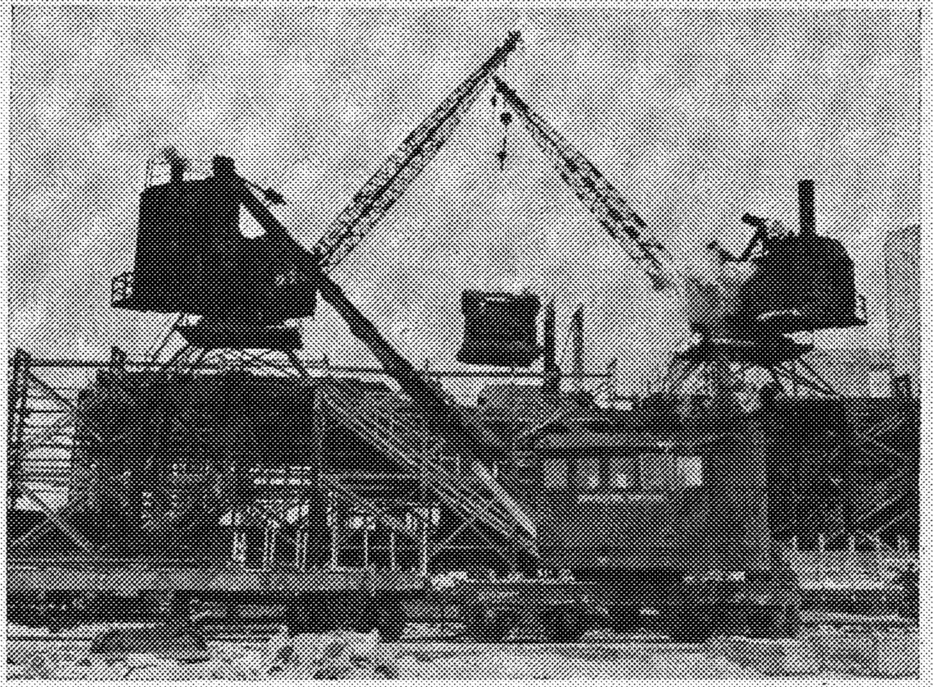
When the Superior yard of Walter Butler Shipbuilders, Inc., was laid out on the bay front on land that was hardly more than a city dump two years ago, Robert Butler, president of the company, investigated the possibility of having ship sections prefabricated in factories near the shipyard, factories that might, because of war priorities, otherwise be out of business. Planning ahead, he arranged with a snowplow manufacturer in Wausau, Wisconsin, a tombstone maker in Cold Springs, Minnesota, and other firms in large and small towns to handle the bulk of the prefabricated parts.

Brought to the shipyard on flatcars, the steel sections are arranged, sorted, lifted by cranes and fastened in their places on the hulls, cutting the time of the actual construction of the vessels by many thousands of man hours, and also freeing badly needed space in the yard for other kinds of work.

In laying the keel blocks for a hull, thirty-foot pilings are driven straight into the ground the entire length of the ship. Across the tops of these pilings are laid the timbers on which the keel blocks rest. These blocks are of spruce, yellow pine or western fir, according to the selections made by the shipwright. As the ship grows, more timber and pilings are needed for shoring up the sides, and where the heaviest weight is called for, wooden cribwork is built around it.

The shipwright continually checks the keel blocks for level, and whenever sagging is found, wooden wedges are used to raise the blocks, or the blocks themselves are built in such a manner that they can be adjusted to take care of the sag usually caused by the change of seasons.

The prefabricated inner bottom sections are usually laid directly on top of the keel blocks, and to these the prefabricated ship sides are attached. These inner bottoms are first placed amidship and then toward the fore and aft end of the vessel in order to evenly distribute the weight of the hull on the ways. Center bulkheads and shell plates are put in place as soon as the inner bottoms are set and welded. The entire hull is built from the center toward either end, with the fore and aft sections the last to be installed.



PHOTOS COURTESY OF WALTER BUTLER SHIPBUILDERS INC.

THESE GIANT CRANES in the Superior yard are lifting up a boiler for one of the cargo ships. Such cranes are able to move to nearly all parts of the yard and are used to transport parts to the destinations where they will be used in ship construction.

THE PREFABRICATED INNER BOTTOM SECTION is laid directly on top of the keel blocks, and to this the prefabricated ship parts are attached. The keel blocks are usually spruce or yellow pine and as the ship grows more timber and pilings are added.

Scaffolding Attached

Ordinarily the deck and shell plates are laid out with several inches of salvage on their lapping ends so that it may be burned off to make a good fit. As the ship grows, scaffolding goes up around it, both inside and out, and a good deal of shoring is used inside the vessel to adjust and hold the plates and bulkheads in their proper positions. At the Superior yard scaffolding is built in tiers around the vessels, while in the Riverside yard in Duluth the scaffolding is attached directly to the hulls.

In the construction of a ship the girders, strongbeams, brackets, stringers and pillars must fit to within a small fraction of an inch. If one plate or section is even slightly out of line, the bulkheads or sections on top or adjoining it will also be out of line, with the result that the ship itself may be imperfect.

For that reason, the shipfitters, the men who build the vessels, should have a fine working knowledge of the complete construction of the ship. Usually the ship-

(Continued on Page 165)

Are You Hep To

G. I. JIVE

BY LYNWOOD G. DOWNS
ASS'T PROFESSOR OF GERMAN

GILBERT CHESTERTON asserts that "the one stream of poetry which is constantly flowing is slang." War appears to accelerate the rate of flow and to stir up more muddy sediment from the bottom. How will this affect the language of tomorrow?

The linguistic purist might object to the term "poetry" as applied to army slang, just as the unknown creators of military jargon would scornfully reject the title of "poet." Be that as it may, the extensive use of a particular vocabulary among fighting men has a justification of its own as a builder of morale. The speakers of a common slanguage have a feeling of belonging together, of comradeship, which is a necessary ingredient of morale. Then too, for the front-line fighter slang offers a "safety-valve for pent-up emotions." In the recent issue of a local newspaper, a Yank in Italy is quoted as follows: "We aren't afraid of those German hand grenades. We call them hen eggs. That makes them seem less dangerous." Isn't this reason enough for the soldier's use of G.I. vocabulary?

Soon, we hope, ten million servicemen and women will be returning to civilian life, bringing with them their slanguage. What will be the result when our respectable English speech feels the impact of this more or less disreputable lingo? It is often difficult for the different generations to understand one another, even when they use the same words. Will the old of the World War I generation be unable to understand the speech of the youth engaged in World War II and the gap become even greater? For a satisfactory answer to these questions, it will be helpful to turn to the past and investigate the influence of war slang upon the standard language of yesterday.

Roman Slang

During every period, words have risen or fallen in public esteem. When the ancient Roman soldier called his horse *caballus* "a nag" instead of the standard *equis* "horse," he may well have been using army slang. From this colloquial form we have received, through the medium of the Romance languages, such delightful words as *cavalier* and *chivalry*, not to speak of *cavalry*. In addition to his pay, the Roman Legionnaire was allowed money for the purchase of salt, *salarium*. This was a technical army word rather than slang, but it has passed from the barracks to the counting-house. Today, if we earn our salt, we receive a salary. Of the official army terms, which may have developed similarly, the following are examples: *cannon* from *canna*, "a reed or pipe," *torpedo* "a fish" and *grenade* "a pomegranate."

In the Middle Ages, a catapult, ancestor of the present-day cannon, was given the nickname *Domina Gunilda* "Lady Gunhilda" (was she the gunner's sweetheart?), from which some scholars derive the word "gun." The nickname applied to the Flying Fortresses of today are in the line of an old tradition, but it seems doubtful whether any of them, even in the censored form, will contribute a new word to our language. In passing, it may be of interest to mention a few noted cannon of the past. In the American Revolution, we find the "Old Sow" of Ticonderoga, later removed to Boston. To quote a contemporary diary: "Oct. 4, 1775 the old Sow with Shells, etc., arrived from Ticonderoga. On the 6th the old Sow is Placed on the Bumb Battery and in the Evening Seven Shells were flung from her on the Forts." Apparently the name did not appeal to the "brass hats," for General Putnam personally christened her the "Congress." The results were disastrous. To quote another diary: "Our people Splet the Congress the Third Time that they fired it." Other cannon were: "Whistling Dick" at the siege of Vicksburg, "Long Tom" of Manassas, "Big Bertha" of World War I, and "Tobruk Tom" of North African fame.

Origin of Slang

The story of "grog" offers an example of a nickname—this time of Navy origin—rising to a position of respectability. Since Admiral Vernon of the British Navy liked to wear a cloak of grogram (a coarse cloth, today called grosgrain), his sailors called him affectionately "Old Grog." In August, 1740, the Admiral ordered the raw spirits, which were issued to the men, to be diluted with water. This mixture the tars named, probably not so affectionately, after their admiral. In a Revolutionary diary, we read, "Josiah Kory was groggy this day and put under guard."

The word "tar" still has the dictionary rating of "colloquial," but that is at least one step away from slang and toward the linguistic peerage. The sailor's cap and other articles of clothing were made of tarpaulin, a canvas material impregnated with tar to make it waterproof. Since soldiers and sailors are frequently named for their battle dress (cf. *Red Coats* in the Revolution, *Bluecoats* and *Grayjackets* in the Civil War), it was natural to call the sailors *tarpaulins*. That is too long a word for men in a hurry and "tars" they became. Today this word seems to be passing from the linguistic scene without ever having acquired high social standing.

In 1778, General Washington ordered the Commissaries "to issue the head and pluck" of beef to his men. Here we find the old meaning of "pluck," the parts of the animal that are plucked out, the heart, lights and liver. The modern significance developed from slang, perhaps Army parlance, possibly pugilistic phraseology, as the Oxford Dictionary suggests. From whatever lingo it came, the word now occupies an honorable place in every dictionary. Its present slang counterpart, which the sports writers euphemistically call "intestinal fortitude," was once dignified enough to be employed in Sir Philip Sidney's translation of the Psalms (1580).

Accepted Standard English

Let us turn to World War I. A study of the dictionary after 1918 reveals among others the following entries which were not found before 1914. The first group of words bears no label and may be accepted as standard English.

Ace—Borrowed from French, where it designated an aviator who had brought down five enemy planes behind the French lines; Now *H.P.* (In the Civil War, *H.P.* meant "high private," that is, *Pfc.*)

Anzac—Formed by a journalist from the initials of Australian and New Zealand Army Corps. It was so overworked that the Australians preferred to be called "Aussies."

Billet—Where the soldiers were quartered in France, sometimes a barn or a pigsty. In the Civil War the soldiers said: "Every bullet has its billet."

Camouflage—From French thieves' cant, meaning "to disguise." It had already become respectable in French before it was borrowed into English.

Dugout—Is good English. *Funk Hole* is listed as slang, while *fox-hole* does not appear at all. The Civil War soldier said "gopher hole."

(*Continued on Page 162*)

What Have We Missed from
THOSE EGYPTIAN ENGINEERS

BY JEROME J. SCHWAB, M.E. '44

MOST of you have heard of the Seven Wonders of the World and everyone has heard of the pyramids in Egypt which are just one of these amazing feats. Because of the many unexplained facts surrounding the construction of the pyramids and because of their massive size, they are considered to be one of the unsolved problems of our day by the engineer and the archeologist.

The study of these tombs has brought to light more than just the problem of how they were constructed. It is not possible to conceive how the early men managed to quarry and pile the tons of masonry which went into these huge forms. If the size of the pyramids were the only problem left unsolved, it would not be so difficult. Instead, they have left us with the problem of how Pi (Π) was used when it was supposedly an unknown, how the Zodiac, the North 30 parallel and other things had such intimate relationships with the pyramids. Looking over this list of significant facts related to the pyramids, one wonders how they overlooked tying it to Einstein's theory or relativity or finding the lucky number in the Irish Sweepstakes by pyramid mathematics. At any rate, there is much more to the pyramids than their size to make a modern engineer stop and think twice.

No Records Kept

There are no recorded facts left concerning the pyramids. Evidently these ancients did not believe in statisticians, and, if they had, it would probably have required the building of more pyramids to provide wall space for all the space it would have taken for their hieroglyphics. They have therefore simplified matters and left us with just the records of their accomplishments. If the Egyptian had been aware that we would want records, he would no doubt have constructed pyramids for the hieroglyphics as time and labor meant nothing to him. Probably the one reason that so much work was done, was that the workmen were not rushed; they were allowed to work slowly and finally the work reached completion. According to tradition 100,000 men were employed 30 years in quarring the stone and building the Great Pyramid. The blocks used in the lower courses are four feet ten inches high and some are 30 feet in length. Each block is said to weigh over 50 tons and the entire edifice is estimated to contain over 143,000,000 cubic feet of masonry spanning a ground space of over twelve acres.

One of the most startling facts about the construction of the Great Pyramid of Gizeh is that it is constructed on a rock that is beveled to a curve with a rise of eight inches. This is the exact curvature of the earth. When we consider that it took Columbus in 1492 to prove that the world was round, we wonder why the ancients used this curve and where they secured their information. The mathematically curious have found that the base lacks but six-tenths of an inch of being a perfect square and it lacks but 12 seconds of a degree of being a perfect rectangle.

The mammoth bricks were piled in terrace-formed courses and today two hundred and three of these courses remain. The stones were put together with such exactness that to this day a person is able to run a knife blade over the surface without finding the joint. The workers then filled in the terraced steps with a mixture of small stones and mortar. Today this outer casing has been scraped away and we see the outer surface as a stairway formed out of the huge rocks.

To the student of history of mathematics, the pyramids offers a study almost unlimited in imagination and scope of ingenuity of its builders. The appearance of Pi (Π) in pyramid measurements is unexplainable because according to history, it was not until 1300 B. C. that it was given a definite value. Regardless, the length of twice the pyramid's base is to the height as a circle is to its diameter, that is, twice the base divided by the height of the pyramid is Pi. Could these ancient engineers have known the secret which caused so much concern to the early mathematicians. Again we must blame this deficiency of knowledge to the lack of written records because it was the Greeks who first recorded it. Until it had been proved that the ratio of the circumference of any circle to its radius is independent of the radius, or that (Euclid, XII, 2) the areas of any two circles are to one another as the square of their diameters, there was no Pi to be taken. Here is further proof of the Egyptians' knowledge. The sum of the length and height of the so-called King's chamber of the Great Pyramid when divided by the width gives the result which equals Pi.

For a people who once achieved such magnificent art, it must be admitted that the Egyptian efforts toward geometry are, for the most part, trivial and disappointing. Had the forgotten Egyptian responsible for the above remarkable achievements proved his methods he would certainly rank high among the great creators of mathematics. One of the most remarkable results gained in pre-Greek geometry was discovered or guessed at by the Egyptian mathematicians in whose minds existed these great pyramids. He gave a numerical example of the correct formula $\frac{1}{3}h\ (a^2 + ab + b^2)$ for the volume of the frustrum of a truncated square pyramid, "h" being altitude and "a" and "b" the sides of top and bottom bases. To prove this formula, the theory of limits or integral calculus must be employed. To prove the formula for a truncated pyramid we might proceed by inscribing and circumscribing stairways whose steps are rectangular prisms with square bases, and it is conceivable that the Egyptians inferred his rule from the easily calculated approximations given by stairways with a few steps. The earlier pyramids were of this type. The Great Pyramid itself presented just such an appearance before the final smooth sheathing of dressed stone was applied. But regardless of how the Egyptian reached his rule, his intuition gave him the correct result that is provable only by integral calculus in some guise. If it was a lucky guess, he was so good at guessing that he did not need mathematics. Several of the greater mathematicians have emphasized intuition in mathematics as a necessary spark without which there is no discovery. No one can deny that the Egyptian had this spark.

Also Knew Astronomy

The astronomer looks to the pyramid as an astronomical observatory. The Egyptian did not overlook our stargazing friends when they designed the pyramids. They left him just as many unexplainable "coincidences" as the geometrician. If we consider the standard unit of measure of the pyramid to be the pyramid inch, and twenty-five of these inches equalling the "cubit" we find a new field to tease our superiority complexes or our highly advanced civilized education. The base of each side measured in cubits is just 365.242242 which is the number of days in our solar year. This figure is exact to the second, and the reading in minute and second is 365 days, 5 hours, 48 minutes and 49.7 seconds. Our present year, 1944, is one of the quadannual years to take into account the fraction of the days in a year making it necessary to add an extra day every four years.

The causes of the regular change of conditions known as the seasons are the passage of the earth around the sun and the inclination of the earth's axis to the plane of the orbit. In the season known as spring, the sun's rays fall perpendicularly upon the equator, day and night are equal all over the world, and the event known as the vernal equinox, March 21, occurs. In

(Continued on Page 166)

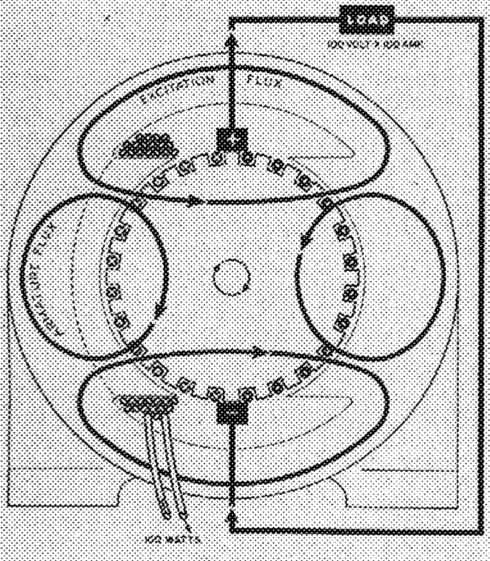
Amplidyne Makes Use of

THE EDUCATED SHORT-CIRCUIT

BY EUGENE R. ANDREWS

ONE of the most annoying trouble makers encountered in engineering practice, the short circuit, has recently been put to work. The device, known as the amplidyne, which incorporates its use, is quite simple in principle and in structure. It has literally stepped up thousands of military and industrial applications, ranging from the mining of basic raw materials to the manufacturing, maneuvering, and firing of the weapons of war.

The amplidyne is an externally driven generator, outwardly similar to the conventional motor or generator. However, its ingenious and unique use of a short circuit and compensating winding creates such precise electrical balance that a signal as weak as half a watt will instantly release power capable of controlling the most powerful electrical machine.



COURTESY OF AERO DIGEST

Figure I

In explaining how the amplidyne works, let us first consider Figure I which is a two-pole, ten-kilowatt, direct current generator driven at a constant speed. For the sake of simplicity, the armature is shown serving also as commutator and a single exciting field coil is shown on the north pole. The small circles with dots show conductors where the current is directed toward the reader and the small circles with arrow tails show conductors where the current is directed away from the reader.

In flowing through the rotating armature conductors, the load current creates a stationary armature flux because the armature conductors on the left of the brush axis always carry current in the same direction and the armature conductors on the right of the brush axis always carry current in the opposite direction. The combined effect is the same as that of a stationary solenoid directed along the brush axis, producing flux as shown in the left and right flux loops. This armature flux is of about the same magnitude as the excitation flux but does no useful work.

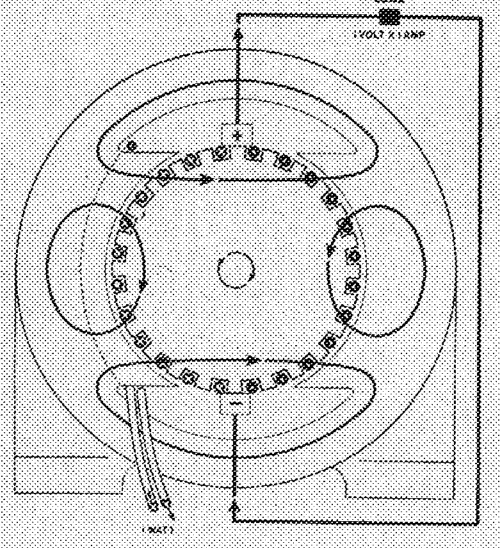


Figure II

With a smaller field coil, and with excitation power reduced from one hundred watts to one watt, the same conventional generator appears in Figure II. The new reduced excitation power creates only one per cent of the original excitation flux. Voltage at the brushes is reduced from one hundred volts to one volt, and the load current, also reduced from one hundred amperes to one ampere, produces only one per cent of the former armature flux.

A short circuit across the brushes, as shown in Figure III, restores the armature current and, consequently, the armature flux to their full original values. This is because the internal resistance of the armature winding is assumed to be 1/100 of the load-circuit resistance. The load has been disconnected. Excitation power and flux continue to be extremely small, but they now control the full-sized armature flux.

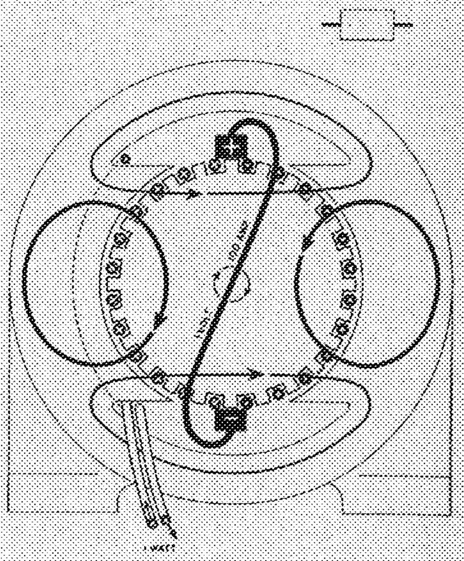


Figure III

To put the short circuit to work two new brushes are added, as shown in Figure IV, one in the center of each armature flux, just as the conventional brushes are located in the center of the excitation flux. Assuming that these new brushes are not connected to any load and only the voltage between them is measured, the armature flux produces full voltage, one hundred volts, between the new brushes. Connecting these new brushes to the same load, one brush directly and the other through a compensating field shown on the south pole, then the full current, one hundred amperes, circulates through the load. In the same armature conductors, the new load current adds to and subtracts from the short-circuit current. This is shown by the four different combinations of "dots" and "tails" seen on the armature conductors.

However, the new load current in the armature conductors cannot set up its own armature flux which would be directed from right to left, because any tendency in this direction is neutralized by a compensating field of equal and opposite strength. The output of ten thousand watts is released by an excitation power of one watt.

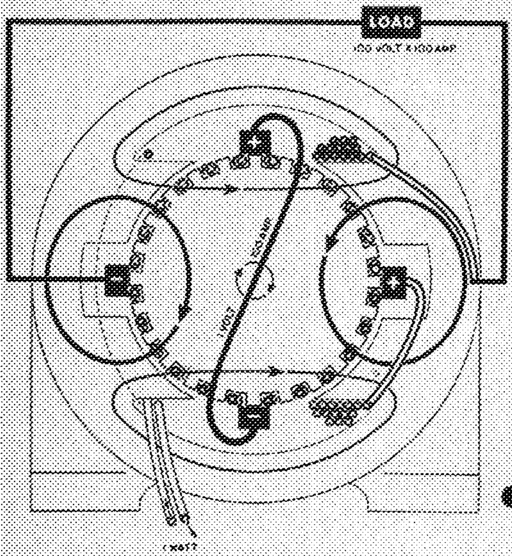


Figure IV

Assuming that the excitation current is suddenly doubled (an increase from one watt to four watts), Figure V shows that instantly the short-circuit current doubles, producing double output voltage (two hundred volts) and forcing double current (two hundred amperes) through the load. Thus, by merely raising the control input by three watts, output is raised from ten to forty kilowatts. To obtain comparable changes in output in response to minute changes of excitation with conventional generators would require two generators where a small control signal would excite

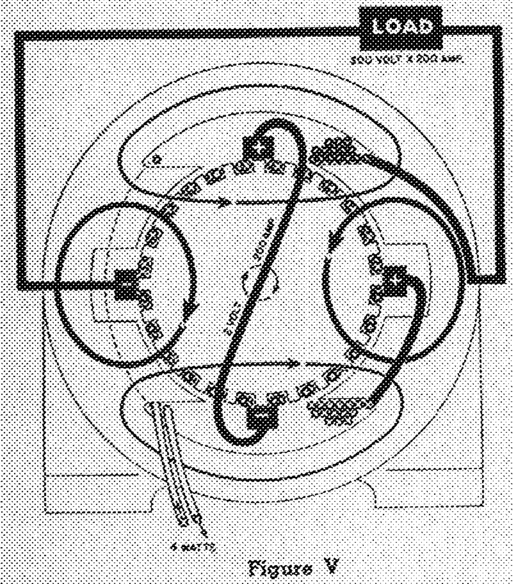


Figure V

the first one and the output of the first would excite the second. The output of this second generator would considerably amplify the small control signal to the first one but with a cumulated delay in response.

The symbol shown in Figure VI represents the amplidyne as two full-sized generators "compressed into one." The minute control field and the short-circuited circle are identified with the first stage. The compensating field and the other circle connected to the load are identified with the second stage. Thus the amplidyne is shown as a two-stage amplifier responding to a single control field.

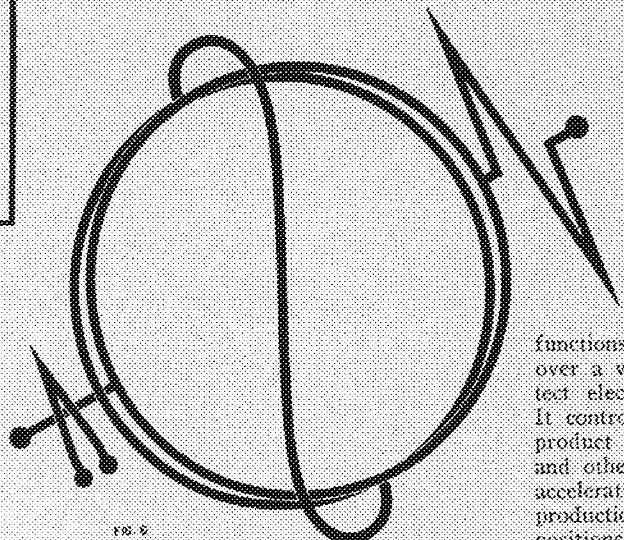


Figure VI

In the amplidyne, the equivalent of a full-size exciter, utilizing the armature structure and conductors, is available to excite the output generator for fastest response. The speed of response is further accelerated because the output flux is produced by the armature structure so that even the flux which leaks through the air produces useful voltage. An entirely new combination of amplification and speed is provided with two stages of amplification faster than any single stage could be, delivering 10,000 to 0 amplification and reaching full output in one-tenth of a second.

About one hundred watts of excitation power supplied to the field coil creates the excitation flux. This flux produces a full-load voltage of one hundred volts, which circulates one hundred amperes full-load current through the load, taken as a resistance of one ohm.

Closed Control Systems

The qualities of the amplidyne make it an ideal agent to use in the so-called "closed cycle" control systems. A function of the performance characteristic of the controlled device in a closed cycle operation—for example a voltage proportional to the speed of a motor—is impressed upon the controlling device compared with a standard also expressed in the same function—in this case also a standard reference voltage. The controlling device acts on the difference between these functions (voltage) to minimize any deviation of the performance characteristic from the ideal.

In addition to the proper expression of the controlled and reference characteristics into the same function, there are two other important factors for a closed cycle control system. One is that the voltage difference representing the deviation be amplified to a sufficient magnitude so that it may be used to produce the correction in the controlled process. The second factor is stability, for hunting or oscillations of the controlled process must be minimized. Instability is brought about by the existence of long time delays between correcting signals and the appearance of the desired effects in the process. When controlling large machines whose high electrical or mechanical inertias cause inherently long-time delays, the over-all lag can only be minimized by keeping the time delay in all other portions of the system, including especially the amplifier, at a very low value.

The amplidyne, a natural partner of electronic devices, is proving its versatility by performing a wide variety of functions. It controls speed accurately over a wide range. It limits loads to protect electrical and mechanical equipment. It controls torque and tension to improve product uniformity in winding, drawing, and other similar operations. It speeds up acceleration and deceleration to increase production of high-inertia machines. It positions machine-tools and arc furnace electrodes, simply and precisely. It regulates current, voltage and power.

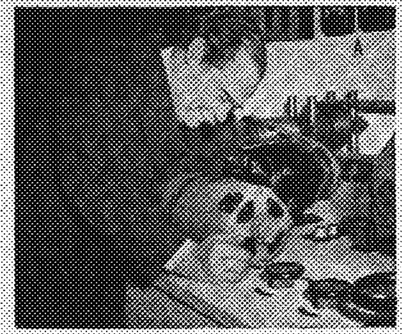
Amplidyne War Assignments

A typical amplidyne war assignment is the controlling of guns in aircraft turrets. Although one man could not by himself, without extreme difficulty, maneuver guns against the strong wind resistance encountered by a plane flying four hundred miles an hour, with the amplidyne he controls fire power as easily in the air as he would a machine gun battery on land, and with the same ease as he would a rifle on a target range.

Already the amplidyne is in operation on fire-control equipment aboard ships, on anti-aircraft guns and on searchlights both ashore and at sea. The device provides accurate control and quick response over a wide range, and because of its simple construction is not particularly vulnerable to bomb impact and flying splinters from shells. Simplicity of operation also is an important factor in installations aboard planes flying at high altitudes, where atmospheric conditions frequently impair the operation of certain types of equipment.

A very important application of the amplidyne is on the new Curtiss automatic engine speed synchronizer for multi-motored aircraft. An amplidyne, whose speed is controllable by the pilot, operates a series of three-phase motors, each of which is synchronized with a three-phase generator driven by one of the engines. A phase difference will apply correcting action to the pitch of the propellers so that all engines are operating at the same speed as the amplidyne. Engine speed is thus automatically adjusted by merely changing the speed of the amplidyne.

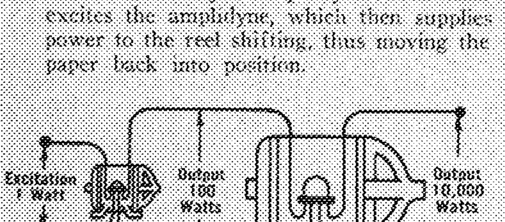
One of the commonest uses of the amplidyne is its application to the current control. In the process it holds current in a motor or generator circuit within close limits, and remains unaffected by speed, voltage, and load changes. The advantages derived from its use in this manner are of



AMPLIDYNES, such as that which Dr. E. F. W. Alexanderson is working with, can produce amplification factors of approximately 10,000 to 1.

major importance for machinery can be operated for long periods at maximum efficiency with no danger of overload or mechanical failure, constant tension can be held in a constant process, and maximum acceleration and deceleration rates can be obtained. In particular, the use of the amplidyne with a reel motor is typical. By using two amplidynes in the circuit, the motor can be operated over a wide speed range with constant current and tension assured. Precise control is maintained by using the reel motor current to excite one amplidyne, which then excites the second, and this in turn, through a "buck-boost" connection, supplies the motor field.

The amplidyne was instrumental in solving the problem of accurate positioning in motion—the positioning of any material running through a machine—for instance, alignment of a moving roll of paper in a papermill. With the use of a side-register control, the amplidyne can hold an accuracy of 0.01 inch in controlling the position of the edge of the paper, and it can move the paper through the entire width of this positioning zone in one-hundredth of a second or less, while maintaining smooth, stable operation. This is accomplished with the aid of a photoelectric cell, set to watch the position of the edge of the paper. Reflected light striking the cell is converted into an electric signal which is amplified in an electronic amplifier and passed into the amplidyne control field. The signal from the control field is compared to a reference field and any discrepancy between fields excites the amplidyne, which then supplies power to the reel shifting, thus moving the paper back into position.



IT IS PRACTICAL and economical to use the amplidyne as an exciter, not as a power supply for a motor when great quantities of motor power are needed.

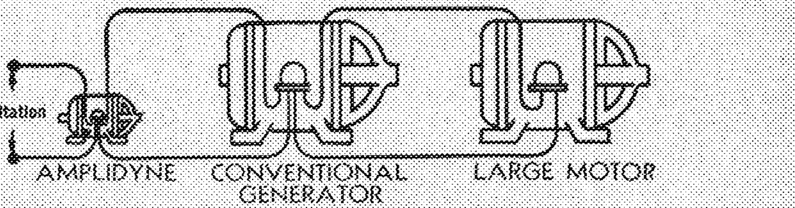
Another application of the amplidyne is that of power control for positioning objects at rest. The amplidyne can be used to regulate power wherever electrical characteristics are adjusted by mechanical means, such as in an electric-arc furnace. Used as an arc furnace control, the amplidyne maintains uniform heat, automatically adjusts individual electrodes, and provides power for smooth positioning, whether up or down. In this case the amplidyne is used on an a-c circuit as a generator to supply power to the electrodes' positioning motors to move electrodes in the proper direction.

The amplidyne has helped to double the cold-rolled steel-plate production of the country in the short space of one year. It enabled hot strip mills, formerly used for rolling thin sheets for automobile bodies, to be pressed into service as plate rolling mills and thus breaking the bottleneck in the armor and ship plating. With amplidyne control, motors which were formerly driving continuously running tables delivering strip steel to the coilers, were converted to the intermittent starting and stopping of the rolling operation. This control has meant operation at peak motor capacity, using maximum rates of acceleration and deceleration, utilizing available motors at their peak capacity, and insuring maximum tonnage production.

Amplidyne control has introduced faster, more accurate operation in strip mills where flying shears crop the steel strips speeds of two thousand feet per minute. Speed regulation and coördination between the several mill stand motors and the shears, through the sensitive yet powerful controlling action of amplidynes, has meant highest production efficiency and output with no sacrifice of quality. Both high and low mill speeds are held accurately to a few per cent of the limit.

Amplidynes have been applied extensively to machine tools, positioning the cutting heads on a boring mill, for example, to an accuracy of .002 inches per ten foot travel. Maximum acceleration is provided on the return strokes of reciprocating machinery; on one installation in a saw mill carriage, the total round trip time for a thirty-foot travel was cut to four and a half seconds.

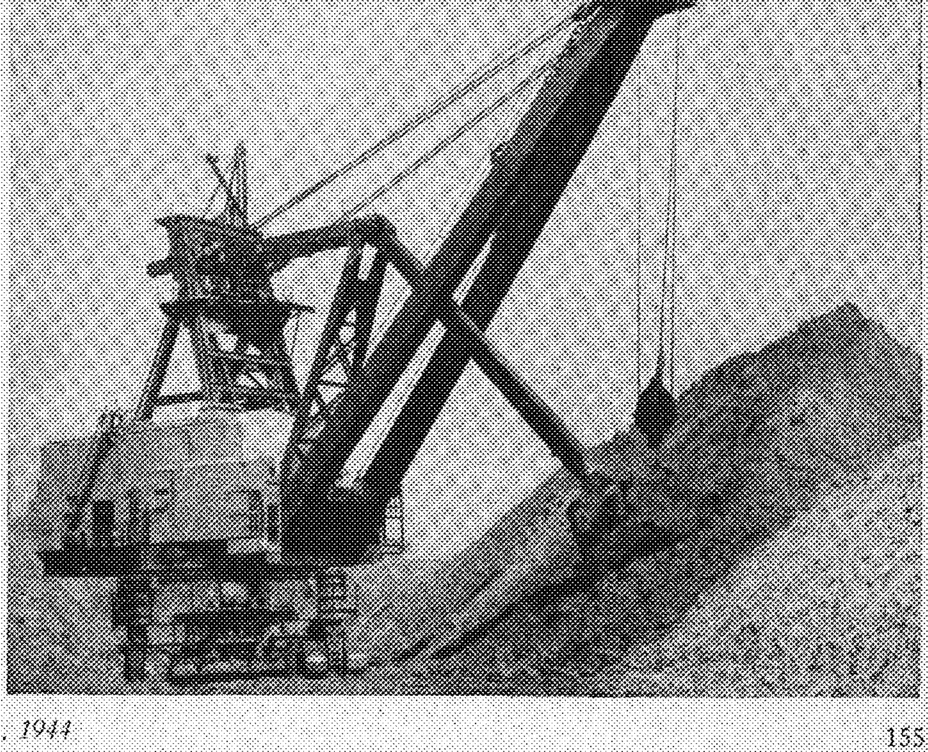
Wherever the amplidyne is used, this new, well-behaved, cooperative short circuit is increasing production, efficiency, and accuracy, as well as improving quality and conserving manpower and materials. Its role in the postwar industry will be even greater.

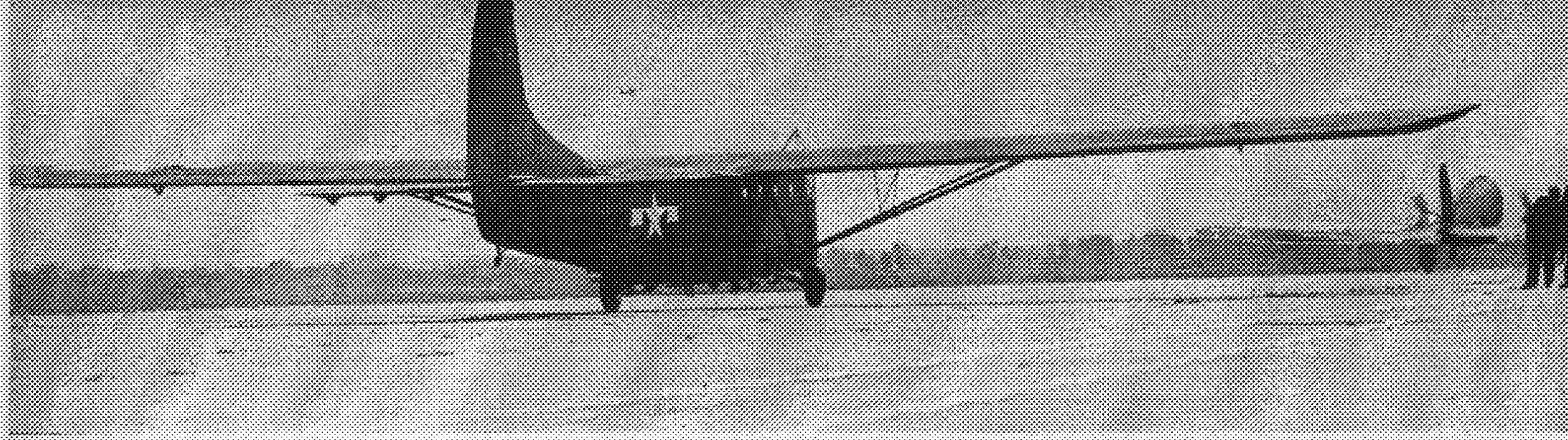


THE AMPLIDYNE GENERATOR has great possibilities because it is often desirable to produce changes in the operation of a power drive. These changes are governed automatically by changes which occur while the work is performed.

PRECISION CONTROL of this mammoth shovel is possible through the amazing amplidyne. With a flick of the wrist the operator scoops a carload full of gravel from this open pit mine. By using this generator the operation takes only 50 seconds time.

PHOTOS COURTESY OF GENERAL ELECTRIC





Paratroopers Carried By

GLIDERS FOR INVASION

FANNY S. BRYAN
NORTHWESTERN AERONAUTICAL CORPORATION

This is the third in a series of articles in which the TECHNOLOG is presenting some of Minnesota's Industries at War. The purpose of these articles shall be to familiarize the University students with Minnesota concerns and the work that is being accomplished in our state.

TRANSPORT planes filled with paratroopers and towing gliders laden with fully equipped airborne infantry flew over the coasts of Sicily one night last summer as the vanguard of the invasion. Presently the night sky bloomed with parachutes and the released gliders descended silently to their designated landing places, well behind the enemy's coastal defenses. It was the first Allied attempt at this new type of aerial warfare.

Some of the troop carrying gliders which made history that night were made at the Minneapolis Airport plant of the Northwestern Aeronautical Corporation. Beginning in 1942 as a prime contractor to the Army Air Force, Northwestern Aeronautical completed its first contract, ahead of schedule, on July 23, 1943. The contract covered the manufacture of CG-4A, transport gliders for the Army Air Force.

In general the CG-4A is an externally braced high wing monoplane of wood, steel tube and fabric covered construction. It has a wing spread of 84 feet and an over-all length of 48 feet. It is not at all like the small fragile sail planes that were once called gliders. The CG-4A can be towed by an airplane at better than 120 miles per hour or can glide at 38 miles an hour without stalling. One of its important features in its extreme maneuverability. It is equipped with many of the complicated devices found on the modern high speed airplane with, of course, the exception of the motor.

The CG-4A carries 15 fully armed and equipped men, or the equivalent in cargo. The cargo may be a jeep, a small tractor or truck, or a 75 mm. Howitzer and carriage, each with its crew of several men. The nose of the glider is lifted to permit loading and unloading.

The ratio of this glider's forward progress due to loss of altitude varies from 6-1 to 30-1 with wind direction, weight, and other variables. This means that even at the minimum ratio, a glider towed to an altitude of 25,000 feet could fly more than 25 miles into enemy territory without its presence being discovered by sound detectors.

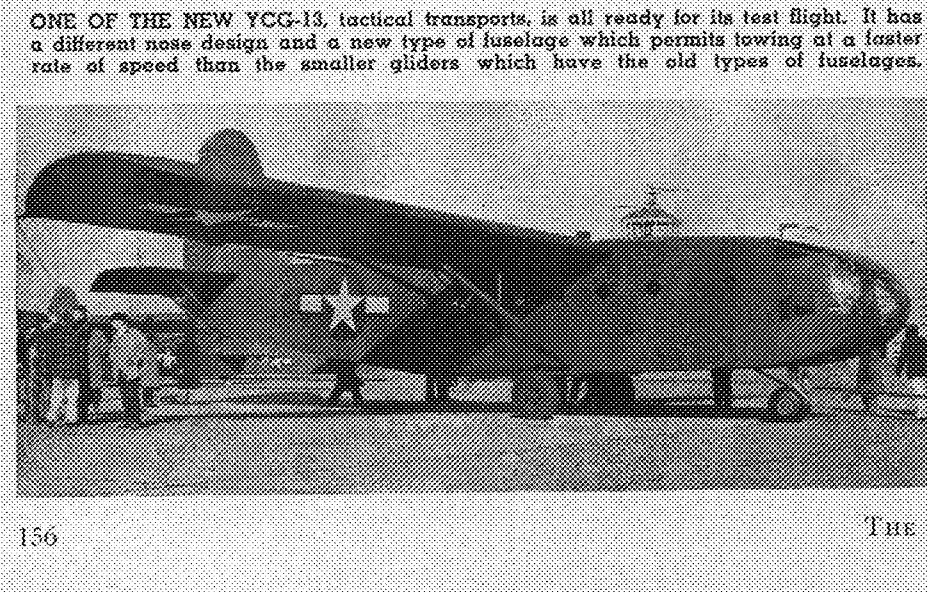
Two sub-contractors in the Twin Cities, the De Ponti Aviation Company in Minneapolis and the Villaume Box and Lumber Company in St. Paul, provide the steel tube frames and the wings, floors and other wooden parts of the CG-4A which are then assembled at NAC's Airport plant. Hundreds of vendors throughout the country supply the thousands of small parts that go into the assembled glider. Each of these small parts, as well as the other materials receives rigid inspection as it enters the plant, and each step in the manufacturing procedure is inspected as the sections are assembled. Finally the completed ship is checked. Thus, each part is examined individually in relation with the other parts and finally it is checked for its relation to the whole to assure the ultimate safety of the glider.

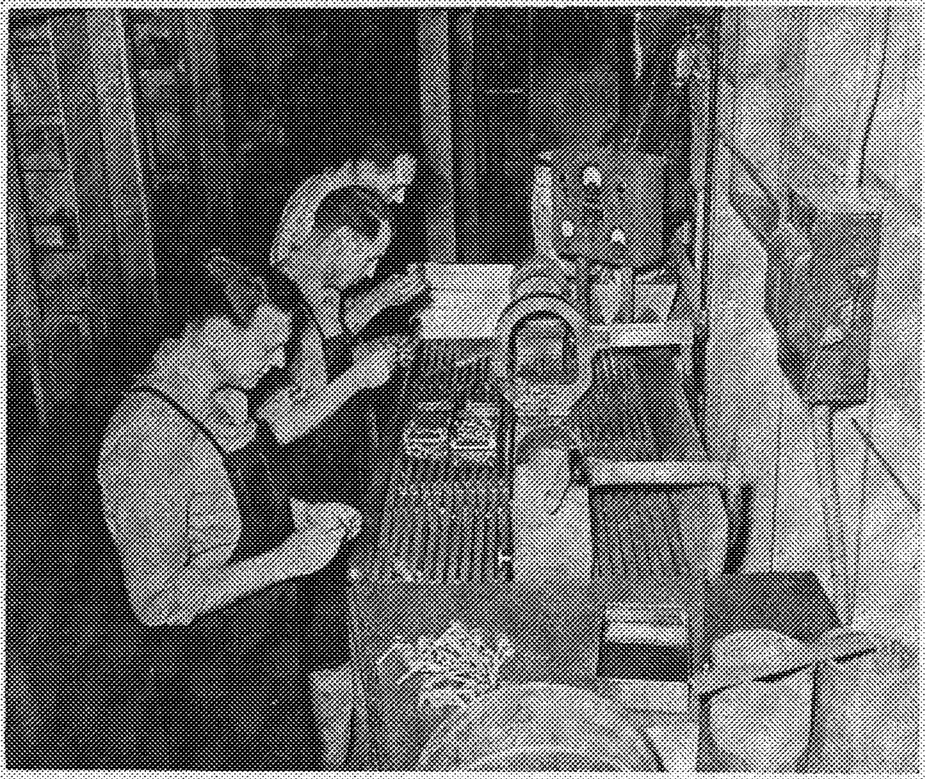
When the company started operations the completed gliders were taken down and crated for delivery to the various Troop Carrier Command bases throughout the country. That is still the principal method of transporting the gliders to the battle fronts, but for many months now all the CG-4As assembled at NAC have been flown to their destinations.

Troop Carrier Command transport planes are flown to the Minneapolis Airport bringing glider pilots and co-pilots. The gliders, with their ballast of sandbags, are lined up on the edge of the field, the pilots take their places at the controls, and a fast-moving crew stretches the towropes alongside the runway and brings the first glider up to the starting point. The tow plane is taxied into position and the tow line attached. The glider begins to leave the ground at a relatively low speed and they are on their way. Within a matter of seconds another pair is made ready for the takeoff. When the planes take double tows, as is frequently done, the procedure is carried out just as easily.

Recently Northwestern Aeronautical also began production of a new and larger motorless tactical transport known as the

ONE OF THE NEW YCG-13, tactical transports, is all ready for its test flight. It has a different nose design and a new type of fuselage which permits towing at a faster rate of speed than the smaller gliders which have the old types of fuselages.





THE MAGNIFLUX MACHINE is used to test some of the small metal parts which are used in assembling a glider. Each part is checked during every step in the construction and when the glider is completed, it is tested to insure its ultimate safety.

YCG-13. This ship was designed by the Waco Company on the same general principals of construction as the CG-4A. In this ship the load capacity has been more than doubled. The fuselage has been streamlined in order that the ship can be towed at a faster rate of speed than the smaller one. Other changes and improvements include: a different nose design which provides additional view for the pilots; hydraulic operation of the wing flaps and the mechanism for opening the nose of the plane; a tricycle landing gear and an aerial delivery rack.

Hundreds of tools and jigs were designed and made at the plant before production was started on the new type gliders late in September. The first one was completed and given a successful test flight at the Minneapolis Airport on December 1. It was not only the first YCG-13 to be completed by NAC but the first to come off an assembly line anywhere in the United States. The maneuverability of the giant YCG-13 was spectacularly demonstrated in Minneapolis just recently. While another of these gliders was being tested at the Airport it was unpremeditatedly released before attaining any great altitude and the pilot was forced to make an emergency landing. The big ship was brought down successfully on a small fenced-in field some distance from the airport.

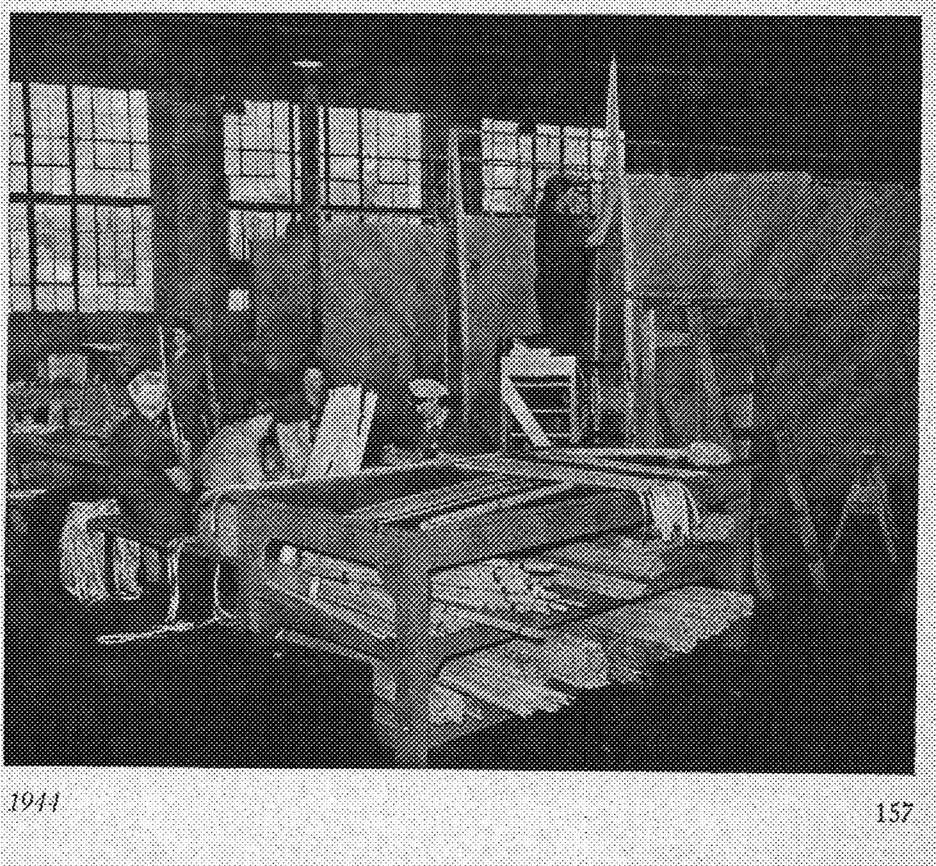
The expanded operations resulting from the contract for the new YCG-13 made it necessary for the company to enlarge its facilities. In the new plant the wings and floors for the large gliders are made. The assembled sections and the wings are then transported to the Airport to be assembled for test flying and delivery to the AAF.

As production was increased there was a demand for more trained workers. This problem was solved by in-plant training, training within industry classes and courses offered by the local vocational schools in welding, woodworking, etc. Women now make up approximately 40 per cent of the personnel and they are found working in almost all departments; cutting and sewing fabric, taping and sizing the fabric on wings and fuselage sections, making small parts, woodworking, rigging and assembling, welding, machining and tooling, drafting in the engineering department and inspecting.

The glider program is constantly developing as the Troop Carrier Command gains in size and importance and as new uses for gliders in war and peace are opened up. Recently, the Army held the largest air-borne maneuvers ever attempted in this country. A full wing of the Troop Carrier Command employing several hundred transport planes and gliders lifted a reinforced division of air-borne infantry, 10,000 men, with their hundreds of tons of equipment and deposited them successfully on pinpoint targets of strategic "enemy territory." This part of the maneuver took place at night and the landing fields were small patches of land that had been previously designated. Although the country was "blacked-out" for 50 miles around, 85 per cent of the gliders landed on the designated fields. A "highly successful" performance according to the officers who were present.

Some time ago a CG-4A loaded with cargo was towed across the Atlantic in a successful test of the use of such craft in the transportation of freight by air. And in May of 1943, Col. Fred Dent, then head of the glider program at Wright Field, put to test another development. Using two light motors, which could be installed and removed in a matter of minutes, attached to the wing struts of one of the CG-4As, he proved that these gliders were capable of getting off the ground and landing under their own power. This experiment has opened up untold possibilities for use of gliders now and after the war.

WOMEN ARE EMPLOYED in almost all departments such as woodworking, machining, and drafting departments. Here they are shown working on some of the hundreds of small wooden pieces which will go into the construction of the glider's plywood wings.



AS WE SEE IT

Science and Religion

This is not the first time that the relation of science to religion has been spoken of. Many people are losing the benefit of religious uplift simply because of the antagonism engendered by many of the teachings of the formal religious groups. Here the purpose will be to try to show the importance of religion in a philosophy of living, rather than to attempt to advocate any type of religion.

It is well to remember that engineering is not an end in itself, and whatever is your devotion to your profession, you are not living to become engineers, but rather you are learning engineering to enjoy a more satisfactory and useful existence. Then again, engineers may tend to belittle culture and ignore the fact that it really fits the individual for living in the broadest sense. Culture provides a background of knowledge and social experience which serves as a bulwark against uncertainty and surprise—two vital elements in the creation of fear which is the greatest curse of the ignorant and uncultured.

Unfortunately the multiplying triumphs of science have created a belief in some minds that there is no limit to its development and possible achievements. There are two possible points where science is definitely limited. Perhaps it is not necessary to remind you that science is organized knowledge, individual facts are classified and their relationships generalized into laws. These general laws may appear sufficient, but upon investigation there will still remain impassible barriers which separate us from the unknown. For example, "What is energy?" When we mentally expand the progress of science to its final possibility, we find that ultimate causes are beyond its scope and are limited by the limitations of our finite minds.

The second field is in the realm of higher human emotions. When we consider human experience, we find emotional reactions are subjective and complex, and they do not even admit measurement. Consider the difficulty of measuring an emotional state of pity which is accompanied by fear, disgust, hope or admiration and I think you will agree that it is impossible. If you limit your observations to the ideal element, pity, difficulties are multiplied. Even though science may have such limitations, does this necessitate a need for religion?

Religion will be defined here as the spiritual reaction of the individual to his environment; it is embodiment of ideals which afford the highest spiritual satisfaction to the individual and hence vary according to his spiritual experience and capacity. It is the response of the individual to the fundamental harmony of the universe. Thus defined there can be no conflict between the two as one is spiritual idealism and the other is organized knowledge on sense perception.

True, spiritual needs differ, just as physical needs differ, so must spiritual satisfaction. For some of you who have satisfaction in teachings of an established church there is no problem, but for others who have not, perhaps further search may bring success. To the rest, established religions exist which have proved of the greatest benefit to the social welfare of the greatest number of people. Nevertheless, there are certain sociological verities which are common to nearly all modern religions and it would be well to observe them closely before you ignore the accumulated spiritual experience of mankind.

Faith of the Engineer

The following pledge was taken by the Engineers' Council for Professional Development at its annual meeting October 23, 1943, on the recommendation of the ECPD committee on principles of engineering ethics.

I am an engineer. In my profession I take deep pride, but without vain glory; to it I owe solemn obligations that I am eager to fulfill.

As an engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity.

When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies.

Jealous of the high repute of my calling, I will strive to protect the interests and the good name of any engineer that I know to be deserving; but I will not shirk, should duty dictate, from disclosing the truth regarding anyone that, by unscrupulous act, has shown himself unworthy of the profession.

Since the Age of Stone, human progress has been conditioned by the genius of my professional forebears. By them have been rendered usable to mankind Nature's vast resources of material and energy. By them have been vitalized and turned to practical account the principles of science and the revelations of technology. Except for this heritage of accumulated experience, my efforts would be feeble. I dedicate myself to the dissemination of engineering knowledge, and, especially, to the instruction of younger members of my profession in all its arts and traditions.

To my fellows I pledge, in the same full measure I ask of them, integrity and fair dealing, tolerance and respect, and devotion to the standard and the dignity of our profession; with the consciousness, always, that our special expertness carries with it the obligation to serve the public and humanity with complete sincerity.

Swimming Pools a
ALLIS-CHALMERS EQUIPMENT HELPS F
By building equipment that helps turn out U. S. subs—Allis-Chalmers work
1600 Allis-Chalmers Products Work for Victory —Mining Metal for Subs and Planes —Turning Wheels in Factories — Pumping Water to Our Big Cities!
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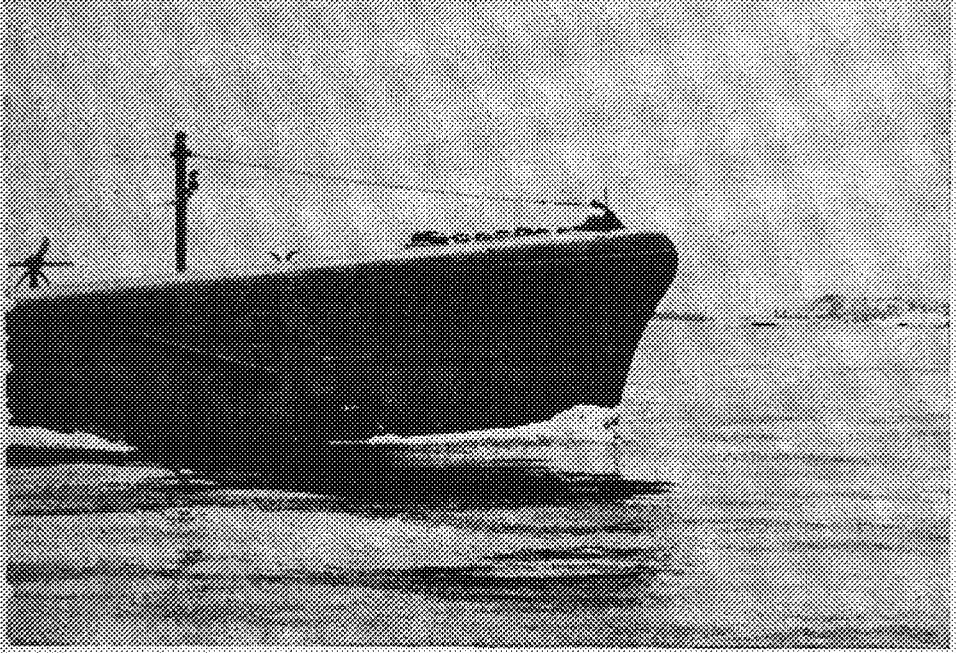
NE—BUILD THE OTHER!



lping to sink the Rising Sun!

WE'RE WORKING for "THAT MAN" (Soldier talk for Uncle Sam) today! More than 1600 war and war-industry products are pouring out of our plants... machines that help make everything from subs and planes to soldiers' shoes.

Allis-Chalmers equipment is also helping to pump water to our cities...to produce 8 out of 10 U.S. loaves of bread...to do hundreds of jobs which are vital to the health and morale of the Nation.

And Allis-Chalmers engineers in the field are helping manufacturers *produce more*, not just with new machines—but with machines now on hand!

Every one of the thousands of Allis-Chalmers men and women is working *all out* for Victory—and every one is gaining production experience which will be invaluable to the Nation in the Peacetime rebuilding program which must follow!

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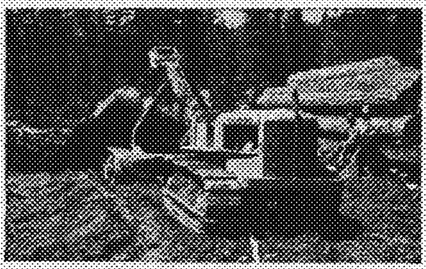
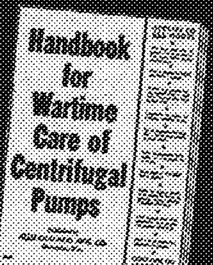


Allis-Chalmers is the largest supplier of sawmill equipment in the world!

A-C equipment puts rivers to work—supplying power for the war effort!

VICTORY NEWS

Converted Carriers Aid Navy! Official Navy Photos reveal that merchant vessels are rapidly being converted into auxiliary-aircraft escort ships to protect convoys from subs and bombers. On some ships already converted a great variety of A-C equipment has been installed—including main propulsion turbines, auxiliary generating sets, condensers, centrifugal pumps, motors and control.



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FREE! Write for your copy of this centrifugal pump maintenance guide! Jam-packed with *practical* suggestions—new ideas you *need* today! This valuable new book belongs in *your* technical library!

New "Electro-Cooler"! Vitally needed increases in power transformer capacities can now be obtained quickly with a new system of forced-oil cooling that saves 25% in critical war materials on new transformers.

This new Allis-Chalmers cooling unit, called the "Electro-Cooler," will step up capacity of transformers already in service by about 20 to 60%.

This new unit makes the forced-oil system of cooling transformers highly practical because it is built compact, factory-assembled and factory-tested at high pressure to minimize the possibility of future maintenance. If transformer has radiator valves, the unit can be removed without draining transformer oil and parts can be replaced without delay in transformer operation.

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G. I. Jive

(*Continued from Page 151*)

No man's land—But not what the Canadians meant when they applied the name to Canada after they had all gone overseas.

Slacker—Always with us. The British called him *Cuthbert.*

Strafe—From the German slogan *Gott strafe England,* "God punish England." When the Zeppelins dropped bombs on London, they were *strafing.*

As colloquial are listed:

Buddy—What's the modern equivalent? *Mac* or *G.I., John* or *dogface* or?

Bunk—But bunk *fatigue* and "What's the bunk?" are still slang.

Hun—This word has improved its rating, but note *Fritz, Jerry* and *Heinie* below.

Among the disreputable creatures still branded as slang we find:

Archibald—The British called the anti-aircraft guns and shells "Archies."

Boche—The French name for a hated enemy.

Cootie—A ticklish subject.

Dud—A shell that didn't explode. Much older as an appellation for persons.

Fritz—What the Tommy called his enemy in the early part of the war. Later it became "Jerry," still very common, but labeled "Soldier's Slang" it is "Heinie."

Pup tent—In the Civil War the soldiers first called the new kind of tent "dog tent," but this soon changed to "pup tent." Despite the long history, the word is still in the linguistic dog-house; but then, the same dictionary says: to "major" in mathematics is cant!

Sammy—The journalists tried to foist this name of the AEF but without success. On March 28, 1918, the *Stars and Stripes* wrote: "It is a name he did not invent, does not like, never uses and will not recognize. When he sees it in the papers from home, it makes him sick." Fortunately the dictionary says "obsolescent."

In the preceding, examples have been given of slang words which have moved up in the social scale, some only to the humble status of "colloquial," others into technical Army terminology, and still others to positions of dignity and distinction. It must be emphasized, however, that the number of words, which in the past have achieved success, is small in comparison to the many to be found in any slang dictionary. The overwhelming majority are still linguistic outcasts. After this look at the past, we turn to the future. Reluctantly the historian assumes the role of prophet and ventures the following predictions.

G. I. Vocabulary Increased

First, most of the G.I. language of today will be continued as slang in the army of tomorrow. Army lingo is conservative. A great majority of the World War I terms are still used by the soldier of today. True enough, there has been a great increase in the size of the G.I. vocabulary, but the new words are not coined to replace but to supplement the old, because of the intensified specialization of the new army. Let us examine some words with a long life behind them.

A recent song describes the activity of the doughboys as "We march, we march, we march." The Grose dictionary (1785) calls him a foot-wabler (i.e. wobbler); in the American Revolution we read of "foot-padding"; in World War I, the infantry man was a foot-slugger, gravel-grinder, mud-crusher; terms from this war are "blister-foot, gravel-agitator, stone-crusher," all variations of the same theme. Another military operation is the acquisition of objects not one's own. Partridge records as occurring before 1830: "bone, make, nab, nail, pinch scrounge, snaffle, win." Private Hargrove uses "snafle" in his recent best-seller. In the Civil War, the "bummers" said: "flank, acquire, borrow, clean out, confiscate, convey, find, forage," usually placing the word in quotation marks. From World War I comes this rhyme:

Soldiers never stoop to theft,
Nor to borrow when bereft;
So there's only one way left—
That's salvage.

Strangely enough, the familiar "doughboy" was not used in the

(*Continued on Page 164*)

G. I. Jive

(Continued from Page 162)

Civil War. It is first recorded in a letter, written in 1867 by General Custer. As a cavalryman, he was emphatically "not a doughboy." The "cannon fever" of the American Revolution seems to have been the "shell shock" of World War I. Here are a few more words from the Civil War: "frog-eater" (Frenchman), "God's country" (back home), "gunboats" (G.I. shoes), "Holy Joe" (chaplain), "sow belly" (salt pork).

A Vigorous and Vivid Language

Army slang is hospitable, but to receive general acceptance, the new coinages must meet certain entrance requiremnts. The soldier dislikes the pretentious, the pompous, the bombastic. He wants his language to be vigorous and vivid, direct and to the point. "Bubble dancing" sounds like the invention of a fugitive from vaudeville; the soldier says "K.P." The reporter may write galvanized gelding," the soldier says "tank." The glossary of slang may contain "motorized freckles"; the soldier says "cootie," even if not so frequently as in the last war. With this reservation, the postwar army will continue to use the lingo of today, creating new words as the need may arise.

In the second place, the technical military vocabulary of the future will be enriched by the army jargon of today. Which words will be accepted no one can say, but they may include "jeep, mae west (often not capitalized—a sign of acceptance), walkie talkie, seabees, dogfight, bazooka." Possibly these words are already proper, but only future dictionaries will tell.

Finally, it seems safe to prophesy that of the hundreds of G.I. words only a select few will ever rise from their lowly positions. When the ten million servicemen and women return, they will soon pattern their speech after that of the one hundred and twenty million they left behind. Walt Whitman said this much better long ago: "Slang . . . is the wholesome fermentation and eructation of those processes, eternally active in language, by which froth and specks are thrown up mostly to pass away; though occasionally to settle and permanently crystallize." If you hear some one assert that the English language of tomorrow will be the army slanguage of today, you may safely retort, "Tell that to the Marines!"

COURTESY OF WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.

"Names, addresses and telephone numbers of all the bridesmaids."

Winter Construction

(Continued from Page 150)

fitters work in crews of from two to four men under the supervision of a shipfitter leadman who is in turn responsible to the boat foreman.

It is possible to add much of the superstructure on a hull before launching, but most ships are launched as soon as possible to make way for the laying of another keel. Once a ship is in the water, the shipfitter must use his own judgment in determining whether or not a pillar or plate is exactly vertical. The surveyor establishes some kind of bench marks on a hull before launching so that afterwards the gun mounts, winches and other equipment can be set at an exact level. Also the engine beds are ground and planed before the ship is in the water.

Watching the plates and section that have come from factories all over the central west being laid, welded and built into a great steel ship is a sight that is stimulating to construction men. But when the tremendous hull first moves toward the slip on its launching timbers, and then thuds into the water, rolling slightly and sending up a great wave, the men who have built it know their work is only approximately 30 per cent completed. For now the superstructure, the winches, pumps, booms, masts and hundreds of other items and fixtures must be installed.

Steel Superstructure

The steel plates of the superstructure are not as heavy as those of the hull, for they do not, of course, have to withstand the water pressure. But they are erected in the same way, being pulled into place, burned and welded as were the hull plates.

Frigates, fighting ships for the United States Navy, are being built at the Superior yard together with the cargo ships which are so necessary for the transportation of vital fighting equipment to our men overseas. The construction of frigates differs considerably from that of the cargo vessels. Where all space possible is built into the cargo ships for the storing of supplies, space in the frigates is used for the actual functioning of the vessel.

The new cargo ships now under construction in the yard will be powered by six-cylinder Diesel engines weighing about 104 tons that rest on bed plates weighing 55 tons. The ships will be equipped with Diesel generated 250 watt generators which must supply the power to drive auxiliary machinery, winches and pumps. The yard receives the engines knocked down, and completely assembles and installs them in the ships. These new victory cargo boats will be 336 feet in length compared to the 258 foot length of the ones just completed.

The workers at Lake Superior have proved to the country that they are able to build, launch, and deliver ocean-going vessels in spite of adverse weather conditions and other difficult situations. Thus, if the Federal Government should plan to build a recognized Merchant Marine, it will find the Great Lakes playing an important part in the building of these vessels.

Those Egyptian Engineers

(Continued from Page 152)

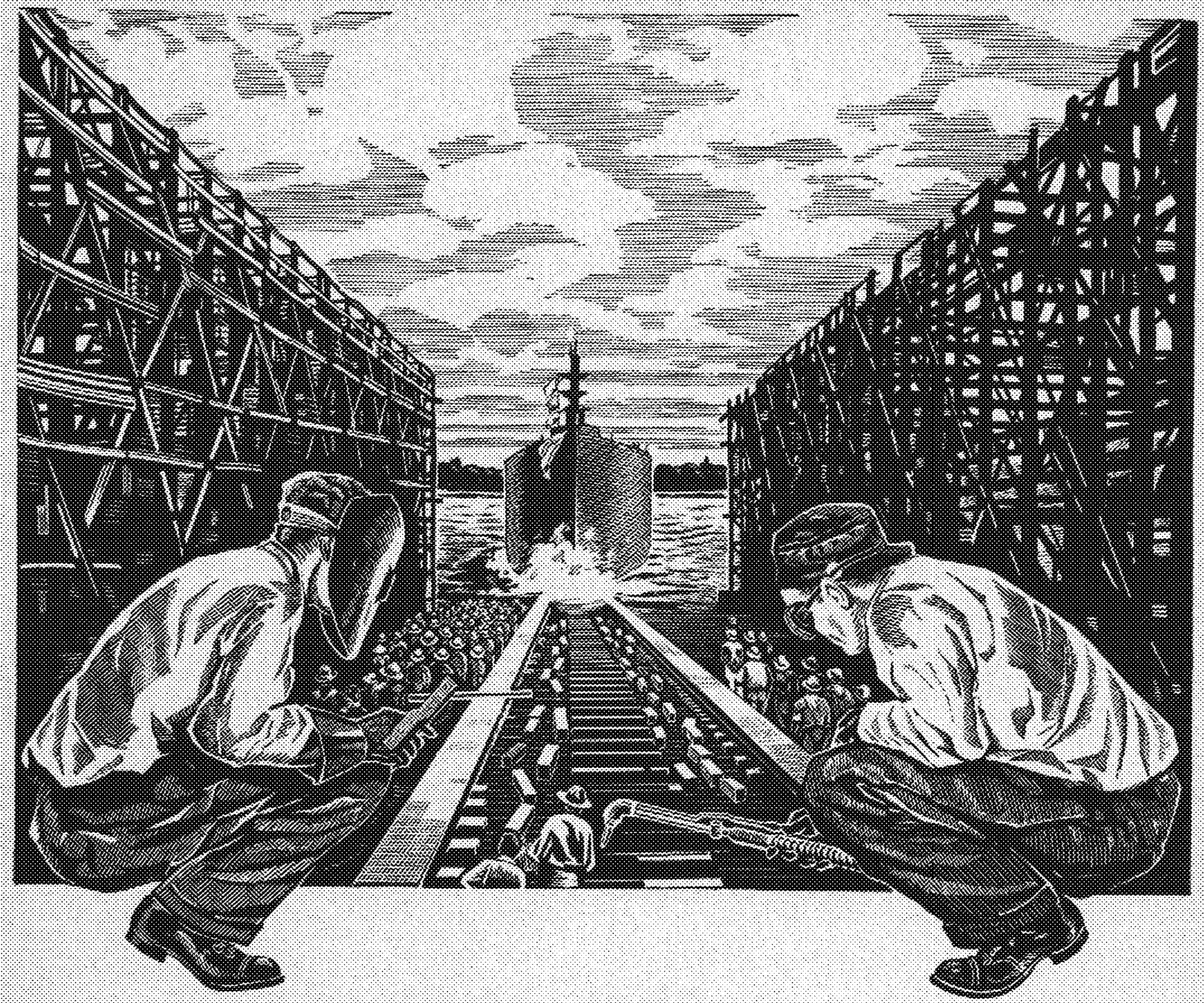
autumn, September 21, the same thing occurs, and the event is called the autumnal equinox. Evidently the early Egyptians observed this and they had also determined the time of the westward journey of the equinoxes. If we measure the base diagonal of the Great Pyramid in inches, we find it is 25827.5, the time in years needed to complete the journey of the equinoxes around the celestial equator. The king's chamber, already mentioned above, is built on a level with the fiftieth course of masonry and the perimeter at this level is again the number 25827.5. We can obtain the number 25827.5 again if we multiply the height at the fiftieth course by the then supposedly unknown Pi.

An intimate geometrical relation between the 30th parallel, the pyramid and the zodiac was opinioned by Col. D. W. Lockwood, Corps of Engineers, and published in *Professional Memoirs*, Engineer Bureau, United States Army, in 1909. About the 30th parallel, it was noted that its latitude was N 29° 58′ 51″ or 1′ 9″ south of the 30th parallel. This right pyramid with a square base was oriented so that its sides ran north, south, east and west. In 1864, Professor Piazzi Smyth, Astronomer Royal of Scotland, determined the error in orientation to be about 4′ 35″. The significance of the 30th parallel can be seen if we consider for a moment a sphere whose radius is R. The diameter of a circle 30 degrees from the great circle is $R\sqrt{3}$, the cubic diagonal of R^3, the diameter of a sphere circumscribing R^3. Now, in a pyramid with a square base, this gives rise to two squares, their areas being to each other as 3 to 1, and their sides as $\sqrt{3}$ to 1, or the same relation that exists between the diameter of a circle of 30 and the radius as stated above.

If two squares are constructed whose areas are to each other as 3 is to 1, with a common center, and their sides are parallel, they will constitute a square zodiac. This can be proven by geometric construction if there is no dispute as to the sine of 30 degrees equal ½. The resulting figure will give a square with 12 equal angles each originating from the center and therefore each angle will equal 30 degrees. If a circle were inscribed in the square with the area of 3, it would be divided into 12 equal parts and this probably is the basis of the division of the time of one revolution of the earth on its axis into 24 parts. If another circle were drawn from the center of one side of the small square, whose area is 1, and the diameter of the circle being equal to the side of the small square, a chord drawn connecting the intersection of the two circles would be on the North 30 degrees latitude of the larger circle.

The relation 1 to $\sqrt{3}$, between the radius of a sphere and the diameter of the 30th parallel suggests a cube circumscribed by a sphere. A cube circumscribed by a sphere is the basis of ancient universal symbolism, the cube the determinate, symbolizing matter, and the sphere indeterminate, symbolizing spirit. Matter circumscribed by spirit is a universal condition and the symbol, according to ancient theory, is applicable to everything from an atom to a universe, including man. "The principle of quality as exemplified in opposites as, for example, good and bad, above and below, spiritual and material, and therefore symbolism should include this feature." If we take a double cube and draw the circles which are described in the preceding paragraph we will obtain a capsuled-shaped figure which constitutes the so-called egg of symbolism. This can be done because what holds true for the N 30° holds true for S 30°. "As above, so below." Examples of this figure as well as the zodiac are to be found in the ancient temples and monuments in Egypt; the Guals, contain ideograms without the double square, and constitute the cartouches of former rulers and other people of that country. Many examples of these figures can be found in modern art. On the floor near the main entrance of the Congressional Library at Washington there is a highly ornate square zodiac; its sides run north, south, east and west. The east and west line through the center of the square separate the signs of Pices and Aries on the east side.

At this point we again stop and say, what manner of men were the pyramid builders. This discussion is by no means the extent of study which the pyramids offer. Perhaps scientists try to bestow in the pyramids more significance than originally intended by the builders, but the fact remains, these relations exist which bewildered the mathematician, architect, astronomer and geometrician down through the centuries. What is the meaning of all these things?



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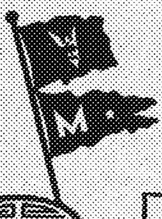
In the short space of time since Pearl Harbor, more than a thousand 10,000-ton Liberty ships have been built in America's shipyards.

Two things are chiefly responsible for this epic production achievement: the resourcefulness of our shipbuilders and new mass production methods made possible by the oxyacetylene flame and the electric arc.

By widespread use of revolutionary pre-fabrication techniques, America's shipbuilders have created a gigantic fleet of cargo ships which are now helping to turn the tide of war in our favor.

In many other vital fields of industry the oxyacetylene flame and the electric arc have played equally important roles. And their proven efficiency and economy in war production foreshadows the important place they will assume in peacetime manufacturing.

Air Reduction research and engineering has made many important contributions to the development of oxyacetylene and electric arc processes. If you would like to receive our informative publication "Airco in the News," we shall be glad to send you a free copy. Address your request to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd Street, New York 17, N. Y.



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TECH NEWS

EDITED BY HARRY FOEHRINGER, M. E., '44

Training Program Doubles

The training program for Electricians' Mates at the University of Minnesota has been expanded to twice its former size. Trainees now take the first eight weeks of their course on the Ag Campus where they live in quarters left by the Machinists' Mates School. The latter program has been discontinued at the University.

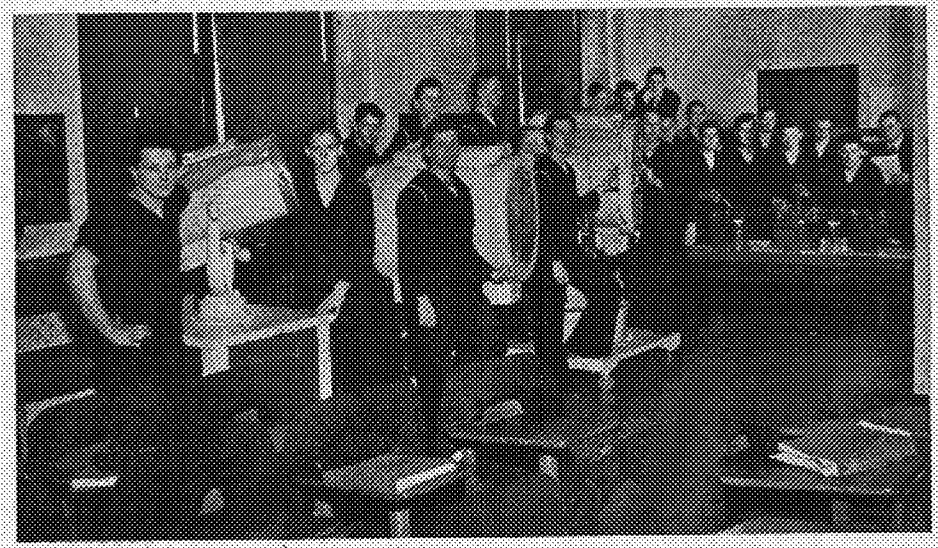
During the course on the Ag Campus, each trainee builds a small D. C. series motor in Mechanical Shop. In the Wiring Laboratory, trainees construct circuits with metallic and nonmetallic cables, flexible conduit, two types of rigid conduits, marine type-cables, and marine fittings. The curriculum on the Ag Campus also includes the following: D. C. circuits, blueprint reading, electric theory, and mathematics.

On Main Campus, trainees get to know "Tug Boat Annie." "Annie" is a model of a ship and has a D. C. propulsion motor which is driven by a D. C. generator with a direct connected exciter. Speed control is provided by the Ward Leonard System.

The basement of the Electrical Engineering Building now has both Forward and Aft Generator Rooms. In these rooms, the trainees practice parallel operations of D. C. and A. C. generators, using switchboards. In order to simulate the procedure for parallel operations aboard ship, generators in the "Aft Room" are paralleled with generators in the "Forward Room," load conditions, meter readings, and other pertinent information being relayed from one room to the other by sound-powered telephones.

Trainees receive preparation for trouble shooting and emergency repairs in Damage Control Laboratory. The types of trouble planned for the trainee range from identifying and locating trouble in communication cables and getting cables back into service, to testing leads from a motor to find the armature, field pole and inter-pole circuits, tagging the respective leads and connecting the leads to a starting box. Incidentally, if a trainee looks carefully, he will probably find an open circuit in the holding coil of that starting box. Since damage and trouble are of an unpredictable nature, Damage Control is designed so that the student does not know what type of trouble he will encounter in his next Damage Control Class.

The following courses are also included in the curriculum on the Main Campus: D. C. Machinery, A. C. Circuits, A. C. Machinery, Interior Communications, Maintenance and Repair, and Electric Theory.



Membership Drive Swells ASME Ranks

The A.S.M.E. under the direction of a new executive committee, held its opening rally Wednesday, January 12, at the Union. The feature of the evening was three films shown through the courtesy of Champion Spark Plug Company. The meeting was open to all techs; 78 people attended. The following week a membership drive was started. The results were satisfactory; nearly 100 per cent membership among the M.E.s was attained. The first business meeting was held at the Union on Tuesday, February 1. After the regular meeting which lasted an hour and a half, the members adjourned to the engineer's Union library (i.e., the billiards room) and vied with each other over the green-topped tables until 10:00 P.M.

Winter Quarter Enrollment Drops

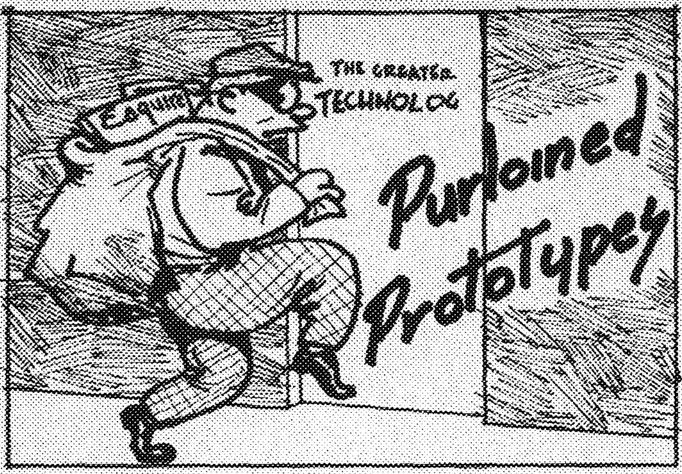
The present trend in the Institute is toward smaller classes, perforce. At present the frosh class accounts for 199 men; the sophomore, 159; the junior, 143; and the senior, 233. The largest school in the Institute is Chemical Engineering; it now has a total enrollment of 179. Aeronautical Engineering is next with an enrollment of 157. The total enrollment in I.T. this quarter is 734 as compared to 897 Fall quarter of this year; 1983 last Winter quarter; and 2276 Winter quarter of 1939-40, the greatest enrollment in I.T. The percent decreases are from: Fall '43, 18.2; Winter '42-'43, 63.0; Winter '39-'40, 67.9. One compensating thought: "Who wants to go to school, anyhow?"

Tech Alumnotes

The E.E. class of '40 seems to be well represented in the Signal Corps Laboratories out New Jersey way. Walter J. Moe and George Bower are stationed at Camp Cole in that state. John Erhart is at Fort Monmouth, and Charles Strom is in Eatontown. These men are all engaged in radio work in Signal Corps laboratories.

Orville Jensen, E.E. '34, is the foreman of a division of the Colonial Radio Corporation of Buffalo, New York. His department is turning out several types of commercial aircraft transmitters.

Charles Goldberg, E.E. '40, is now stationed at the Aircraft Radio Laboratories at Wright Field, Dayton, Ohio. He recently returned from a two-year tour of duty with the Signal Corps in the West Indies and northern South America.



BY BOB REYNOLDS, E.E., '44

A farmer was once phoning a veterinarian. "Say, Doc," he said, "I've got a sick cat. He just lays around licking his paws and does not have any appetite; what shall I do for him?"

"Give him a pint of castor oil," instructed the vet.

Somewhat dubious, the farmer forced the cat to take a pint of castor oil. A couple of days later the vet met the farmer on the street.

"Hows' your sick calf?" inquired the veterinarian.

"Sick calf! That was a sick cat I had."

"My God, did you give him a pint of castor oil?"

"Sure did."

"Well, what did he do?" asked the vet.

"Last time I seen him," said the farmer, "he was going over the hill with five other cats. Two were diggin, two were covering up, and one was scouting for new territory."

• • •

"Big boy, you're like a locomotive when you hold me this way."
"You mean I puff and wheeze?"
"No, I mean you're on the right track."

• • •

Margie: "At first it was love. He fascinated me, and I kissed him."

Lou: "Yeah, I know, and then he began to unfascinate you, and you slapped him."

• • •

When you see a lady go
Slim and supple as a doe
Wearing satin cut to fit
As if madame were poured in it;
When you almost lose your mind
Notice how it clings behind
And notice how the curves before
Invite attention more and more;
When thus you stand, romantic mad,
Take your warning from an ad:
Be sure this vision that you see
Is not the work of corsetrie.
Be sure that all these curves are truly
Acts of God and not unduly
Brought about by man's worst foe,
That two-way stretching so and so.

• • •

"Bill and Sue were the best looking couple on the floor last night."

"Oh, did you go to a dance last night?"

"No, I went to a cocktail party."

• • •

She was a second-hand dealer's daughter and that's why she wouldn't allow much on the old davenport.

• • •

Jane: "Jim proposed to me last night and I'm sore at him."
Josie: "What makes you so mad?"
Jane: "You ought to have heard what he proposed."

• • •

Irate Coed: "Hey, what are you following me for? Didn't you ever see anyone like me before?"

Aero: "Yeah, but I had to pay a quarter."

Coed: "Officer, this man is annoying me."
Officer: "But this man isn't even looking at you."
Coed: "I know it—that's what annoys me."

• • •

Overheard during a conversation between two E.E.'s: "I asked her if she was doing anything that evening and she said she wasn't so I took her out and sure enough, she wasn't."

• • •

Always remember, fellow engineers, that the difference between a model woman and a woman model is that the former is a bare possibility and the other is a naked fact.

• • •

Dolly: "Surely you're not going to let that redhead steal your boy friend?"
Polly: "Never. I'll dye first!"

• • •

To My Sliderule

Women are babbling all the time, of dates and drinks and dresses,
Which wouldn't help at all when I'm computing stresses.
My slip stick conquers without a doubt, whole hosts of sines and surds,
And helps me work in peace without an avalanche of words.
Sliderules are always accurate, women never so;
And although they're not affectionate, they never answer "No."
So hence with women's wanton ways, with eyebrows, lips and curls,
My little log-log polyphase is worth a dozen girls.

• • •

A drunk, staggering along the street, bumped into a telephone pole, felt around it several times, then muttered, "S.no use. Walled in."

• • •

A colored preacher was hearing a confession. In the middle of it he stopped the young sinner, saying: "Young man, you ain't confessin'—you is braggin'."

• • •

A fellow we know has a broken arm which he received fighting for a woman's honor—It seems that she wanted to keep it.

• • •

History Professor: "What could be more pitiful or sadder than a man without a country?"
Gen. Coll. Coed: "A country without a man."

• • •

Absent-minded Salesgirl (as date kisses her good night): "Will that be all?"

• • •

A Westerner entered a saloon with his wife and three-year-old boy.

He ordered two straight whiskies.

"Hey, Pa," said the kid, "ain't Ma drinkin'?"

• • •

Comstock date: "Am I the first girl you ever kissed?"
Ch.E.: "Why-er-a I don't know. Your face seems familiar."

• • •

Coroner: "What were your buddy's last words?"

M.E.: "He said, 'I don't see how they make any profit on this stuff at a dollar and a quarter a quart.'"

• • •

(Scratching) "How do you get rid of these awful cooties?"

"Simple. Take a bath in sand and rub down in alcohol. The cooties get drunk and kill each other throwing rocks."

• • •

First Kappa: "Why dearie, the boys simply run after my kisses."
Second Kappa: "That's nothing, after mine they limp."

• • •

Two friends, who had not seen Macpherson for some years, called at his house on Saturday evening. Mrs. Macpherson answered the door.

"Does Macpherson live here?" they asked.

"Ay," was the woman's reply, "just carry 'im in!"

• • •

"What's the difference between caution and cowardice?"

"Caution is when you're afraid, and cowardice is when the other fellow's afraid."

• • •

He: "You're thinner."
She: "Yes, I've lost so much weight you can count my ribs."
He: "Gee! Thanks!"

Life is so involved this month, that even the editor doesn't know whether to sink or swim. How this column was to be written and who the author was to be he didn't know, and then, a week before going to press, the momentous decision was made. Ah, let the girl friend write it, and if she refuses, but no, she wouldn't do that. So, here I am writing this and hoping that it will be satisfactory. He offered only one word of advice, "Please, don't turn it into a woman's column."

• • •

New additions to the office force are two young ladies from the business school, namely, Mary Ann Busch and Eleanore Odegard. As co-personnel managers, they are increasing the number of staff members and are helping to tie the force together. In their spare moments they telephone and arrange interviews with prospective staff members. Also, they're finding out what really makes the magazine click. Bob Giantvalley, ex-editor, is assisting them in their work, and they are helping him make a job analysis on the Log, that is, making an analysis of the different staff positions. They're doing a fine job and we hope they'll keep it up.

• • •

After the January edition of the Technolog reached its public, the editorial staff had its monthly get-together. Dinner was served at Ann Unger's Tea Room and magazine and staff problems were discussed. This gala affair is one of the outstanding features which aids the staff in preparing the magazine. Mistakes in older editions are taken up and ways to make future editions better are discussed at these meetings. It helps especially to coördinate the staff and to make the work very much more enjoyable.

• • •

The new author of *Purloined Prototypes*, Bob Reynolds, has been working hard to get his column organized and spent a good part of his strike vacation gathering the jokes. Bob says that it is great sport and wonders if there is anyone who would like to help him browse through other magazines getting material for the column. If you have a suggestion for the column or a humorous note to add to it, just drop it in the Stray Scraps box. For those who aren't acquainted with its whereabouts, it is located on the first floor by the front door of Main Engineering.

• • •

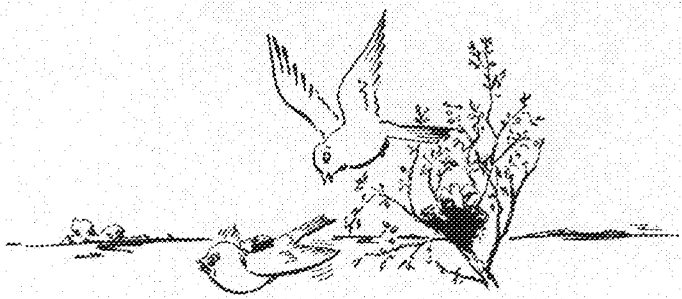
It was men for a time that the Minnesota Technolog lost, but now, we have lost a woman. Marie Vachon has volunteered for the Air WAC and leaves on March 8 to begin her training. Like all others who enter the army life she will take her medical examination out at Fort Snelling and then she will be sworn into the Air Forces. Marie will then leave for the six weeks of basic training at either Fort Oglethorpe, Georgia or Fort Des Moines, Iowa.

• • •

An All-Tech coffee hour was held on Tuesday, January 11, and coffee and doughnuts were served by the feminine members of the staff. Secretaries of the organization, Andrews, Giantvalley & Co., reported that the coffee hour was a success. Its purpose was to secure staff members and by flattery, threats and coercion they managed to talk a number of people into working on the Log. There is a place for all interested people to come in and apply for work on the magazine. B.P.S.

Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

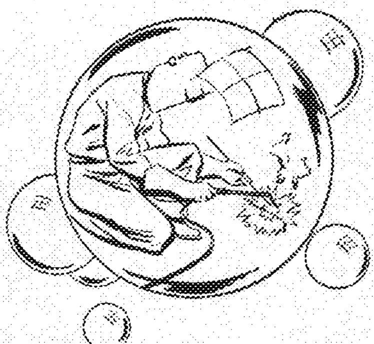


TEST FLIGHT

TINY electric strain gages on the wing answer one of many plane-design problems. No bigger than a penny matchbox, these gages give on-the-spot readings that tell the engineers where to strengthen, where to lighten many of the plane members. Frequently, the readings on dials lead to a more efficient design technique and a desirable reduction in weight.

Armed with the General Electric strain gage, engineers can get the answer to ship, plane, and gun design problems quicker than ever before.

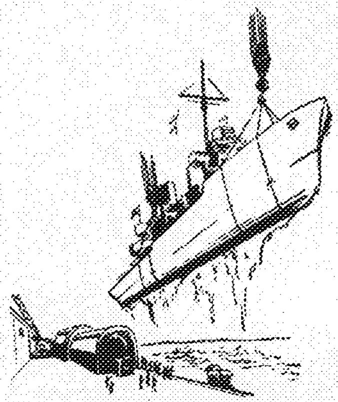
How deep can a submarine submerge? How big a firing charge will a gun stand? How great a load will a roll-bending machine take? The strain gage knows the answers.



BUBBLE–WELDING

"BUBBLE, bubble" takes the "toil and trouble" out of welding magnesium, the strong, lightweight metal derived—among other sources—from sea water. Magnesium is so light that a grand piano made from it could be lifted by one man . . . so strong that its use in airplane construction is desirable.

General Electric has developed a technique for welding this metal inside a "bubble," an invisible one of non-inflammable helium gas surrounding the welding arc. By means of the bubble, nitrogen and oxygen—which would otherwise combine with the magnesium—are excluded, and the welding conditions brought under accurate control.



200 FEET A MINUTE—UP!

A DESTROYER *could* move that fast, in that direction, if the world's most powerful motor were lifting it.

This giant direct-current motor is one of the youngest in the General Electric family of motors. It was recently completed at the company's Schenectady plant, and has just been shipped to Geneva, Utah. It possesses a maximum of 4,100,000 pound-feet torque, thus developing more turning power than any other motor, either a-c or d-c, ever built.

At Geneva, it will be installed in the DPC plant which is operated by the Geneva Steel Company, and will help roll out steel for Navy ships.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.

TECHNOLOG

Engineers' Day Issue

MARCH

15c

MINNESOTA

THE new world—the world of the post-war era—will be a world of wheels to a greater extent than ever before. The development of new kinds of production and transportation equipment, and the recreation of existing machines will greatly increase the necessity for and importance of bearings capable of meeting new conditions of speed, precision, load capacity and endurance.

Then the same bearings that have consistently and successfully anticipated so many revolutionary developments for more than three decades, again will rise to the occasion with the same versatility and efficiency — Timken Tapered Roller Bearings.

As a designing engineer your work will include the solving of many bearing problems, but with a thorough knowledge of the design and application of Timken Bearings as part of your stock-in-trade you never need be at a loss for a satisfactory solution. Begin to acquire that knowledge *now*. Timken engineers will help you.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

this month

BY HELEN HELLAND

Harold Morton, mechanical engineer, 1945 writes about model basins in this issue. Harold is a member of the newly- commissioned NROTC's.

Art Tatum records and good Boogie Woogie fascinate Harold. It's a fact that his nickname, "Jellyroll," was adopted from one of his favorite Boogie Woogie pianists, "Jellyroll" Morton of New Orleans. Minnesota's "Jellyroll" maintains that eating and sleeping are his pet pastimes, although he will admit to a few that music and outdoor sports are "fun at times."

Harold confesses that he has a slight preference for the brunettes, especially the pretty ones. He is a member of Pi Tau Alpha and also Anchor and Chain, Naval fraternity.

Chuck Amann, a regular staff member of the TECHNOLOG, is the author of the article concerning the principles of jet propulsion. He is majoring in aeronautical engineering and under the present accelerated program he will graduate in June, 1946, if Uncle Sam doesn't need him first.

Chuck attended St. Paul Central High School. While there, he was a member and treasurer of the band. He likes popular music so much that he has organized his own band. Chuck plays the trumpet and plays at the piano.

Among his other hobbies are swimming and skating. He used to build model airplanes, but now he only has time to read about them.

Chuck advocates more vacations, or at least one more. He thinks that the present schedule is too fast, he hasn't a chance to catch his breath. Right now he is busy working on the committee for Engineers' Day.

When Chuck graduates, he would like to enter the designing field in industry. He likes to draw and we think he knows some of the angles.

Wright Field Cadette Jeanette Croonquist, was busy soldering and wiring up an amplifier when we went to interview her for this page. This is just typical of the type of work the cadettes she writes about in this issue are doing.

Jeanette is a graduate of the University of Minnesota where she majored in home economics. Like all other girls she has one favorite piece of jewelry, a charm bracelet. Her brother, a Navy Ensign, sends her a new addition for the bracelet each time he arrives at a new port. Besides this piece, she also is very fond of rings and has a yearning for all types of music from jive to the classicals.

While at the University she was an active Chi Omega, and upon graduation she wants to do something to really aid the war effort. For this reason, Jeanette is now a Wright Field cadette and she is spending her time learning all about the intricacies of the radio.

Seymour Barer is one of the NROTC seniors who graduated from chemical engineering and received his commission on February 25. Before he entered the University of Minnesota he lived in Brooklyn, New York. This may account for his interest in athletics, especially that in baseball. Last spring he played a little ball on the NROTC team.

Seymour is president of Sigma Alpha Sigma, an engineering fraternity. After the war he intends to return to the University and study medicine. He would like to combine a knowledge of both chemistry and medicine and in that way contribute to the welfare of society. For a while his plans for a medical career will not be able to take shape, as he will be serving as a commissioned officer in Uncle Sam's Navy.

MINNESOTA TECHNOLOG

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The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is twofold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

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MARCH 1944 VOLUME XXIV NUMBER 7

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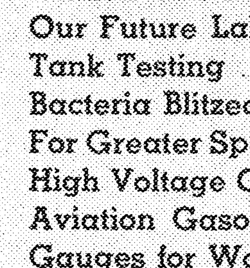


THE COVER. Marcie Larson is the 1944 Engineers' Day queen and she will partake in the "E" Day ceremonies on March 3.

FRONTISPIECE. A mass spectrometer for analyzing rapidly and accurately gases formed in making butadiene, the principal ingredient of several types of synthetic rubber. (Courtesy of Westinghouse Electric and Mfg. Co.)

Steep Rock Lake, the Source of

HIDDEN IRON ORE

BY T. L. BAILEY
OTIS & CO.

NEARING the point of production in the Rainy River District of Ontario is one of the most spectacular and potentially most valuable mining developments in the long mining history of the Dominion of Canada, the 7,000-acre iron ore development of Steep Rock Iron Mines Limited.

The existence of high grade iron ore in the Steep Rock Lake area has been known for nearly half a century, due to the presence along the southern shore of the lake of large quantities of high grade iron ore in the form of "float" ore eroded from the parent body by glacial action. Although the southward movement of the ice-cap in the glacial age would tend to indicate that the ore bodies must be north of the place where the float ore is found, most of the preliminary exploration ignored this theory, probably because no one wanted to undertake the complex problems presented by Steep Rock Lake if, in fact, the ore bodies were under it.

The studies and explorations leading to the present development covered a period from 1930 to 1937, and resulted in the formation in 1938 of Steerola Exploration Company, Limited, all of the assets of which were purchased in 1939 by the present Company. Explorations by these companies resulted in locating three high-grade iron ore bodies known as A, B and C.

The method of exploration followed was, in general, diamond and churn drilling. As most of the drilling necessarily was in the form of vertical holes, it could only be accomplished in winter when the lake was frozen over.

Scout Drilling

Scout drilling was first undertaken. This was a rapid method of reconnaissance beginning in the winter of 1937-1938, and was designed to outline the ore bodies in plan. Concurrently with the scout drilling, geophysical surveys of the lake bed were made in detail. While the scout drilling served its purpose of partially outlining the three ore zones in plan, it was necessary to undertake deep diamond drilling in order to prove them at depth.

While the deep diamond drilling established that the ore persisted to depth, it was necessary to undertake Mesabi-type vertical churn drilling in order to obtain accurate data upon which estimates of tonnage and grade could be based, and operating plans drawn up. This type of drilling was, therefore, undertaken in the winter of 1940-1941, and proved eminently successful, both as to the reliability of the samples recovered and as to the cost and speed of drilling.

Steep Rock Lake, which lies about forty miles north of the international boundary and 50 to 75 miles north of the Vermillion and Mesabi iron ranges in Minnesota, is shaped like a gigantic M some 15 miles in overall length. The A ore body is under the lake at the left-hand top of the M, the B ore body in the middle of the M, and the C ore body at the right-hand top. The A ore body is from 100 to 250 feet, the B ore body 90 to 180 feet and the C ore body 400 feet below the surface of the water. The over-burden consists of from 30 to 180 feet of muck, heavy clay and gravel which will require stripping, some of it hydraulic.

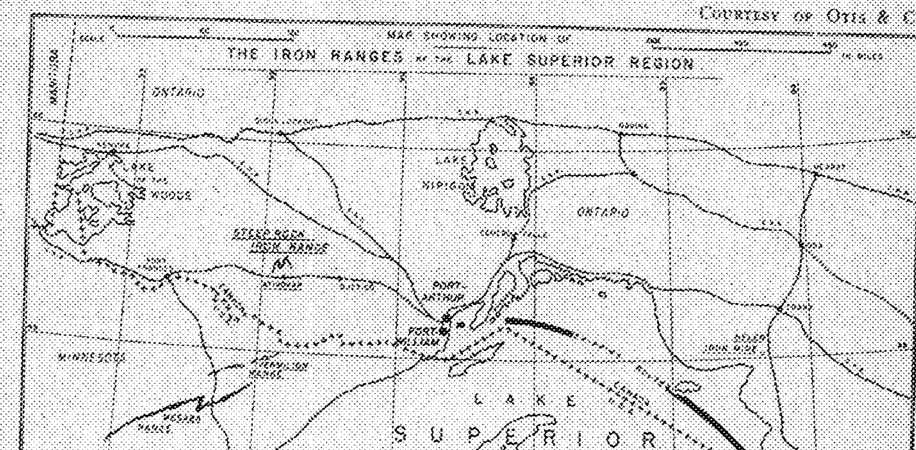
Once the presence of substantial quantities of high grade iron ore was established, it was necessary to work out the problem of dewatering the lake, through which the Seine River ran, and at the head of which was a hydro-electric power plant generating power for paper mills in the area. Exhaustive surveys of the area were made, by mining engineers and geologists. The plan finally adopted and now rapidly nearing completion contemplated the diversion of the Seine River from those portions of Steep Rock Lake in which the A, B and C ore bodies lie, closing down of the power plant at the head of the lake, the bringing in of new power, the construction of a spur rail line from the lake to the town of Atikokan, about three miles to the south on the Canadian National Railways, and the construction of loading docks at Port Arthur, about 142 miles away on Lake Superior. There was, of course, the further problem of financing this gigantic project before the work could get under way.

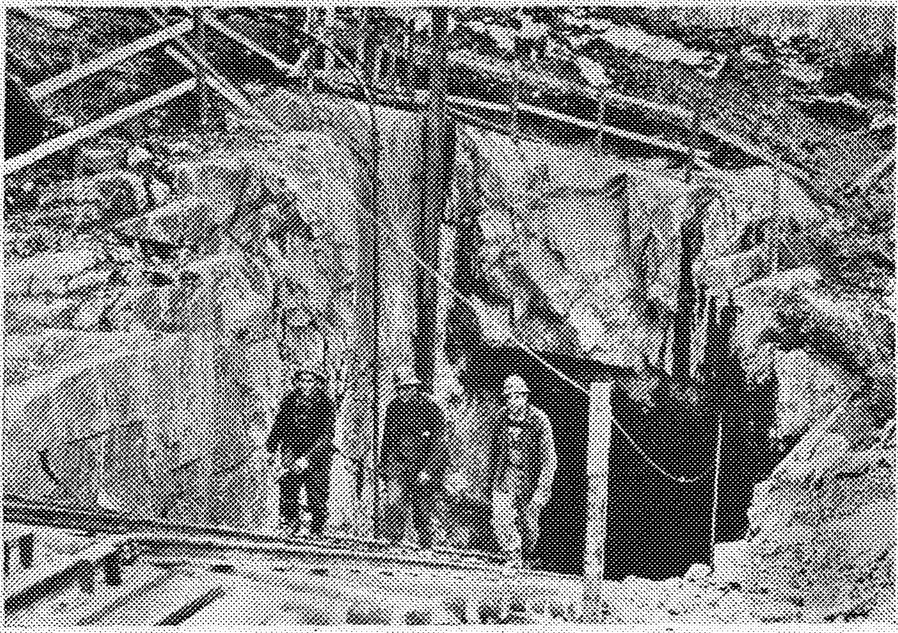
Financed by Stock

Financing was accomplished through the sale of Debentures and Common Stock in the United States, the granting of a first mortgage credit by the Reconstruction Finance Corporation, an agreement by the Hydro Electric Power Commission of Ontario to build a power line from Port Arthur to Steep Rock Lake and an agreement by Canadian National Railways to build a spur track and the ore loading docks.

The Seine River has now been diverted north through Finlayson Lake (which was lowered about 35 feet) around the head of Steep Rock Lake and into its west arm, which had been dammed off. The power

COURTESY OF OTIS & CO.





PHOTOS COURTESY OF THE EDITORIAL SERVICES, LTD.

A TUNNEL under the Esker cut will be used as a giant drain pipe to lower the level of Finlayson Lake well below the level of Marmion Lake. These hard rock miners are coming off a shift at the tunnel mouth during the final stages of the construction.

line from Port Arthur was constructed by the Hydro organization through most difficult country in only 180 days, and the construction of the spur track and the loading docks at Port Arthur is well under way.

The development has now reached the point where pumping of the water from the lake into the west arm has begun. This stage was reached in nine months, against an original scheduled time of 15 months, and a battery of pumps is now lowering the lake at the rate of about 6 inches or 500,000,000 gallons per day. The area to be unwatered is more than 5 square miles, and a total estimated 121,000,000,000 gallons of water will be pumped, the biggest pumping operation ever undertaken in any mining operation on the North American continent. The pumps are exceeding their rated capacity and the lake level by the middle of January this year was already down about 13 feet.

As soon as the water in the lake reaches the level of the overburden at the B ore body, stripping operations will follow the water down and iron ore in substantial quantities is expected to be mined from this body by August of this year.

High Quality Ore

Analysis of Steep Rock iron ore have revealed a striking uniformity and a remarkable combination of chemical and structural characteristics. The superior quality of Steep Rock ore was established by analysis of composite samples drilled from the A and B zones with an average analysis of standard ores shipped from the Lake Superior district in 1941.

High in iron, low in phosphorous and hard in structure, Steep Rock iron ore is classified as "Old Range Bessemer," and is entitled to the price premiums that this type of ore commands. Independent engineers estimate that at least 25 per cent of Steep Rock ore is Lump Grade, which brings a substantial additional premium.

With these exceptional qualities, Steep Rock Iron ore, in its natural state, is ideal for the blast furnace and the open hearth, as well as for direct reduction in the electric furnace.

Because its phosphorous content is well below the Bessemer maximum limit of .045%, Steep Rock iron ore can also be mixed with one or more tons of non-Bessemer ore to produce two or more tons of Bessemer grade.

Similarly, the low silica content of Steep Rock iron ore makes it desirable as a "sweetener" for high silica ores. One ton of it can be mixed with two tons of ore carrying 10.29 per cent silica, for instance, to produce three tons of furnace feed within the 8 per cent maximum limit imposed by blast furnace practice.

Perhaps the most outstanding and valuable characteristic of the Steep Rock ore is its suitability for open hearth use. It was early recognized that the physical characteristics and chemical composition of certain parts of the ore were such as to make it suitable for open hearth "feed ore" or what is termed in the trade open hearth lump. This ore carries a substantial cash premium on the market and it was conservatively estimated that 25 per cent of the ore mined would be such open hearth lump. It was later thought possible that the Steep Rock ore might also be suitable for open hearth "charge ore" and an investigation into the suitability of the ore for general open hearth use was therefore authorized.

The investigation was first made on a laboratory scale by the Battelle Memorial Institute of Columbus, Ohio, using "float" ore from the south shore of the lake. This particular ore was a little lower in grade than the average of the ore bodies as determined by the drilling. The tests were made in comparison with the best natural and sintered open hearth ores in use in the United States. The extensive reports submitted by the Battelle Institute established that the Steep Rock ore is an outstanding ore for open hearth use.

Slag Easily Removed

Later tests were made in full scale runs in the open hearth furnaces of the Republic Steel Corporation at Buffalo, New York, Steep Rock "float ore" in lumps being used and these tests confirmed and amplified the results obtained by the Battelle Institute.

The quality and ease of removal of the flush slag indicated rapid chemical reaction with consequent faster heat time and a higher tonnage per unit of time. The analysis of the flush slag indicated lower total iron losses than is normal when using 70 per cent hot metal heats. (Actually 71.76 per cent was used.) This is consistent with the fact that this heat produced 89.15 per cent ingot yield as compared with a normal of 88 per cent.

The time of steel making was reduced from 10 hours and 17 minutes which is the normal average of this furnace to 8 hours and 35 minutes. Normally steel is made in the open hearth using 50 per cent pig iron and 50 per cent scrap metal with the proper amount of limestone and hard ore. Because of the scarcity of scrap the amount of pig iron has been raised until the ratio is now approximately 55 per cent pig iron and 45 per cent scrap. In the run using the Steep Rock ore, the ratio was raised to 71.76

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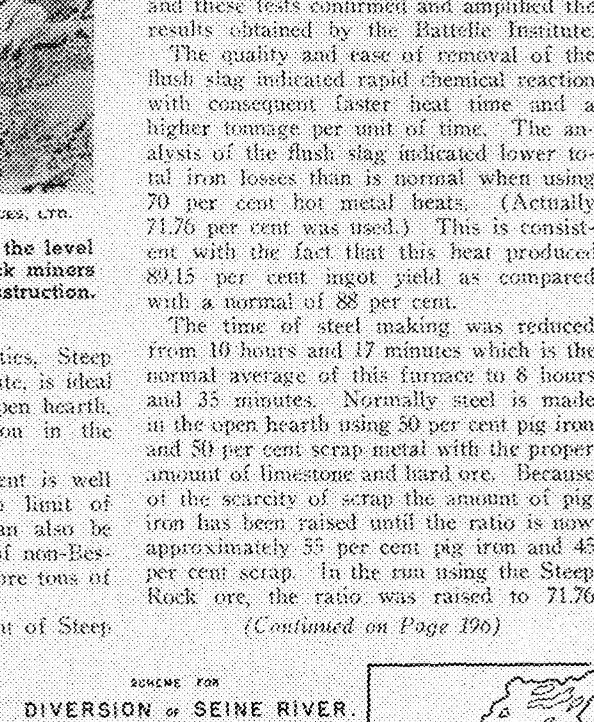


Plans Near Completion on

OUR FUTURE LABORATORIES

MARION EDWARDS
RESEARCH ASSISTANT

In this article, which is the first of two concerned with the new Mechanical-Aeronautical building, Marion Edwards presents a few of the many ideas which will be incorporated into the Mechanical division's building program. In a following article the proposed plans of the Aeronautical department will be presented to complete the glimpse of the building's progress.

Miss Edwards, research assistant on the Mechanical Engineering staff, has been closely associated with the building's progress, both during the promotion of legislative action and now in the establishment of a sound building program.

THE immense jig-saw puzzle of fitting twelve hundred students into one hundred and ninety thousand square feet of space is developing gradually into a coherent, well-defined picture of the new mechanical-aeronautical engineering building.

On the day the federal authorities say "go" ("cessation of hostilities in the present war," bill passed at Minnesota State Legislative session 1943), the State appropriation of $1,175,000 for the building will begin to flow for materials, workmen, and equipment to make a reality out of a twenty-five year dream. The Departments of Architecture, Mechanical Engineering, and Aeronautical Engineering of the university are busy planning and will soon have the structure designed down to the last pencil-sharpener.

Four-Story Building

Time estimated for completion of the building, once the cornerstone is laid, is not more than one year. At the end of that time, the brick face of the electrical engineering building will extend toward University Avenue by another one hundred and sixty-five feet, and an interior corridor will make possible indoor communication between the electrical building and the new structure. The new building will have four obvious stories at the front to align with other campus architecture, but the central section, set aside for mechanical laboratories, will add on an extra story to provide ample space for all divisions within the Mechanical Engineering Department.

The Aeronautical Department occupies the west section of the building and the Mechanical the east and central sections. More space is required by the Mechanical Department to accommodate the service courses given to other departments, including Aeronautical, in the Institute of Technology.

Noticeably lacking in the interior will be wooden stairways, low beams and rafters, dark, narrow passageways, old, empty swimming pools converted into classrooms, and students with heart failure. Stairways will be reinforced concrete, ceilings will be twelve feet high, hallways will be nine feet wide, and swimming pools are out.

Lighting, ventilation, and safety will reach a new pinnacle of perfection in campus buildings with the adaptation of the best features in these three fields to the mechanical-aeronautical building. It is anticipated that all artificial lighting will be fluorescent. Ventilation will be mechanical with suspended ceilings in the corridors where equipment between this ceiling level and the laboratory ceiling level will circulate air freely. Accidents will be much less likely with the elimination of such danger spots as belt-driven machines. Each machine will be electrically power driven.

Chimney Will Fall

Classrooms occupy the front of the building, with offices interspersed from basement to roof. The basement along the center is reserved for storage and pipes, eliminating the usual sub-basement, as a step in the trend to get away from open space on the ground level around campus buildings.

Demolition of the "leaning tower of Pisa" chimney on the old mechanical engineering building removes a much-berated landmark from the campus. No substitute will be provided. The old chimney was needed as an outlet for the power plant within the building, where steam engineering courses were taught. New provisions are for concentration of the steam division in the experimental engineering laboratories. Power for operation there will be supplied by the regular maintenance power plant of the University Buildings and Grounds Department.

The thousands of cubic feet in the interior have all been assigned and patterned with the assistance of the division heads within the department. Recommendations in each field have designed a veritable wonderland for training mechanical engineers. Expansion not possible in the cramped quarters of the old building has made room for modern improvements. Professor F. B. Rowley, Head of the Department, and several division heads have visited recently constructed engineering buildings throughout the country, assuring a combination of the best ideas from each in Minnesota's building.

An outstanding feature of the building is its provision for expansion into research in every field. Research rooms are spaced off on each floor so that experimentation can be conducted by specialists in each branch of mechanical engineering. "These are the rooms from which great benefits to Minnesota industries will undoubtedly accrue," believes Professor Rowley.

Large Freight Elevator

A complete car and equipment comparable in size may be easily transported between floors by the large freight elevator centrally located. A driveway focusing on this elevator from the back of the building facilitates deliveries.

On the first floor a machine shop will accommodate probably seventy-five students in comparison with thirty students accommodated by the old shop. All shops will be known as the "industrial laboratories"—a term more accurate, and more significant than "shop" to the average layman. Time and motion study, previously handicapped through lack of space and facilities (as were almost all divisions) will benefit by a 90 by 20 foot laboratory on first floor and all essential equipment.

Lockers occupy a considerable portion of the second floor. Showers for men are on second floor, and tentative plans include showers for women on third floor. Opening of the engineering profession to women during the war is a reliable indication, based on previous postwar trends, that a significant per cent of postwar engineering students will be women.

Second floor includes an 89 by 41 foot refrigeration laboratory—laboratories for heat treating, arc welding, and metal working, as well as a spacious student organization office. Third floor combines laboratories for juniors, including industrial instrumentation, automatic control, vibration, and photoelasticity. This laboratory brings together facilities formerly scattered in three buildings, two of them almost a mile apart—mechanical engineering and Oak

(Continued on Page 196)

The Origin of Modern Ship

TANK TESTING

BY HAROLD MORTON, M.E. '43

IMAGINE, if you can, the task involved in estimating the power required to drive a new type of ship—estimation without the benefit of positive experimental data and with only the performance records of a somewhat similar but older design to go on. This was the problem which used to confront shipbuilders who had contracts with the Navy. Our Navy was undergoing rapid expansion at the turn of the century, and many radically new designs were being projected and developed. In ordering new types the Navy sets up certain performance standards which must be met; but because the designers were unable to be certain of their estimates of the power necessary to produce the required speed, it was common practice to overpower ships just to be on the safe side. This is wasteful because at high speeds extra performance is obtained only at the expense of great increases in power.

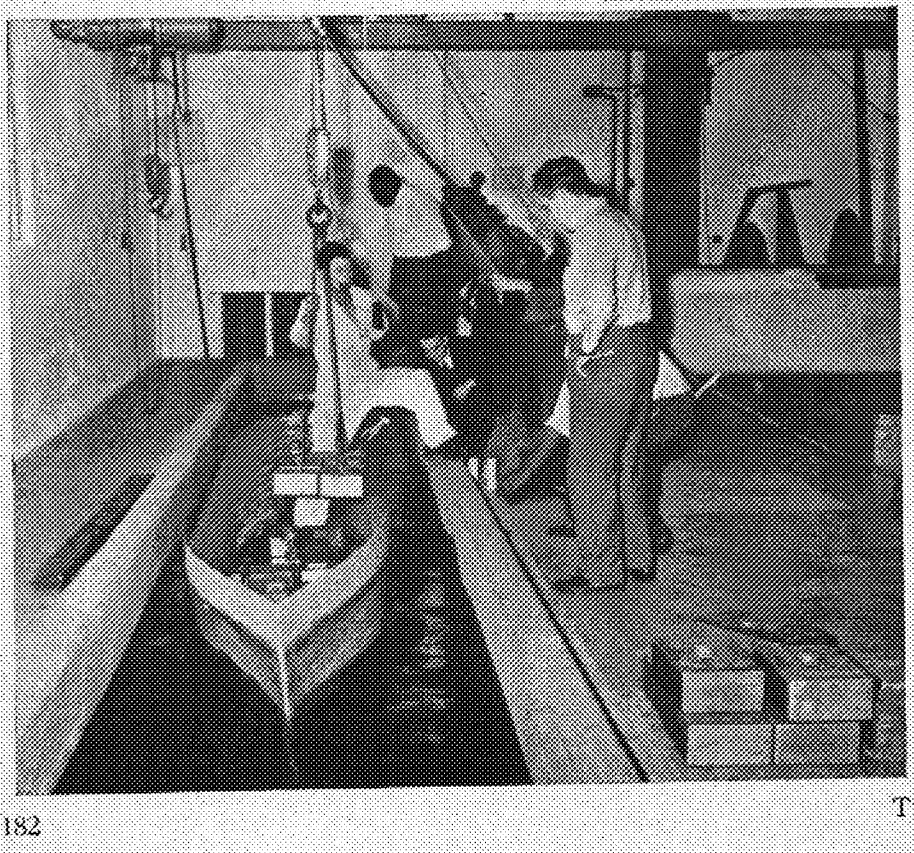
Shipbuilders were formerly awarded contracts with bonus and penalty clauses based on speed performance. Under this scheme the Navy had to pay substantial premiums for speed above contract almost every time a new ship was sent down the ways. The usual rate was $50,000 per quarter knot (1 knot = 1.15 miles per hour). The old cruiser "Minneapolis" was intended to develop 21 knots, but earned her builders an extra $414,600 by making 23.07 knots during trials. In one case the extra-speed bonus paid amounted to nearly one third of the contract price.

Finally, adequate experimental methods were developed to take much of the guesswork out of ship design, and to enable the designers to predict the performance of new vessels on the basis of tests run on a scale model in a special testing basin. A test basin is an enclosed tank, in appearance not unlike a huge swimming pool, much longer than it is wide. It is spanned by a bridge-like carriage running on rails and equipped with electric drive and braking. Models are towed from this carriage, and their resistance at various speeds may be measured by a very sensitive dynamimeter mounted on the carriage. Formulas, developed originally by an English engineer, William Froude, make possible a comparison between the performances of the scale model and the actual ship.

Speed problems are not the only kind that a test basin is equipped to solve. The Navy's new ship experiment laboratory at Carderock, Maryland, the David Taylor Model Basin, which will be described in greater detail later, is, from a scientific viewpoint, one of the wonder buildings of the world, and has furnished the answers to some of the most unique and baffling problems in the history of ship construction and operation.

THE MEN ARE removing weights from one of the models at the David Taylor Model Basin. These weights were added to give the model the correct displacement, turn and drafts.

OFFICIAL U. S. NAVY PHOTOGRAPH



Uses of the Basin

Not long ago the Navy was faced with a job of transferring one of our big new carriers from one ocean to the other through the Panama Canal. The Canal, built before the time of our present big ships, is a tight squeeze for them; the dimensions of its locks, especially the width, have long been a limiting factor when designing our capital ships. Would the carrier be able to go through them without mishap, without swerving into the walls of the locks, damaging them and herself, and possibly rendering the Canal useless? The clearance at the sides of the big ship—a matter of inches—would have been barely sufficient for a normal ship. But a carrier is not a normal ship in that it is built lopsided—her superstructure rises on one side of the flight deck—and consequently she has a different pull through the water, a drag greater on one side than the other. Under tow, and moving at slow speed she might be pulled sideways.

This was a rush job for the Taylor Basin. Within a few days the ship-testing experts had constructed in the deep-water basin a scale replica of the canals locks, and had devised special test apparatus and measuring instruments. The model-making shop turned out an exact twenty-seven foot duplicate of the big ship. Conditions were set up so as to approach the actual in every way possible. Then testing was begun, and after careful checking the results showed that the carrier could be taken through safely and handled without trouble with the existing equipment. Some days

(*Continued on Page 202*)

Ultraviolet Light Produces

BACTERIA BLITZED

BY DEAN BABCOCK, E. E. '44

A BATTLE that is not seen or heard by men, and yet one that has as great a bearing on our future welfare as any battle now being fought, is now being waged against tiny air-borne bacteria. Foremost among the discoveries which have appeared on the horizon within the past decade, is the development of the ultraviolet light. Although the development of this light is still in its infancy, this method of attack has shown amazing and far-reaching results under actual use. Already it has been put to work in factories, canneries, meat packing plants, restaurants and a thousand other places to control the ever-present microscopic germs. In hospitals, this light has been used to suppress cross-infection in contagious wards.

University of Pennsylvania scientists disproved a commonly accepted theory, that germs breathed into the air fell to the ground and died. They found that these tiny organisms are so small that they live in the tiny droplets of water which are suspended in the air. Just as it is impossible to keep the air that bears them away from the wound, so is it impossible to keep these myriads of tiny gangsters out of the wound. In operating rooms, every single thing that comes in contact with the incision is sterilized, except the air. No matter what great precautions surgeons took when sterilizing their equipment, infection still took hold.

While work at Philadelphia was being carried on, Dr. Deryl Hart of Duke University began to study the problem. After numerous experiments that tended to confirm his belief, that air-borne particles caused postoperative infections, he decided to try ultraviolet irradiation to sterilize the air. He turned to the able scientists at Westinghouse Lamp Division research laboratories. Here a most fortunate coincident helped to speed the progress of the search. Dr. Harvey Rentschler and his assistant had just developed a lamp that they called the sterilamp, a tubular mercury vapor lamp that generated ninety per cent ultraviolet light and only ten per cent visible light. Dr. Rentschler made arrangements with Duke hospital to test the light. He installed eight of them in a circle over the operating table where the success was immediate, and postoperative infection dropped ninety per cent.

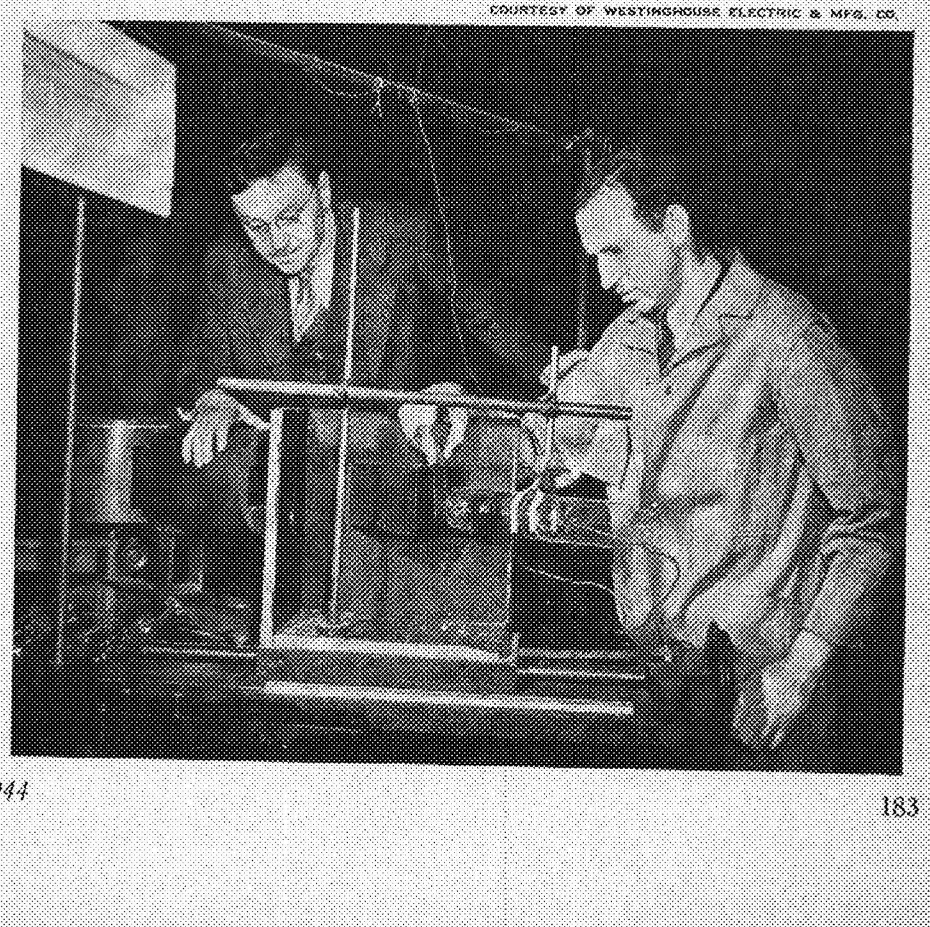
While the ultraviolet was doing its work in the hospital, Dr. Rentschler again went to work in his laboratory. As he did not have instruments to measure ultraviolet irradiation and as the bacteriologists were not able to assist him in this matter, he was not able to determine how virus would react under the action of light. The reactions of such virus under lights could not be watched because they were too small to be observed under a microscope. The scientific approach necessitated making sufficient tests so that results would not be attributed to chance. Could bacteria be made harmless by merely injuring them, or, was it necessary to kill them to produce the desired effect? Dr. Rentschler studied the threats of an endless number of bacteria and after 10 years' research he announced some conclusions that were applauded by professional bacteriologists. Experimentation proved that bacteria of the same strain were not equally resistant to ultraviolet light. The bacterias which had been injured took much longer to divide and they produced a much weaker offspring.

Although the control of the bacteria may be almost within the reach of the scientists, almost unidentifiable virus still take a staggering toll of lives in plants, animals and men. No one has ever seen a moving virus, they are too small to be seen through an optical microscope. Unlike bacteria, they do not move, scientists do not know if they are dead or alive. Under some conditions they act like ordinary crystalline chemicals, but they seemingly come to life, thrive and multiply when they are given the proper environment. It is almost impossible to tell the effect of ultraviolet on the virus. They cannot be viewed under an electron microscope check because the electron beam is likely to have as great an effect on the virus as does the ultraviolet. Dr. Rentschler observed the virus by using a bacteria culture as a host for the tiny virus.

It is very difficult to determine the exact changes which occur under the light. There is no way to determine how many virus are injected into a culture; a single drop may contain one million or none at all. There is no satisfactory way to determine the number of virus in a solution and therefore thousands of tests are being made so that the results may no longer be attributed to chance. As it takes ninety-six hours to grow and to destroy a single culture, Dr. Rentschler and his staff are anticipating many years of painstaking study and labor before they can hope for the conclusive evidence of the effect of the ultraviolet on virus.

DR. H. C. RENTSCHLER and D. E. Henry, both of the Westinghouse Lamp Research Laboratories, expose the meter to invisible sun tan rays which are generated by a tubular mercury vapor lamp that generates 90 per cent ultra violet light.

COURTESY OF WESTINGHOUSE ELECTRIC & MFG. CO.



Jet Propulsion Used

FOR GREATER SPEED

BY CHARLES AMANN, A. E. '46

FIVE years ago the average person would have laughed off a propeller-less airplane as something belonging strictly to the Buck Rogers Era, but today, especially since the Allied announcement of a successful jet-propelled aircraft, most people realize that such a machine is no longer a fantasy of the distant future.

As a rule ideas are not developed without a reason, and this holds true with the jet plane. The chief cause for research with this new propulsive means may be summarized in one word—airplane. As aeronautical engineers strive to produce faster and faster planes, the difficulties which they encounter increase by leaps and bounds. Aerodynamic efficiency has been worked out to a point where apparently the simplest way of increasing aircraft speed is by improving the power plant.

As motors become more powerful, the propeller blade area must be increased. Three methods of doing this have been worked out to date: first, increasing the propeller diameter; second, increasing the number of blades, and third, using two contra-rotating propellers on a common shaft. Each of these introduces some difficulty.

Eliminating the Propeller

As the propeller diameter increases, the speed of the whirling blade tips also goes up. When the speed of these revolving tips reaches the speed of sound, peculiar disturbances in airflow within the propeller are created which decrease the efficiency of the propeller. Since the airscrew of today has already reached this point, the simplest way out seems to be to eliminate it entirely. Larger propeller area also necessitates longer landing gear and this introduces the problem of where to retract the undercarriage when in flight so that other mechanisms within the ship will not be disturbed. As the undercarriage grows longer the angle at which the plane rests while on the ground becomes greater. This means that the pilot, when taxiing, usually sees more of the front of his plane than he sees of what lies ahead. Tricycle landing gear eliminates this factor to some extent, however.

The second method of increasing blade area, that of increasing the number of blades, does little to improve the situation. Our planes today are using three-, and, in a few cases, four-bladed propellers, and additional blades would impair the smooth flow of air within the propeller arc so that the efficiency of the engine-propeller combination would fall off sharply.

The use of contra-rotating props appears to be the best solution to the problem. Because of the involved gear system and other complications, however, complete elimination of airscrews should be welcomed. This is just what jet propulsion would accomplish.

Jet propulsion in the modern sense of the word is the propulsion of an aircraft through the air by utilizing the force supplied by some working fluid as it flows through a nozzle under pressure. It works on the principle of Newton's third law of motion, which states that in every action there is an equal and opposite reaction. We, in our everyday lives, have probably seen applications of the jet without realizing it. In turning on a garden hose, for instance, the nozzle, if resting on a smooth surface, jerks suddenly as the first stream of water issues forth. Or, in releasing an inflated rubber balloon, you have perhaps observed how it darts crazily through space as the air stream pours from its stem.

This is the same principle involved in the rocket, and for this reason jet and rocket propulsion have often been considered closely related. But the rocket is different from the jet plane in that it carries its entire fuel supply and is therefore independent of the atmosphere. The rocket not only can operate but reaches its maximum efficiency in a complete vacuum. The jet-propelled ship, however, requires air from its surrounding space and is therefore confined to altitudes within the earth's air blanket.

Turbo-jet Principle

Nearly all jet aircraft motors designed in recent years have used the turbo-jet principle in one form or another. In its simplest arrangement, this motor utilizes a turbo-compressor and a gas turbine on a common shaft. Air is delivered under pressure by the compressor to a combustion chamber in which a fuel is injected and ignited. The resulting expansion of gas takes place in two steps. The first of these occurs as the working fuel flows through the gas turbine, which transfers part of its energy to the compressor. The second expansion takes place as the gas is discharged from the nozzle at the extreme rear of the motor, and the jet imparts to the machine its opposite propulsive force as it leaves.

An alternate arrangement in this type of motor makes use of a reciprocating engine in driving the turbine. In this system the entering air is first used to cool the compressor power plant and in this way gains heat at the start. It then undergoes compression and proceeds to the combustion chamber, where the exhaust gases from the reciprocating motor are added. Fuel may also be introduced and ignited at this point to increase the volume of the gas as it goes on through the nozzle, thereby increasing the power of the jet.

Other ideas are of course numerous. Some inventors, especially the first to work in the field, advocated steam jets, but the weight of the equipment in such a system would limit its use to extremely large planes. Reciprocating compressors were suggested, but rotary components are more desirable because of their greater operating speed and efficiency. Some jet-driven planes were even designed without compressor systems, but it is doubtful whether such machines could be succesfully flown.

Jet-propelled Aircraft

As early as 1849 Charles Golightly patented in England a steam-jet-driven monoplane, and about thirty-five years later a Russian, Fyodor Geschwind, designed another steam-jet plane.

The jet-propelled airplanes and power plants which have been designed since then are too numerous to mention. It is enough to consider the more plausible ones of recent years. The first successful jet-driven plane to be publicized was the Italian Caproni-Campini c.c.-1, first flown for ten minutes on August 27, 1940. On December, 1941, a new and improved model, the c.c.-2, flew 168 miles from Taliedo to Guidonia with an average speed of 130 miles an hour. One stop was made at Pisa, possibly for fuel.

The c.c.-2, quite similar in design to its predecessor, is a low-winged monoplane carrying a crew of two in an enclosed tandem cockpit. It weighs 11,000 pounds, 2,200 pounds more than its single-seated predecessor. In this model, air is taken in through a circular opening in the nose, goes through a rotary compressor, passes over the gasoline engine, used to drive the compressor, goes on to the combustion chamber, where exhaust gases from the compressor power plant and liquid fuel are added, and then it leaves through a nozzle at the extreme rear of the craft. Its speed is regulated to a certain extent by moving a conical plug fitted inside the nozzle on a horizontal axis to control the volume of the jet outlet.

(Continued on Page 200)

Oh, For the Life of the

HIGH VOLTAGE CADETTES

BY JEANETTE CROONQUIST

ALTHOUGH the famous words "we came, we saw, and we conquered" belong to another eventful occasion, we, the Wright Field cadettes may appropriately borrow Mr. Caesar's much quoted remark. Miss Margaret Ann Smith, of Wright Field, had recruited sixty girls from the Fargo, Duluth, and Minneapolis areas. We were completely mystified about the six months' course that lay before us. All we knew was that we were paid $147 per month while training, and lived on or near the campus where we received our training in electrical engineering. Each girl filled the requirements of the War Department's Signal Corps of being eighteen years of age and having two years high school math and a year of college. After writing out government information blanks, we were interviewed. Each cadette had to know their family tree and all facts about relatives, illnesses, births, and deaths.

The first day we met in Murphy Auditorium and were initiated into the Signal Corps. We talked with Dr. James Webb, the associate professor of radio engineering, who was to be in charge of us. Mr. Miller, an instructor, was also there to greet us. Aptitude tests involving mental, mathematical, and mechanical ability were given to us. The next day we began our forty-eight-hour week of classes. For the first time we came face to face with some of the problems of electricity, trigonometry, algebra, direct current lab, mechanical drawing, and shop work. All of us were divided into classes according to our mathematical abilities and backgrounds.

Some think college is a kindergarten compared to our courses as cadettes, but despite it all some amusing incidents did happen during our training. One girl forgot to discharge a condenser and received a shock which according to her took her three feet off the floor. Now she has great respect for electricity.

The first eight weeks were the hardest, because they were our test period to see how we stood up under the training. Nine girls dropped out during this time, but other work was found for them at Wright Field. Mr. Blevin, the representative from Wright Field, came up twice during the test period and interviewed each of us. In this way Wright Field managed to keep close tab on the cadettes that are going through the college training programs.

One of the cadettes said that her biggest thrill was learning to operate a sliderule. "At last," she said, "I am an engineer." In lab work the girls have learned to build a radio chassis, and at one time set up a complete telephone set between two rooms.

The Second Half

The second eight weeks was spent on alternating current, A.C. lab, electronics, shop, and physics. A higher voltage was used in this period, and one girl said she wouldn't attempt to describe the sensation she received when 150 volts passed through her body. Lab work is the most popular of all the work the girls are in.

Our last eight weeks began on January 31 and the studies involve radio principles and practices, radio lab, D.C. and A.C. machinery, machinery lab, transmission lines and radio antenna work.

Four hours a week during our last eight weeks is spent in class in the mechanical engineering building. One night a week is also spent in class work in the electrical engineering building. As one cadette put it, "If we get all the class work and home work done, laundry washed, all our lab hours in along with the one night a week in class, we find that at the end of the week we are an hour in the hole."

Lieutenant Colonel Harnett from Wright Field came up and talked to us about the course that we are in, and also about the work that we will be doing when we get to Wright Field. However, the big thing that we are all looking forward to is that week's vacation which we receive at the end of our training period at the University of Minnesota. Many of the girls are planning to spend the entire time in bed. The Signal Corps furnishes us with train fare to Wright Field where we have another two months of training, after which we are put into groups for work which we are best suited for.

The cadettes all feel that they are indeed fortunate to have this training in electrical engineering and enjoy learning the many phases of electricity while the government pays the bills. When we complete our training for the Signal Corps and start work at the Aircraft Radio Laboratories at Wright Field, we will really be contributing our part toward the war effort. Like all other government employes we will be working forty-eight hours a week for the duration.

GIRLS AND MORE GIRLS are on the third floor of the EE building. They are deeply engrossed in class work while the willing professor explains the intricacies of the mathematical world.

BY TESTING VARIATIONS in lamp bulbs, the cadettes are becoming familiar with the working characteristics of electrical equipment. They are Doris Johnson, Marjorie Rose and Lois Ness.

New and More Powerful

AVIATION GASOLINE

By SEYMOUR BARER, Ch. E. '44

TRIPTANE, aviation's most powerful component of motor fuel, has been known by chemists for a very long time. Many of its important properties, including its ability to produce superior power in aviation gasoline have also been known. A pound of the best aviation motor fuel used today would release 18,700 BTU, or enough energy to move a one pound weight from New York to San Francisco. In comparison, a pound of triptane would release 20,650 BTU, or enough energy to carry the pound weight from New York to San Francisco and then down to Los Angeles. Then, with this knowledge of the twenty-five per cent greater energy potentiality, why has not triptane been put to work? The answer is the age-old limitation, economy.

Originally, it cost about 3,300 dollars to produce each gallon of triptane. A laboratory method of preparation was used which called for a Grignard reagent, zinc dimethyl. This method produced only enough triptane to enable them to study its properties.

It was not until the war that a rejuvenated impetus to find a commercial way to prepare triptane was experienced. The new impulse was again terminated about two years ago, at which time several hundred gallons were produced at 40 dollars per gallon. This price was still too high and the product was used for experimental purposes only. Even if the cost of triptane did not preclude its use, the materials used in its production all had high priority ratings and could not be spared. The more our scientists thought of the potentialities of triptane, the greater became the urge to find a feasible way to produce triptane.

DR. VLADIMER N. IPATIEFF, who was educated as an artillery officer in the Russian Army, later became a great chemist and teacher. He helped develop the process of producing triptane.

COURTESY OF CHEMICAL & ENGINEERING NEWS

Production Cost Lowered

Working on this problem in the Research and Development Laboratories of Universal Oil Products Company were two untiring, conscientious men, Dr. Vlandimer Haensel, research chemist, and Professor V. N. Ipatieff, director of chemical research of the Universal Oil Company. Aided by Universal's technical staff, these two scientists were able to lower the cost of producing triptane. At the present time it is selling for less than one dollar per gallon, and it is believed that under mass production methods the cost will be even smaller. The technical details of the production are all military secrets.

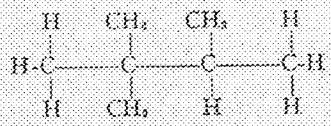
The production of triptane by the Haensel and Ipatieff process uses only easily obtainable materials. These raw materials are the condensable gases produced in petroleum refineries as by-products of noncatalytic and catalytic cracking or reforming of petroleum oils. A relatively low temperature and pressure is used. It is desirable to have low temperature and pressure because triptane is an iso-hydrocarbon and at high temperatures and pressures undesirable substances such as olefins and paraffins form and a lower yield of triptane is produced. This process has been operated for 300 hours in a pilot plant and there has been no indication of catalytic activity.

The Haensel and Ipatieff process contains only two steps. The first involves the reaction of condensable gases at a certain temperature and pressure. Then, a selected portion of the product from this step is used as the changing material in the second phase. In this second step, more than 90 per cent liquid recoveries are obtained and better than 50 per cent of this product is triptane.

During the production of large quantities of triptane, a valuable by-product is obtained. This consists of two hydrocarbons, 2, 3 dimethylbutane and 2, 3 dimethylpentane. Their principal use is as a blending agent with triptane for aviation gasoline.

The final product of the reaction is a saturated liquid stock which is free from impurities. Its use in aviation fuels does not necessitate additional refinery treatment.

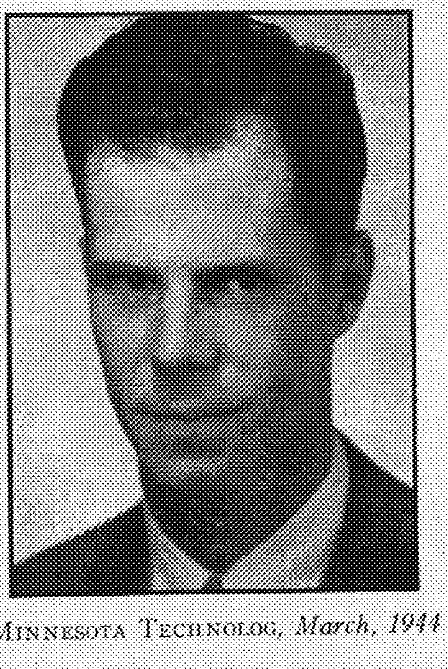
Triptane, or 2,2,3 trimethylbutane or isopropyltrimethylmethane is a hydrocarbon. Its structure is as follows:



The freezing point of triptane is minus 25 degrees centigrade, for an aviation gasoline, this would be a relatively high freezing point. At high altitudes the temperature may go as low as minus 50 degrees centigrade. Pure tripane would freeze at this temperature and thus it would be rendered an unusable aviation gasoline. This problem is averted by blending triptane with other hydrocarbons such as isopentane, neohexane, iso-octane, benzene, and substituted

(Continued on Page 194)

DR. VLANDIMER HAENSEL is among the nation's foremost research chemists. He was one of the men who made it possible to produce triptane at a much lower cost.



Doing Its Part With

GAUGES FOR NAVY INDUSTRIES

BY M. E. TROLLEN

BROWN & BIGELOW

This is the fourth in a series of articles in which the TECHNOLOG is presenting some of Minnesota's Industries at war. The purpose of these articles shall be to familiarize the University students with Minnesota concerns and the work that is being accomplished in our state.

FROM advertising to war production, to lay folk the conversion may sound difficult and almost impossible, but to technicians at Brown & Bigelow the change was taken in stride. The skill and accuracy required for eight-color Taliochrome reproductions was no less than that required on war contracts, and if these craftsmen were able to do this work, why not help Uncle Sam in his desperate hour? Experience in working plastics and metals was not lacking; a compact, efficient machine shop was at hand, a nucleus of skilled workmen was champing at the bit to do their part.

Prime contracts for important Navy requirements were secured in Washington, as well as subcontracts for gauges and machines needed by other contractors. The novelty department, with an output of metal and plastic products, was shifted to war work. The skilled help in the department increased their speed and lengthened their working days on more deadly articles needed at this time. Conversion and expansion were achieved in record time. In four months from the letting of contracts, the tooling up, the training of additional help, and the manufacture of machines had been done, and finished products were rolling off the line.

Increased Production

With production rolling, the engineers and the technicians tried to find means of increasing that production. The motto "When you stop being *better*, you stop being good" was constantly before all the people at work, and they have never stopped being better. Mass production was started. Single spindle screw machines of the smallest commercial size were pushed aside, and batteries of multiple spindle screw machines, with five to eight spindles each and large enough for 2" diameter bars, now are at work. Machine operations are continuous, each machine making one part or doing one operation continues without stopping for months on end. This operation, slowed only by the inserting of raw materials, gives a higher efficiency than is usual for machines in this work. Whereas usual good production for this type of work is 70% of gross, these machines and the men who run them have produced a record of 92% of gross production. Such efficiency has been dreamed of and wished for, but it has seldom been achieved.

Next to the keymen, the sparkplugs in any industry might be said to be in the toolroom. In this shop, expanded many times to meet the needs of Mars, are made the gauges by which specifications are checked. Many of these gauges show maximum and minimum tolerances with a dial indicator, which shows differences between the ideal and the finished product. Unless the dial indicator stops between the indicated maximum and minimum specifications, the part being checked is instantly scrapped. With tolerances ranging from .003 to .0002 inches, the precision of the gauges is very evident.

New Gauges

Besides the gauges used in the factory, the toolroom makes gauges used by other contractors, as well as machine tools. Research in the toolroom proved that certain products could be punched from steel plates instead of being machined from bars as had been the custom. Skeptics scoffed, but a trial run with a punch press showed a 65% saving in stock alone. Further tests proved the process to be labor saving, and there was a 30% reduction in costs. The final test, proved that production could be increased without additional machines, an important feature, with screw machines available only in critical cases. The toolroom also made machines used by other contractors, as well as snap, plug, and flush pin gauges used both on work at machines and in final inspection.

The novelty department made use of a knowledge of plastics which resulted in the manufacture of much-needed items, and an immense saving of brass. Plastic name and number plates were shown to various high officials and after a series of tests, contracts were let for large numbers of the plates. Ease of stamping, using a steel type as with brass plates, lightness of weight, and the quality of being tarnish proof made these plates worth while without considering the savings involved.

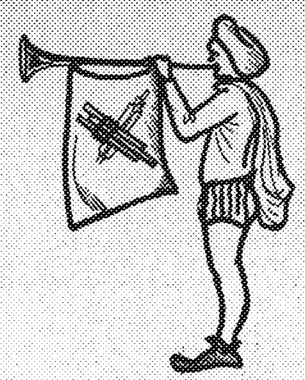
Engravers from the regular plant were called on for work on special dial and spiral gauges. When they had done their part, master craftsmen in metal took over, because in making these gauges, internal stresses developed in sufficient force to throw off the whole gauge. As these gauges are integral parts of other machines, absolute accuracy was the only standard for approval. Research developed new methods of cutting out these gauges, and even with the requirement of accurate graduation markings, each gauge produced is identical with all others.

Many products of brass now are made on punch presses, thus eliminating waste material and effecting a savings in time over the old method of machining from solid bars. Severe coining operations are necessary on some of these products, and the punch press method saves labor and gives much closer tolerances than the machining process. With one small part, approximately ¼ inch in diameter, having thirteen different specifications and tests to be met, one realizes the benefits of this newer system of production. This same part also is made of steel, and here too, punch press production saves time, labor, and reduces costs. One part, made from aluminum, formerly was laboriously machined and drilled and the completed part necessitated quite a few separate operations. Here the same part is made on a punch press at one operation. Blanks are inserted, the press operated, and finished products roll to the inspection line. The ease and speed of this operation has resulted in orders being filled and shipped before inspectors thought there had been time to start production.

Many Types of Parts

Many different metals are used in production; the principal ones being aluminum, brass, carbon steel and stainless steel. One weldment is built up from sheet steel, given a stress-relieving heat treatment, and then machined. Small cam members are machined from steel of a hardness just below the limits of machinability, and they are then heat-treated for hardness. The number of these parts manufactured is a military secret and they are incorporated in the work being done by another contractor.

Size of parts produced is interesting for they vary from comparatively huge pieces, a foot over all, to tiny screws such as might be used in watches. A battery of machines, such as are used in producing watch parts, is at work making weapons of war. The adaptability of these machines to various parts apparently is limited only by the various uses which technicians find for them. These men constantly are on the lookout for new ideas to which the machines can be put, and the engineers produce new ideas almost every day.



Hear ye, Hear ye, all loyal subjects of St. Patrick,

IT IS HEREBY PROCLAIMED:

WHEREAS: All engineers in the sovereignty of Minnesota having been devotedly embracing the curriculum in the Institute of Technology this year past.

WHEREAS: The said engineers have grandeurishly ostentated on wondrous slip sticks.

WHEREAS: Ye engineers have been diligent adherents to the idiosyncrasies of bearded Scobie.

WHEREAS: Having admonished the knolling activities pursued by the peasants in Arts and having virtuously abstained from provocative tantalization of the fairer sex.

LET IT THEREFORE BE KNOWN:

That on the third day of March, in the year of our Lord nineteen hundred and forty-four, that these men shall let things slide and rule the day.

Let it be further known on this day the gala coronation and knighting ceremony will take place in the Union Ballroom. After the faithful seniors have been fittingly honored and knighted frivolities will be in order. Yon gladiators from the athletic contests will cease hostilities to join in the swing of things with everyone at the Sunlite. The frolicking and homage to St. Pat and his Queen will be concluded by a royal Brawl given in their honor at the Nicollet Hotel in the evening.

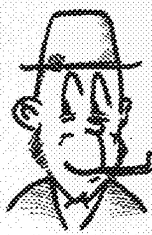
So to St. Patrick symbolizing the engineer we proudly dedicate this day.

Jerome J. Schwab
Roger Williams
Daniel J. Greenwald
Engineer's Day Chairmen

42nd Annual

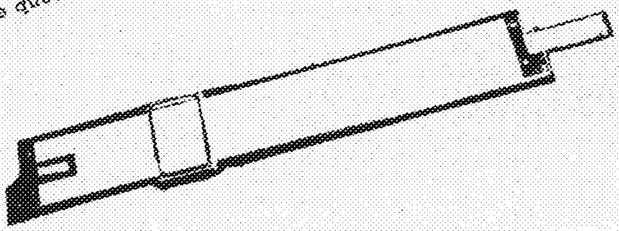
ENGINEERS' DAY

Marshall Burquest Marcie Larson

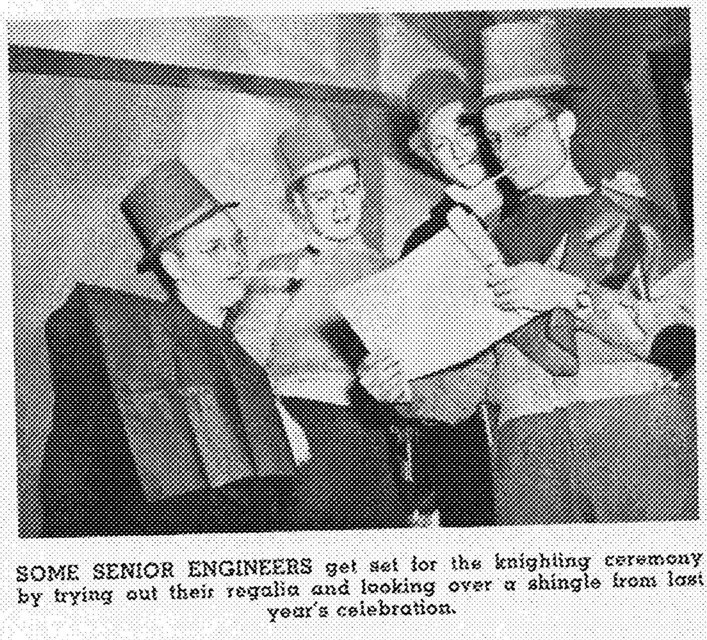


ENGINEERS' DA

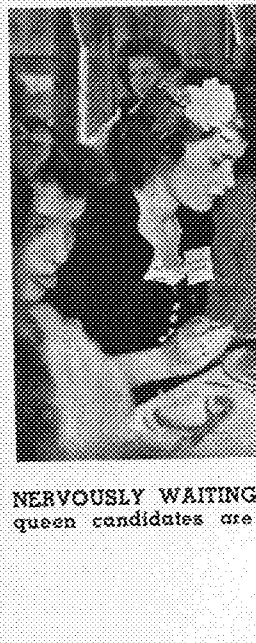
THREE CHAIRMEN, Dan Greenwald, Babe Schwab, and Pinky Williams surrounded by some of the candidates at the luncheon at which the queen was selected.



QUEEN MARCIE LARSO

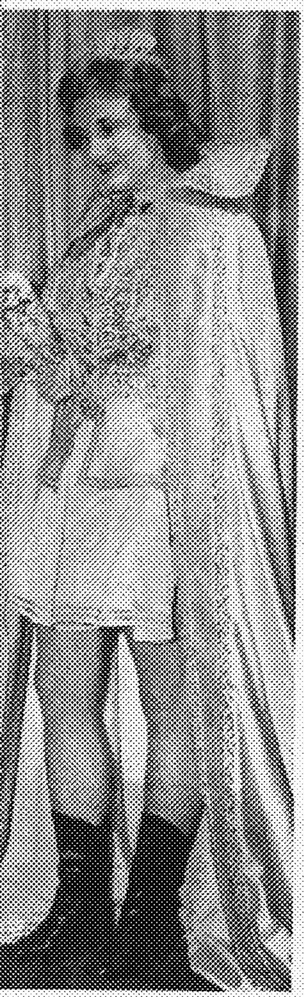


SOME SENIOR ENGINEERS get set for the knighting ceremony by trying out their regalia and looking over a shingle from last year's celebration.



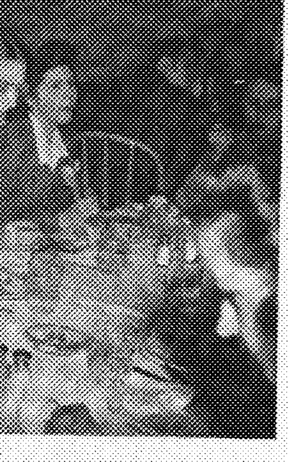
NERVOUSLY WAITING
queen candidates are

—STREAMLINED



arshall Burquest as St. Pat.

HELEN HELLAND, Alpha Gamma Delta candidate, answers the judges after being asked what she thinks of engineers and Engineers' Day.



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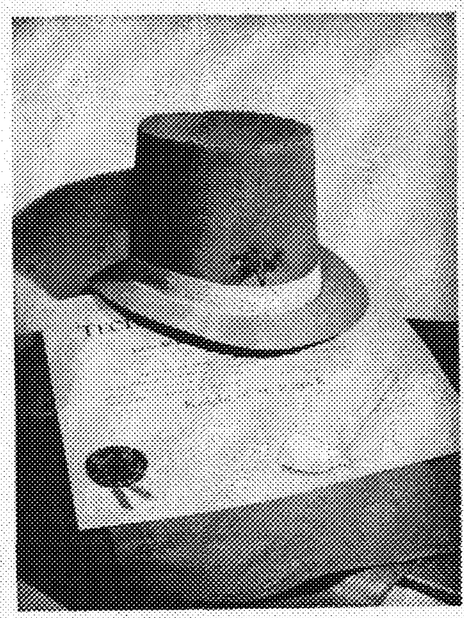
ng at the luncheon given
r.

MEMBERS OF PLUMB BOB get the Blarney Stone out of its hiding place in preparation for the traditional knighting ceremonies.



In Days of Old

E-DAY

ALONG with many other University activities, Engineers' Day for 1944 is slightly curtailed. But be not dismayed. The most important parts of the celebration are to be held on Friday, March 3. Starting off with the knighting ceremony at the Union and ending up with the Brawl that evening all the engineering students and faculty are prepared to take part in the festivities. In order that all may be present the entire Institute is excused from classes Friday afternoon.

In the past the responsibilities of Engineers' Day rested chiefly on the shoulders of junior class, but this year there are not enough juniors and the entire Institute must share in the work.

Perhaps the apparent lack of interest shown by sophomores, and even more so by freshmen, may be attributed to the fact that they do not know what Engineers' Day is. It has been going on each year since 1903. The story goes that on St. Patrick's Day of that year, a group of workmen were excavating near the Mines Building when a large stone rolled away from their project. It came to rest on the foot of one of several engineering seniors who were seated on the grass busily eating their lunches and observing passing coeds. The exact words uttered by the surprised individual who stopped the boulder were never recorded, but the startling discovery made by one of his companions was not to be forgotten. He called the attention of the group to a strange inscription appearing on the stone. Being unable to decipher the odd characters, the engineers carried the rock to the foreign language department. An expert studied the inscription and translated it to "Erin go Braugh," or "St. Patrick was an engineer."

Upon investigating St. Patrick's biography, the excited engineers decided that the statement on the rock was true. They figured that in chasing the snakes out of Ireland, St. Patrick had originated the worm drive. For this reason, he was adopted by the engineers as their patron saint, and Engineers' Day was set aside to honor him.

Realizing that the rock was, in reality, the Blarney Stone, it was immediately intrusted to an organization known as Plumb Bob, the members of which, according to supposition, are supposed to maintain a 3.1416 average. At that time the School of Mines was not part of the Institute. As the sacred rock was found on their territory, the miners felt that it belonged to them. That is why they have tried to steal the Blarney Stone before it has served its purpose in the knighting ceremony on Engineers' Days of the past.

One year, the miners managed to throw the 200-pound boulder off the Washington Avenue Bridge, but the engineers managed to recover it from the bottom of the Mississippi. Another time the boulder was dropped on the steps of Northrup Auditorium by the culprits who were hurriedly making off with their loot. In 1943 a group of mines students stole the rock from its resting place in the Union. As yet, no one has succeeded in permanently keeping the Blarney Stone from the engineers.

Now that Mines is part of the Institute there is not so much trouble from them. Instead, the traditional rivals of the sons and daughters of St. Patrick have become the foresters, and in recent years the axe and sliderule have crossed on the field of battle many times. Annual raids by the engineers on the Ag campus have not promoted a friendly feeling between the two groups when the spring of the year rolls around.

In 1942 a queen contest was inaugurated, and quite an interesting tale is connected with the newest of traditions. In that year, the queen mysteriously disappeared on the eve of E-Day. The engineers were joined by the police in a search for her, but her kidnappers returned her safe and sound in time for the crowning.

Incidents such as these, traditions such as the knighting of the seniors by St. Patrick, engineering exhibits, the E-Day Sunlite, the Engineers' Brawl, sports tournaments, all add up to make Engineers' Day a living part of The Institute. They have served to bind Technology students together so that they possess a feeling of unity which is lacking in many other colleges.

TABLE I

	B.P. °C	M.P. °C	Sp. Gr.
2, 3 dimethylbutane	58.0	—128.8	0.6620
2, 3 dimethylpentane	89.7		0.6944

(Continued from Page 186)

benzenes. Gasolines containing up to 85 per cent triptane will not freeze above minus 78 degrees centigrade. Besides lowering the freezing point of triptane, the addition of the hydrocarbons also lowers the volatility.

One method used to make triptane in small amounts is by heating hexane with aluminum chloride at 96 degrees centigrade. With this method on the basis of 100 parts of hexane, 1.5 parts are triptane. The Ipatieff and Haensel method gives a much larger yield of triptane. The by-products of the latter method, 2,3 dimethylbutane and 2,3 dimethylpentane, have proved to be superior to alkylates when used as blending agents for aviation gasoline. Some of their properties are given in Table II. Triptane and both of the previously mentioned by-products are soluble in alcohol and ether but insoluble in water.

A universal use of triptane as an aviation gasoline is highly probable. This statement is not only based on its superior power potentiality, but also on the ever-increasing drain on our petroleum wells. An important problem confronting our country today is whether our petroleum reserves will be capable of supplying the demands of aviation fuel and lubricants which will follow after this war. Since 1939 oil has been consumed faster than it has been discovered in new fields. This problem was considered so momentous that the U. S. Senate Committee on Public Lands and Surveys appointed a special committee, the War Minerals Subcommittee, to investigate other sources of liquid fuel. In August, 1943, this committee made very encouraging reports at Washington, D. C., Pittsburgh, Pa., Salt Lake City, Utah, and Sheridan, Wyoming. This committee reported that synthetic gasoline could be produced from coal, natural gas, liguite, and vegetable material and that crude oil could be produced from oil shale and tarsands. The supply of the above raw materials was estimated by geologists to be available for a period which would vary from 1,000 to 2,000 years.

In one of the hearings of the subcommittee five methods were introduced for the assurance of a future fuel supply:

1. Husbanding of our present resources and other reserves still to be discovered by restricting the use of natural petroleum, and by substituting lower grades and more abundant fuels where possible.

2. Augmentation of the supply of our indigenous petroleum by distilling or restoring oil shale.

3. Manufacturing of liquid fuels for internal combustion for replaceable sources such as agricultural products.

4. Adoption and improvement of known procedures for using solid fuels in internal combustion engines.

5. Development of processes for producing synthetic oils from other natural resources such as coal.

The five methods indicate that many, if not practically all the sources for the production of liquid fuels, have been investigated. They also indicate the urgency of finding other sources of liquid fuel. Harold L. Ickes, Petroleum Administrator for War, also indicated such an urgency when he spoke before the joint House-Senate Committee and said, "We must insure our future security by lauching a synthetic fuel program and we must do it without delay."

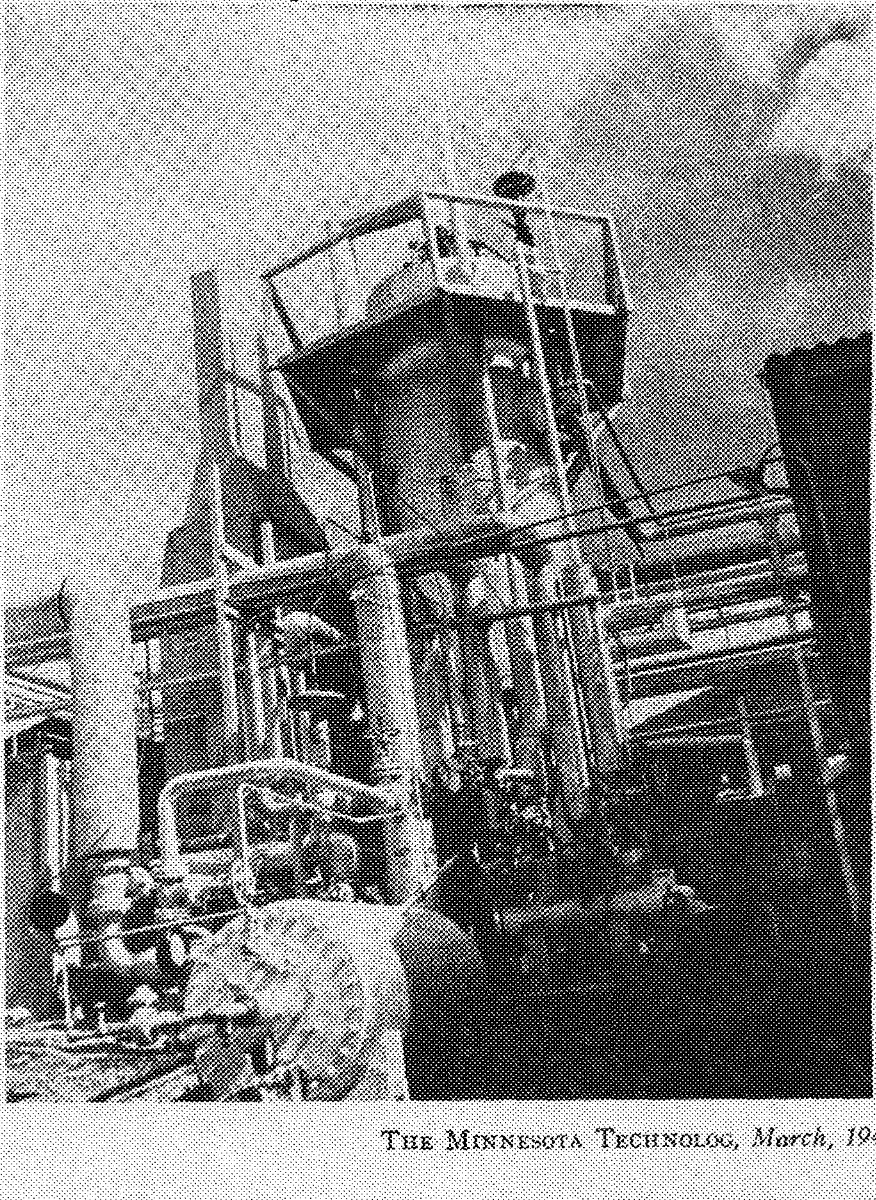
With the advent of a cheap method of producing triptane, much of the petroleum that would otherwise be used in the production of high octane gasoline, would be conserved. Our war needs call for tremendous quantities of the petroleum to be used in production of the octane gasolines. It was estimated that in 1941, 1.04 billion barrels of crude oil were produced. The latest estimate shows that the production of 100 octane gasoline runs from 70 to 90 million barrels annually.

High octane hydrocarbons are produced by two principal methods. The first is by the formation of large hydrocarbon molecules from suitable smaller ones. The second is a rearrangement of the structure of larger hydrocarbon molecules with a change in size. The processes used by industry which involve the two methods are alkylation, isomerization polymerization, dehydration and hydrogenation. It is very probable that these processes are used to produce triptane.

In August, 1943, the Army announced that triptane was twenty-five per cent more potent than any other gasoline which has been invented and that it was ready to go to war. As far as is known, there has been no commercial engine built which is capable of utilizing the full power value of pure triptane. Triptane's high anti-knock properties improve the performance of present-day aircraft engines and it may make possible the design of future engines of even greater power and efficiency.

THIS IS A GASOLINE distilling plant which is utilized in the separation of various hydrocarbons from crude oil by fractional distillation. The distillation takes place in the fractionating column.

COURTESY OF PETROLEUM REFINER



Our Future Laboratories

(Continued from Page 181)

Street laboratories. The third building was experimental engineering, which will still house equipment for the steam division. Oak Street laboratory, long famous for its enclosure of a full-scale house used in insulation experiments, will be turned over entirely to research.

The rapidly developing field of plastics receives space comparable to its importance in the new building. Fourth floor allows a laboratory 46 by 21.5 feet for plastics, as well as a pattern and wood shop, and a foundry, plus small specialized laboratories in industrial radiography, pyrometry, and magnaflux. Internal combustion engine testing will be conducted on the fifth floor, where it is also planned to have test cells for airplane engines, a fuel and lubrication laboratory, a calculation room, aircraft engine models, and chassis models.

Problems of vibration and sound have been anticipated by the architects, who have included individual sound isolation of machines where necessary. Noise from laboratories will be shut off from adjacent classrooms, research and computation rooms by construction which will reduce transmission of sound together with the use of highly absorbent acoustical materials. Air-borne sound through ventilation ducts will be deadened by absorption tile. Psychologically, the elimination of this disturbance factor should enable more efficient work on the part of both students and faculty.

Natural lighting from windows will be used to the maximum by the arrangement of individual laboratories on each floor. Glass interior dividing walls will permit greater diffusion of light throughout all space.

Flexibility in position of equipment will be possible through convenient placing of electrical outlets. All service facilities, sometimes greatest irritant in new buildings, are being given careful consideration with respect to the many demands that will be made upon them.

No one realizes more certainly than the university planners themselves that an institution of higher learning does not thrive on merely fine buildings; but they know, too, thta particularly in the field of science good equipment is necessary to train minds to the best advantage. They know that health is essential to clear thought and good work. They know that protection of health by proper safety measures, by adequate heating, lighting, and ventilation, is a function of an institution which strives to teach the ideal. They know that an investment to promote a higher standard of living will be repaid adequately not only through direct benefits to generations of students but also through indirect benefits to those who profit by the students' learning and by research.

Such an investment is the new mechanical-aeronautical engineering building.

Hidden Iron Ore

(Continued from Page 180)

per cent pig iron to 28.24 per cent scrap with very satisfactory results. It is apparent that the use of Steep Rock ore permits the use of a great deal less scrap. Outstanding metallurgists have calculated that with 2,000,000 tons of this Steep Rock ore available per annum, a saving of 9,000,000 tons of scrap per year can be made.

It is estimated that 12,000,000 tons of open hearth ore are needed in the United States annually at the present rate of steel production but only a fraction of that amount is available from natural sources. The shortage is made up by agglomerating suitable fine ores by sintering or other processes. Even in peacetime there has never been an overabundance of open hearth ore and the Steep Rock ores of this quality should therefore always find a ready market at high prices. The urgent need of such ore in wartimes is quite apparent. Since the Steep Rock ore is also an outstanding blast furnace ore, all of the expected production should find a ready market.

Importance of the Discovery

The importance of the discovery and development of the Steep Rock high grade iron ore deposits is emphasized by the rapidly diminishing supplies of high grade ores in the Lake Superior district under the impetus of wartime production. Various estimates have been made as to the life of the remaining ores of this character, such estimates running from something under ten years to fourteen or fifteen years.

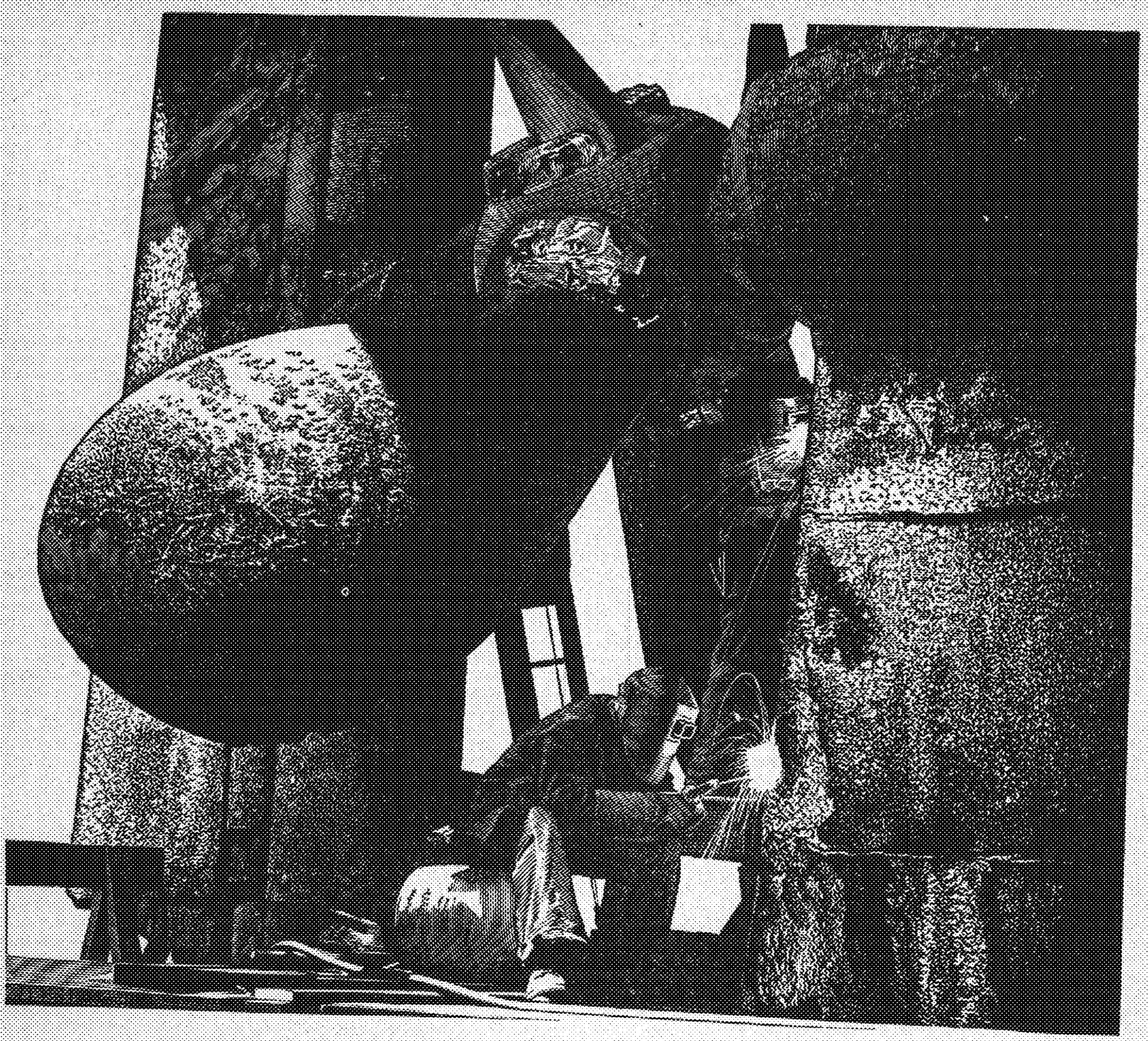
Nearly two years ago, in a report presented to the Materials Division of the War Production Board, Mr. E. W. Davis, Director of the Mines Experimental Station of the University of Minnesota, made a study of this problem and stated that "it is shocking to realize that in a comparatively few years, the great steel industry dependent upon Lake shipments will find itself short of the necessary ore to meet emergency steel requirements. This means either that a foreign ore supply of enormous magnitude must soon be made available, or that the underground ores and the low-grade ores of the Lake Superior District that exist in great quantities, especially on the Mesabi, but which are not now being utilized must be developed and put into production on a very large scale. The reserves of underground Mesabi ore are large, but it is hardly conceivable that any large proportion of the 70 to 90 million tons that will be required annually from the Mesabi can be secured by underground mining."

Most recent recognition of the diminishing supplies in the Lake Superior region is found in the announcement by Oliver Iron Mining Company, the largest operator in the area, of plans for establishing a new iron ore research laboratory at Duluth. The new facilities of this U. S. Steel Corporation subsidiary will enable it to carry on its study of ways and means of improving iron ores currently being mined, as well as a program of experimental investigation of methods of concentrating lower grade ores to meet blast furnace practices. Last year a dozen leading companies operating in the Lake Superior district announced the inauguration of a research program involving utilization of the lower grade ores to be carried on by the Battelle Memorial Institute.

How acute the situation is becoming is also indicated by the remarks of Walter H. Blucher, Executive Director of the American Society of Planning Officials, speaking at a postwar planning conference a few weeks ago in Chicago. He warned that the present rapid depletion of the high grade iron ore reserves of the Mesabi Range will jeopardize the Chicago area's position as a steel center within a decade unless some economical process for utilizing low grade ores in Northern Minnesota and Michigan is developed.

The Steep Rock iron ore deposits constitute the only important new source of high grade ore on the continent and its production should be an important factor in the increasingly serious need for such ore in the United States and Canada.

A SECTION OF STEEP ROCK LAKE under which the A ore body lies, with the original Steep Rock mining camp at right. Ore had been mined here many years ago but the expense of mining was too great due to its undesirable location.



REPAIRING DAMAGED LINKS IN OUR LIFELINES

WITHOUT benefit of ceremonies, American ship repair yards are regularly performing one of the most gigantic and least publicized jobs of the war . . . a task which is vital to maintaining a constant flow of troops and materials over our trans-oceanic highways. As evidence of the scope of this achievement, in 1942 alone American shipyards completed repairs on over 12,000 ships of all sizes.

In this big war job, as in the huge ship construction program, the oxyacetylene flame and the electric arc are indispensable. These speedy modern tools provide the fastest and most flexible method of cutting and joining heavy steel ship plates . . . whether it be for production, maintenance or repair. Similarly in many other vital war industries, the oxyacetylene flame and electric arc have made possible unprecedented production records. Their proven speed, efficiency and versatility in war production foreshadows their increased importance in future peacetime manufacturing.

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AS WE SEE IT

The American Engineer

This is not a time to place emphasis upon nationalism. Our present state of global war springs, in part at least, from the growth in the world during the twenty-five years since the last war of a narrow and destructive nationalism. However, the past contributions of the American engineer to our peaceful way of life and his present contributions to our war effort are so unique in character that a survey of their scope and value points to a potential force in the world reconstruction period that lies ahead.

Science is, of course, and always has been international. It knows no national boundaries. Engineering, however, which is well defined as the application of science to man's living, takes on a national character for the very reason that man's living differs from one nation to another. The common reservoir of world scientific knowledge has been equally accessible to the engineers of all nations. The engineers of each nation have taken from this common source as much or as little as they chose and have converted it into technological practices that have implemented their nation's way of living.

The American standard of living is a term familiar to all. We speak of it with pride, for it is unquestionably the highest in the world. There are many factors that have contributed to this uniquely high standard. Among them are our vast area; our enormous supply of natural resources; the ambition, energy and thrift of our people and our democratic society. The American engineer has made the most of the opportunity offered by these favorable fundamental factors to dip continuously into the world reservoir of scientific knowledge and to draw deeply therefrom of basic knowledge which he has converted into a technology that has made possible our uniquely high standard of living.

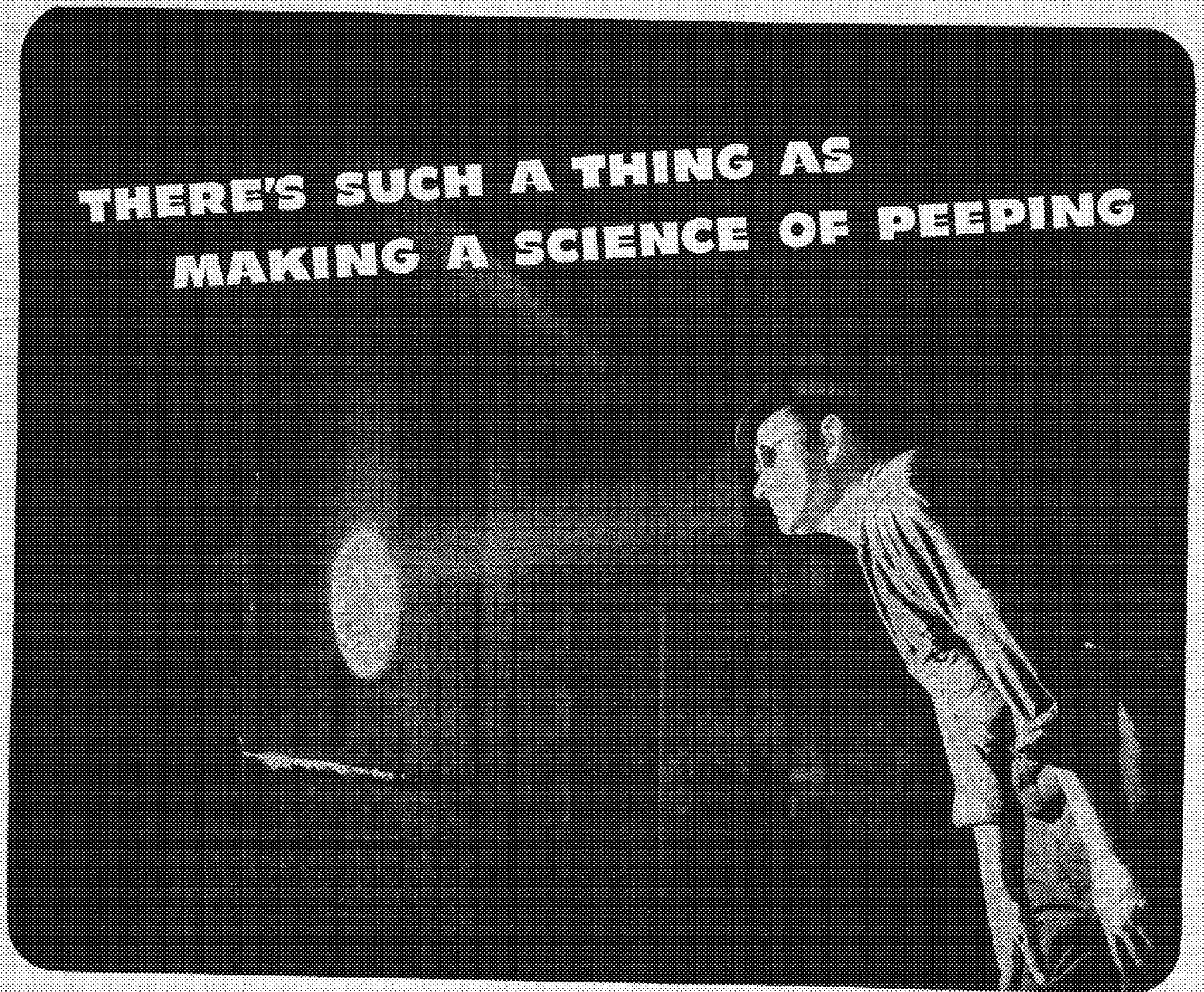
This technology during the past few decades made available, at prices within the reach of a large and steadily increasing percentage of our people, a wide range of facilities that have added to the comfort and enjoyment of living. Typical examples are: the automobile, the telephone, the radio broadcast receiver, the mechanical refrigerator, central heating, home insulation and air conditioning, and electric and gas cooking stoves. These are available to our people in an abundance that is not approached in any other nation. The mass production techniques that we employ in the manufacture of these and similar facilities are uniquely an American engineering contribution. They have made possible the low costs which have permitted such wide distribution.

Our mechanized and scientific agriculture and splendid national transportation systems combine to make our diet the most varied, interesting and nutritious of that of any people. The network of highways that cover our entire country, coupled with the wide distribution of ownership of the automobile, make available to an ever-increasing number of our people recreation trips of scope and variety unparalleled by any other pople. These are only a few examples of the contribution of our engineers to the American way of living.

In a period of less than four years, the productive capacity of our country has been turned completely to meeting the needs of war. A very large percentage of the items making up our present production were not yet developed four years ago. In this astonishingly short period of time we have developed, designed, placed in manufacture and expanded to unprecedentedly high rates the production of a substantial portion of the tools of warfare that our Army and Navy now are so successfully employing. This is, of course, a national accomplishment and one in which almost every citizen has some share. Yet it is at heart technical and highly so; it would not have been possible to accomplishment either in the total volume or in the functional quality of the units except for the unique contribution of the American engineer. It can truly be said that the standard of equipment of the American Armed Forces is fully up to the standard of living of the American people and that both are made possible by the American engineer.

He has measured up to the opportunities for service that America at peace and at war have presented to him. What will be his opportunities for service when peace comes again? This cannot be answered until the conditions of the peace are known. We all recognize that there is a huge task of world reconstruction immediately ahead. We know that after reconstruction, if war is not to come soon again, there must evolve a new pattern of world cooperation.

If the pattern of the reconstruction period and that which follows is one that gives promise of an enduring world peace, I am confident that it will open up large fields of opportunity for service to the American engineer. Can any one doubt his ability to measure up fully to these new opportunities? It is certain that his service to a world at peace will be as unique as has been his service to America at war.



OWI by Palmer, in an Allegheny Ludlum Plant.

WITH this melter, studying the action of some 35 tons of alloy steel in an Allegheny Ludlum electric furnace, peeping is resolved into a science.

His job is one of the earliest in a long series of operations which bring a melt of Allegheny Ludlum stainless, electrical or other alloy steel to its final form, rigidly true to specifications. His experience determines whether the molten mass within the furnace is progressing at the proper rate, and dictates any adjustments necessary to produce the quality of steel specified.

His judgment is double checked, of course, by thousands of dollars worth of amazingly accurate testing equipment, built for analyzing with hairline precision.

For, in wartime especially, the properties of alloy steels must be maintained with the utmost consistency. Lives of men—even the outcome of battles depends upon this uniformity, because the place of alloy steels is always in the vital heart of a war mechanism.

Lives and battles depend upon other things in this war, too—matters that come home to every household. Buying bonds, conserving food, fuel, gasoline, rubber, waste fats and scrap metal—all these have to do with how soon the war will be won, and at what price. They are *everyone's* jobs. Have you done —are you doing—*all* you can?

Allegheny Ludlum
STEEL CORPORATION
BRACKENRIDGE, PENNSYLVANIA

A-8841 . . . W & D

For Greater Speed

(Continued from Page 184)

In Germany, two designs have come from the Junkers Company. One of these models uses an air-cooled, two-stroke internal combustion engine for driving the compressor. The second, a compact unit for wing installation, has a gas turbine to accomplish this task.

A third German model is offered by the Heinkel firm. Its underlying principle is the same as that of other all-rotary jet-propulsion units, but it has one particularly interesting feature. Its combustion chamber is insulated by a layer of cold moving air which is warned by heat that would otherwise be lost in radiation; and is then added to the jet stream before it leaves through the nozzle.

In 1933, Captain Frank Whittle of the R.A.F. began working on a turbo-jet motor, and in April, 1937, his engine ran successfully for the first time. It is this motor that is incorporated in the Allied jet-propelled fighter recently announced by General Arnold. Just how his motor works is of course a secret; however, it is probably similar to one he designed earlier for installation in the tail of an airplane. In this unit air could be admitted either at the nose of the ship as in the Italian model, or through a series of airscoops located along the sides of the fuselage.

The Whittle motor installed in this first British jet-driven plane was shipped to the United States in September, 1941. Here it was studied by General Electric and Bell Aircraft Corporation which was set to work on the design of a jet-propelled airplane. On October 1, 1942, the first All-American jet-driven plane was flown.

Other research has been carried out, especially in America, France, Switzerland, and Sweden, but the motors that have been mentioned represent the most advanced steps.

Increased Efficiency

The increased efficiency of the jet-propelled plane over the ordinary airplane at high speeds and altitudes is of prime importance. In attempting to reach extremely high altitudes, propeller-driven airplanes have made use of superchargers to increase the supply of oxygen in thin air. Since the turbo-compressor is in reality a large supercharger, the turbo-jet motor seems to be the most reasonable solution in the fight for altitude.

It is a well-known fact that greater speeds are attainable in the less dense air found at great heights. Because of this the jet-propelled airplane, operating at great altitudes, should be employed in the future for much greater speeds. According to research figures derived in conditions found equal to those found at 40,000 feet, the efficiency of a jet-propelled machine at 150 miles per hour is only half that of the airplane of today, but the efficiency of the two become equal at 300 miles per hour, and at 550 m.p.h. the jet-driven machine is twice as efficient as the engine-propeller arrangement. These figures, of course, are experimental and have not been substantiated by actual flight conditions, but they nevertheless indicate the trend in comparison of the two aircraft propulsion systems.

The principle of the jet motor itself introduces several favorable factors. In the first place power is applied directly. No intricate gear systems are necessary as in the aerial power plants of today.

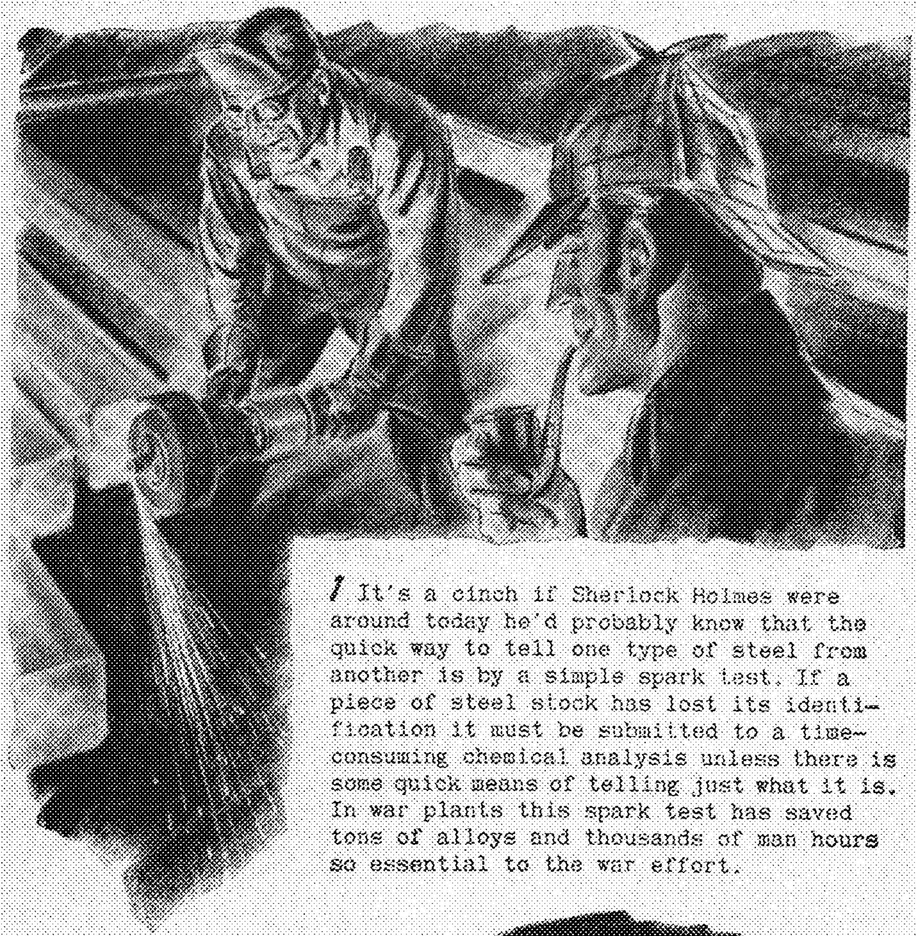
Because of the relatively low pressures at which the components of the turbo-jet motor operate, lighter materials are suitable in its construction. This means an increase in the power to weight ratio, which in turn means an increase in the performance of the ship.

The general form of the turbo-jet motor makes streamlining relatively simple. Thus airplane designers will be able to fit it into the fuselage or practically submerge it in the wings of a plane.

Last but not least on the list of benefits derived from the turbo-jet motor is the possibility in the line of fuel. The need for high octane aviation gas used in the reciprocating engines of today is eliminated. Instead, cheap fuels such as paraffin, diesel oils, and tar oils can be used. Powdered coal and other solid fuel may also be used.

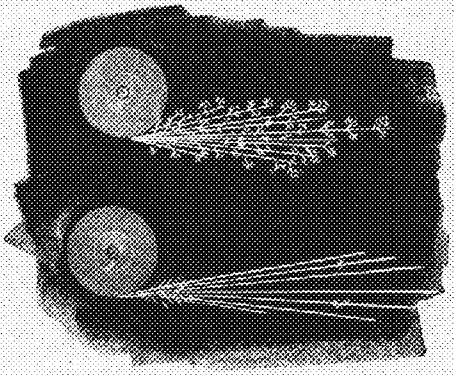
There are, of course, difficulties and disadvantages to overcome, but with skillful engineering these problems should be eliminated. The jet-propelled plane is not expected to be used in private flying. Its use will be reserved for fast, high altitude fighters, bombers and reconnaisance planes, and long range cargo and passenger airliners. The present conflict should hasten the advent of jet propulsion; so watch for its development.

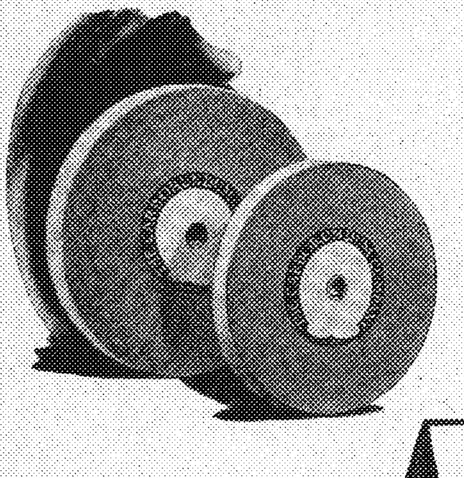
"Can you tie this one, Mr. Sherlock Holmes?"



1 It's a cinch if Sherlock Holmes were around today he'd probably know that the quick way to tell one type of steel from another is by a simple spark test. If a piece of steel stock has lost its identification it must be submitted to a time-consuming chemical analysis unless there is some quick means of telling just what it is. In war plants this spark test has saved tons of alloys and thousands of man hours so essential to the war effort.

2 When you touch the end of a piece of steel with a grinding wheel it gives off characteristic sparks and colors which tell its approximate composition. This dramatic method of conserving strategic materials is another rather interesting and unusual use of grinding wheels such as made by Carborundum.





3 Whether it's spark testing metals, tool sharpening, production grinding or any other operation where you use grinding wheels, when you get out in the field remember that there is a Carborundum Engineer ready to help solve your problems. The Carborundum Company, Niagara Falls, N. Y.

CARBORUNDUM
ABRASIVE PRODUCTS

Tank Testing

(Continued from Page 182)

later the big flat-top actually did pass through—without accident.

Many of the now-familiar landing craft developed since the start of the war were first tested in miniature at the Taylor Basin. The LCI type (infantry), constructed originally for the British, was rough-drafted and tested and its basic design worked out in the amazingly short time of forty-two hours in response to a very urgent request. Although most of the models tested are towed, these were self-propelled, and steered by actual working rudders. They were run up on a sand beach at the end of the shallow water-pool, and as beaching operations were performed, weight simulating motorized equipment were shifted around, taken out, and replaced. A short time afterward, ships produced from these designs were aiding in the invasion of Sicily.

The Basin has also been the means of investigating such various problems as propeller vibration and noise, the construction of paravanes and mine detector gear, the force of suction between passing ships with the use of Bernoulli's Theorem, the size and location of river piers and other harbor installations, and the strength of a ship's bottom plates in resisting underwater explosions. For the latter test, undersized thin plating is used, and a half ounce of TNT (a piece the size of the end of your thumb) is exploded under water. By means of the ultra-slow motion stroboscopic moving pictures, the action can be closely observed.

This super ship-testing laboratory was completed in June, 1939, three months before the outbreak of World War II, and was an indispensable part of the Navy's expansion program which began in about 1936. It was built on the basis of experience obtained at the older Navy Yard Basin in Washington, D. C., and was named after Rear Admiral David W. Taylor who had been in charge of the Washington tank for many years, and who was one of the world's leading authorities on the speed and power of ships. When this new basin was being erected, it was remarked that it was being constructed as though the Hamilton Watch Company were doing a building job for the Pennsylvania Railroad. This is hardly an exaggeration, for the Basin is the only building known to follow the curvature of the earth.

So great is the stepup in transferring the results from a twenty-foot model to a full-size ship, that the rails had to be laid with almost impossible accuracy. They could not be what we term perfectly straight, but had to follow the curvature of the earth, the variation from the absolute horizontal being a total of ¾ of an inch in their length of 1,200 feet.

The reason for this is that any vertical movement, however slight, would permit the force of gravity to act on the speed of the towing carriage, whose speed must be uniform for best results; it could not be allowed to vary more than 2/100 of a knot.

A SINGLE SCREW MODEL is receiving the finishing touches from the hands of skilled workmen. These models must bear similitude to the parent ship in every detail.

OFFICIAL U. S. NAVY PHOTOGRAPH

The foundation for the rails consists of heavy cast iron "chairs" imbedded in concrete poured directly onto the granite-gneiss bedrock. The rails are made of heat-treated carbon manganese steel and are as large as the heaviest railroad rails—55 pounds per foot. The heads meet at a 45 degree angle, and prevent the battering down at the points which occurs in square-set rails. With a "scarph joint," a wheel load is partially carried by one rail before the wheel leaves the preceding rail. But the bases of the rails are cut square sot hat with expansion the bases come in contact before the heads, thus preventing the heads from being forced laterally out of position. The lateral tolerance specified was 5/1,000 of an inch from the true level over the whole length of 1,200 feet. The method of leveling the rails to this extreme accuracy utilized the surfaces of the water in the testing basins as reference planes. Leveling bridges and dial micrometers carried in special floats established a fixed height at all points. The precision checking instruments were so accurate that great care had be taken in eliminating water disturbances. Vents, blowers, and doors had to be closed; even a truck passing outside could raise waves of 1/1,000 of an inch, which was considered excessive. Evaporation and leakage, which lowered the water level at the rate of 7/10,000 of an inch per hour, had to be compensated for in the measuring devices.

The rail laying took eighteen months, but the results have proved its worth, for when a wheel of the 85,000-pound towing carriage (heavy as a Pullman car) passes over a given spot, the vertical deflection produced is never greater than 1/1,000 of an inch.

General Test Program

When a job is first given to the Carderock Basin, it is first discussed in conference by experts from the Basin and designers from the Navy Department's Bureau of Ships. For example the problem may be to find the best hull form and power requirements of a new 10,000-ton cruiser which has some new hull design features to be incorporated into it, and which must be able to do 34 knots. A general test program is outlined, the model is designed and built, and necessary test equipment is set up.

A big-ship model is usually about twenty feet long and is built up of laminated white pine. It is roughed to shape with high-speed cutters and trued to final form by hand with planes and sandpaper. The finished model's lines are within 1/100 of an inch of the ship's blueprint specifications.

A standard model weighs from 1,000 to 2,000 pounds and costs about $400. The total cost of the model and the tests run on it amount to between $1,500 and $3,000, a cheap price to pay for discovering in advance any glaring deficiencies in design. The Navy's first 4,000-ton scout cruisers were of incredibly poor design, and would have required double the horsepower for the same speed as an altered design suggested after several tests had been run.

Upon completion, the model is floated out on a tunnel-like deep-water basin. The only light is artificial, for windows and skylights would let in sunlight which would promote the growth of aquatic vegetation. The huge carriage moves along with all the smoothness of an oil-driven electric locomotive. The model is towed at various speeds, and its resistance at each speed is measured to 32/100 of an ounce and recorded on a revolving drum. Variations in displacement and trim (difference in draft fore and aft) are also made. Hydrogen sulphide solution runs out through underwater holes in the hull, furnishing a means of studying the flow lines. A stroboscopic camera records the whole performance of the model.

The resistance measured by the dynamometer has two principal components, frictional resistance and residuary or wave-making resistance. Frictional resistance depends upon a coefficient of friction, the area of the wetted surface, a power of the speed, and a constant. The values for frictional resistances at various speeds must be calculated and subtracted from the total resistances, because there is no definite relationship between the frictional resistance of a ship and its model. The results of subtracting the frictional effects give a series of values for residuary resistances at various speeds.

Then Froude's Law of comparison and corresponding speed is used to transfer the results up to the actual vessel. Corresponding speeds are speeds which vary directly as the square root of linear dimensions. Hence, towing a 20-foot destroyer model at 7.28 knots would correspond to the actual 340-foot ship's speed of 30 knots. The residuary resistances of similar ships at corresponding speeds vary directly as their displacements.

After the corresponding residuary resistances of the actual ship at the various speeds are found by this means, the frictional resistances of the ship at these speeds are calculated. The sum of the two, residuary and frictional, gives the total resistance at each speed. Knowing the desired speed and the total resistance at this speed, the necessary effective horsepower can be easily obtained. Considering the efficiency of the propulsion system (propellers, transmission shafts, and reduction gearing) the size of the drive units can be determined.

Speedy Solutions

The greatest contribution that the basin makes is the speed with which it enables practical, pressing problems to be solved. In wartime it is imperative that the immediate information be obtainable on new designs in order to intelligently carry out a development.

We have the case of two of our new battleships, the "North Carolina" and the "Washington." These super-dreadnoughts were the first ones built since the 1920's and were in answer to the threat of enemy ships like Germany's "Tirpitz" and "Bismarck." Imagine the consternation provoked when, on putting out to sea, it was found that at high speeds they vibrated so badly that their main batteries could not be successfully operated. Cases of the jitters are not infrequently encountered when power, speed, and displacement are increased, but these two ships outdid themselves.

The Basin went to work with its model propeller laboratory and ran cavitation tests on models of the propellers used. Stroboscopic equipment was used to make the fast-moving props "stand still" so that studies could be made of the cavities formed at both the face and back of the blade at high pressures. Recommended changes in the size and shape of the blades remedied the trouble.

The Taylor Basin has even been used to study ship launchings, such as that of the giant battleship "New Jersey" built at the Philadelphia Navy Yard on the Delaware River. A replica of the ways and the adjacent waterfront was built, and subsequent tests showed that the new ship would require an unusually long run after hitting the water. The length of the run was calculated, and it was found that, as suspected, the stern of the ship would have to be slewed around to avoid the risk of collision.

These are only a few of the interesting problems that come to the basin for solution. This laboratory has been instrumental in the development of new designs ranging from battleships to PT boats, from river barges to Liberty ships, tankers and even the mysterious "sea otters." And you can bet that the basin has more ideas up its sleeve. To paraphrase an advertising statement—if better ships are built, most of them will come from designs suggested by the David Taylor Model Basin.

TECH NEWS

EDITED BY JEROME SCHWAB, M. E., '44

Student Deferment Quota Set

A new bulletin issued by Selective Service and effective February 15, 1944, presents a new policy for deferment of students. A quota of 10,000 students will be the maximum to be occupationally deferred at any one time in the fields of chemistry, engineering, geology, geophysics, and physics.

The National Roster of Scientific and Specialized Personnel of the War Manpower Commission will certify to requests for occupational deferment of students. Requests for occupational deferment of a registrant graduating before July 1, and also for those graduating after July 1, 1944 will be prepared by the institution and forwarded to the National Roster for endorsement, and will be sent to the boards after return to the University making the request.

The 10,000 men quota will be divided between different schools and the allotments will be based on the number of deferments which existed on January 11, 1944. The students who were deferred at this time and who will graduate before July 1 will not be counted in this new quota system. Students deferred for other reasons and students not yet 18 will not boost the number of deferments assigned to each school. As some of these men will obviously seek deferments when they reach the draft age, this must be met when the school and draft boards grant the deferments. There are 165 seniors who will graduate before July 1, and the quota assigned to the University of Minnesota was two-thirds of the remaining students.

The students are placed on the quota list by scholastic achievement and at this time the bottom honor point average is 1.34. The student must complete his course in 24 calendar months from the time of his deferment. If a student reaches his eighteenth birthday, and if he will complete his course in 24 months, he is eligible for deferment in the quota system providing his scholastic average merits this. The Dean's office is holding ten places open for students who will come against this problem.

As the student's position is clarified the faculty meets another problem. Although the number of students has decreased, the number of classes offered still remains about the same. The staff members in the 22-38 age bracket are facing draft orders. It is hard to tell what the outcome of the new plans will be, but it is hoped that the Roster will fulfill the war needs of our nation in both civilian industry and military operations.

ASTP Students Study 40 m.m. Bofor

Everyone going into the Electrical Engineering laboratory these days stops and looks twice at the formidable piece of apparatus sitting majestically in the center of the floor. The gun is a 40 mm. Bofor Anti-aircraft gun being studied by the ASTP advanced Electrical Engineers.

The 40 mm. gun is an intermediate between the heavier 90 mm. gun and the calibre .30 and used mostly to combat low-flying attack planes. The tracking and firing of the gun may be done manually or by director mechanism. It is the electrical controls of the director that the Army students stationed here are studying along with their regular ASTP studies. To the soldier in the field the gun is merely operated by "Hydraulic Remote Control" but to the Electrical Engineer the gun's electrical mechanisms offer a rather complete course of study. When the director is in use the gun automatically tracks the plane according to the setting placed on the director by its operators. Two operators are used in tracking, one to establish horizontal direction or azimuth, and the other to determine angular elevation. A third operator working with the range finder estimates the range and directs the firing. With these three men making settings on the directors, the director calculates the speed of the plane, time of flight of the projectile, and through its electrical mechanisms operates the hydraulic system on the gun, keeping the gun on the plane ready to be fired at any time.

The electrical and hydraulic power equipment is mounted on the carriage of the gun and is connected to the elevating and transversing mechanism. A portable a.c. generator supplies the power to the director which transmits controling currents to the gun by means of cables.

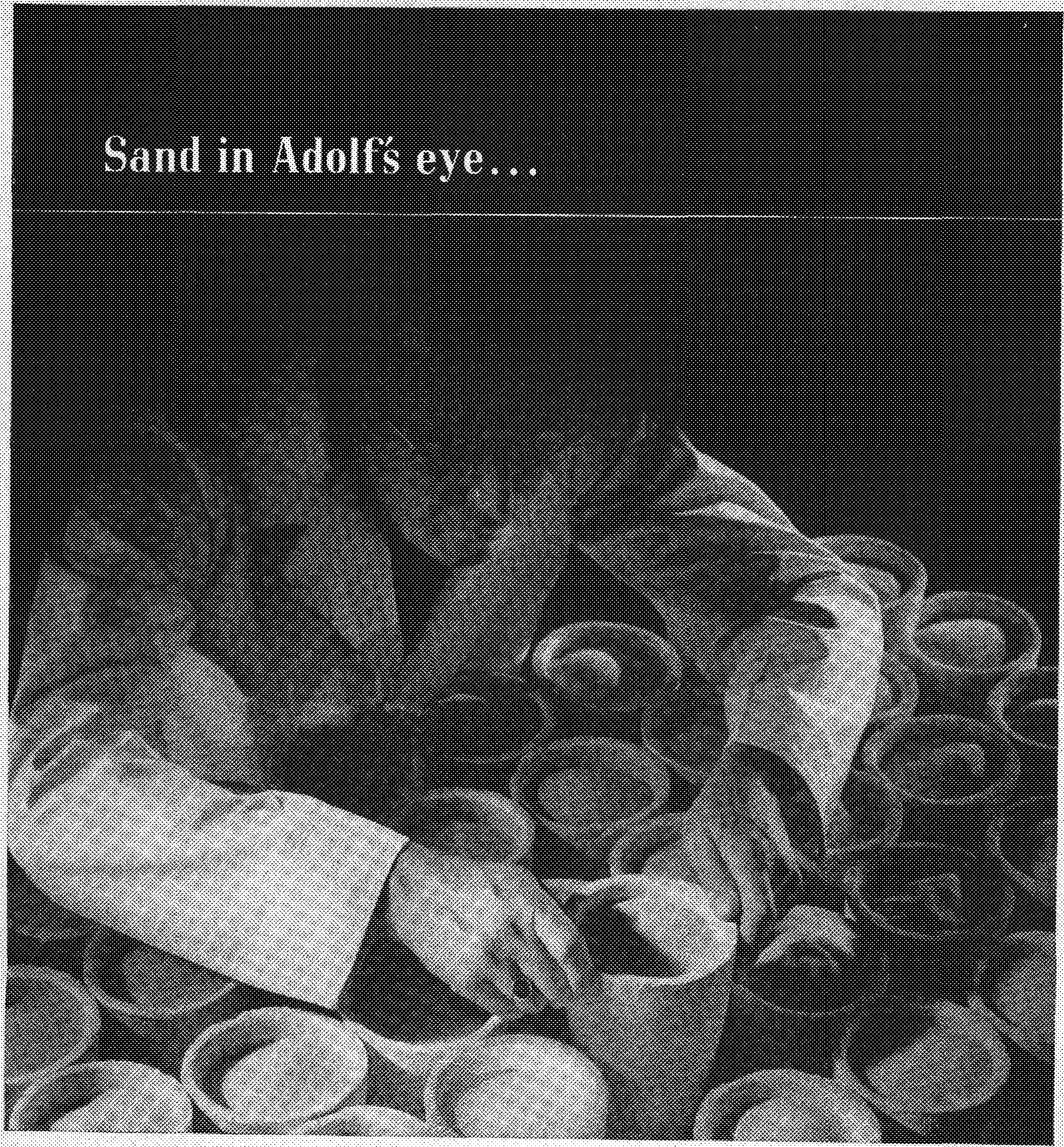
This gun is the type used extensively by our forces in practically every theatre of operation. The R.O.T.C. men stationed on campus were trained in the operation and care of this model gun before and after entering active service. The work being done with it now in the Electrical Engineering Department is from a purely theoretical and practical electrical standpoint. The ASTP men are dismantling the different electrical elements used in the gun and studying and testing their performance.

AIEE Holds Business Meeting

The business calenders of most societies at this time of year show that it is time for the selection of new officers. The A.I.E.E. held their election last month and the new officers were installed. Stanley Brown is the chairman, Deith Sucker is vice chairman, and Wallace B. Hokensan is secretary-treasurer.

These new officers presided over the first meeting of the new year on Wednesday, February 16. Mr. Perry Peterson of the Control Corporation of Minneapolis, was the guest speaker, and he spoke on "The Use of Remote Control Apparatus." He brought two control units to the meeting to demonstrate how outlying power stations can be controlled from a central station. With the unit which he demonstrated, the operator is able to tell at a glance the position of the circuit breakers at a distant station and also how the operator can control them at will.

After everyone had fulfilled his desire for knowledge of units, the formal meeting was dismissed and refreshments were served.



THIS man is a glass chemist. And the sand he's working with is going to get into Adolf Hitler's eyes and hurt.

Here's how. Glass, basically is made from sand. And glass in this war, in the skilled hands of American glass makers, is a potent weapon. It replaces metals on many jobs, metals needed for killing Huns and Japs.

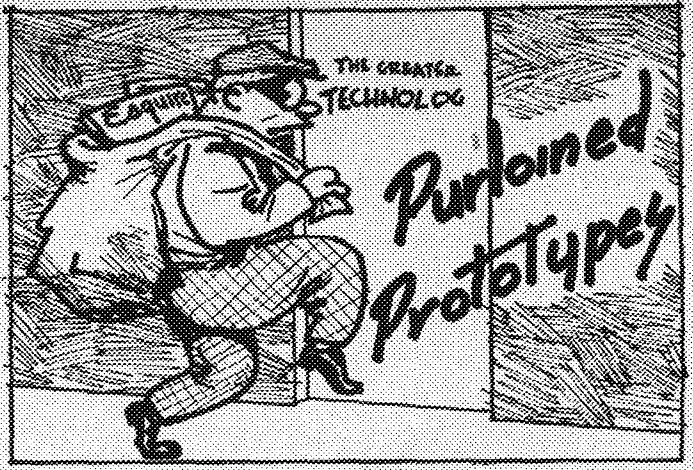
In bombsights and fire control instruments glass helps to rain accurate death on the enemy. In heavy industries, such as the explosive industry, its characteristic resistance to corrosion speeds powder output. Glass in medical and laboratory fields puts us and our allies ahead in hospital treatment and in vital laboratory developments.

The U.S. is lucky in having a well established glass industry and not having to lean upon any part of the outside world for this essential material. Glass was ready for war, and was able to contribute to the speed records set by other industries such as gasoline and synthetic rubber.

It took a lot of research to make American glass the best in the world. At Corning way back in peacetime, more than 200 laboratory men were working steadily on new forms of glass and new uses for this amazing material. More than 25,000 formulae for glass were developed. Today around 250 different types of glass are in production under the "E" pennant at Corning's main plant.

There are glasses for example that withstand corrosive chemicals, that cannot be harmed by heat, that have high electrical insulating qualities, that are extremely resistant to mechanical breakage. And these are only a few of the reasons that engineers, too, consider glass the material with endless possibilities for the future. Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass



BY BOB REYNOLDS, A.E., '44

Junior carried the following excuse to the teacher the morning following his absence: "Please excuse Junior for being absent from school yesterday. He has a new baby brother. It was not his fault."

• • •

And then there's the cannibal's daughter who liked the boys best when they were stewed.

• • •

A young lady taking a vocational school course in the operation of a factory machine defined a bolt and nut as follows: "A bolt is a thing like a stick of hard metal, such as iron, with a square lump at one end and a lot of scratching wound around the other end. A nut is similar to a bolt, but just the opposite, being a hole in a little chunk of iron, sawed off short, with wrinkles around the inside of the hole."

• • •

Law Prof (at registration): "So you are a pre-legal, eh?"
Student: "Like hell. I'm the youngest in our family."

• • •

It was midnight and the street was dark,
The passing cars were few,
Just then a girl came walking by,
In the flower of her youth.
I asked her if she would like a ride,
She seemed to hesitate,
Then stepped in and breathed a sigh.
Alas, I could not wait.
I took her to a lonely road
Where the stars lit up the sky.
My blood ran through my veins
With a feeling of do or die.
Her eyes were of the deepest blue,
Her hair was fair and blonde.
And when I touched her hand
I knew that she was mine.
Iput my arms around her waist
And kissed her ruby lips.
And as I drew away
My hand slipped gently to her hips.
It was then I found out who she was,
It hit me like a bomber,
For around her waist was slung a gun,
It was PISTOL PACKIN' MAMA.

• • •

A drunk searching diligently along the edge of the pavement and the gutter was approached by an officer who said:
"What are you looking for?"
"I just lost fifty cents."
"Where did you lose it?"
"About a half a block down the street."
"Well, why are you looking for it here?" asked the impatient officer.
"Oh," replied the drunk, "the light's much better here."

• • •

Imagine the newsboy's embarrassment when he opened the wrong door in the depot waiting room and yelled, "Extra Paper!"

• • •

Blessed are the censors for they shall inhibit the earth.

A half breed is a man with a cold in one nostril.

• • •

Grace: "Are you in town for good?"
Percival: "Naw, I'm in the Navy."

• • •

Also there is the engineer who calls his girl "discontinuous integral" because she has no limit.

• • •

A sweet young gal breezed into a florist shop and looked around the shelves for something she wanted.

Then she saw an old chap puttering around a plant in the corner and went over to him.

"Have you any passion poppy?" she inquired.

The old boy looked up in surprise.

"Gol ding it!" he exclaimed. "You just wait till I get through prunin' this lily!"

• • •

I call my girl "A" book because I can't get anywhere with her.

• • •

Ed says that he knows a guy so innocent that he chopped down all the trees around his house because his wife said she wanted a little son.

• • •

It was lunch time at a downtown hotel. The flippant young man marched into the dining room with two ladies and ordered the waiter to bring a glass of milk. "One glass, waiter, and three plates."

The three plates were duly brought, and the young chap took three sandwiches from his pocket, and the little party proceeded to enjoy themselves.

But the outraged waiter scurried off and told the manager. The manager exclaimed: "Look here, you, what do you take us for? Ordering a glass of milk, and then using our plates to eat your sandwiches from! Why I nev . . ."

"Who are you?" demanded the customer, frowningly.

"Who am I? Why I'm the manager."

"Oh you are, are you! Then you're the guy I'm looking for. Why the 'ell isn't the orchestra playing?"

• • •

"Morning, Mr. Boggs, Y' gettin' some exercise?"

"Heck, no, djay got me walled in . . . I sh' can't—hic—finda djoor!"

• • •

A few days ago we were considerably startled by the sudden upthrowing of a first-floor window and the sudden catapultic emission of a middle-aged gentleman therefrom. His nose was the first part of him to strike the pavement, and it bled furiously as he arose—now surrounded by an admiring throng—and limped painfully away.

"Calls himself an 'Arctic Explorer!'" he cried, sarcastically, as he looked up at the window. "Comes home pretty often for an 'Arctic Explorer,' I'm thinkin'!"

• • •

"My grandfather plays the piano by ear."
"Well, if we must boast—my grandfather fiddles with his beard."

• • •

He was sitting in the beverage room of a downtown hotel surveying his empty glass, and he had definitely had enough. Something also was decidedly wrong and presently, he turned to the man next to him.

"Shay," he asked, "didjo shpill a glass o' beer on me?"

"Certainly not!" answered the fellow guzzler.

The souse turned to the man on the other side.

"Mishter," he wanted to know, "Didjou by any chance throw glass o' beer in my lap?"

"No!" snapped the man.

The drunk mulled over this information thoughtfully.

"Jusht what I been sushpecting," he declared solemnly. "It'sh an inshide job!"

• • •

She was only the miner's daughter, but oh! what natural resources!

• • •

"Thish match won't light."
"Washa madda with it?"
"I dunno—it lit all right a minute ago."

• • •

"Ah," he murmured as the lights went out across the street, "now I can sleep."

Harry Brenner will take over the editor's position for the April edition of the TECHNOLOG; and with the kind permission of the draft board Harry will probably be around to put out many more good issues. Harry is really quite a busy fellow about the University for not only is he the future TECHNOLOG editor but he is also working hard on Engineers' Day besides belonging to several fraternities on the campus. Harry is working toward his degree in aeronautical engineering but he thinks he will be serving a while with the armed services before he has a chance to use his aeronautical training.

The following poem was used by the editor of another engineering magazine to express the worries and tribulation that an editor must pass through as the press time grows near, and I feel it is worth passing along:

He Should Have Knocked

'Twas the night before deadline,
  and all through the tower,
the editor's voice
  boomed out like a flower.

Where the —— is that story
  that filled in the back?
We can't run an issue
  that hangs like a sack.

The managing editor
  groaned with despair,
as he glanced in a file
  to find 'twas quite bare.

The rest of the staff
  was by now on their knees,
to see if the story
  had flown with a breeze.

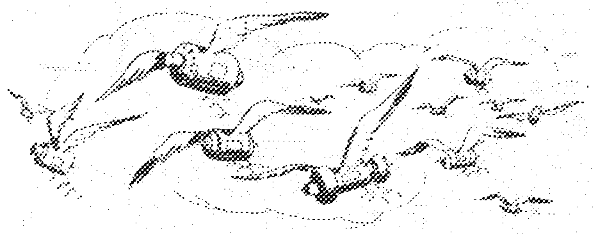
The telephone jangled,
  and over the wire,
the printer's "hello"
  was a ball of fire.

Then into this maelstrom
  a freshman dripped cheer,
as he waltzed in and said,
  "Can I help out here?"

As I pass my duties along to the next editor, I wish to thank the many people who have worked hard to keep up the high standards of the TECHNOLOG. It has been a great pleasure to me to edit the TECHNOLOG and I only wish that I might have had the opportunity to put the magazine out for the entire school year. I also want to remind those of you who stay in school that the TECHNOLOG is your magazine and published for your benefit, so make the most of it.

Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

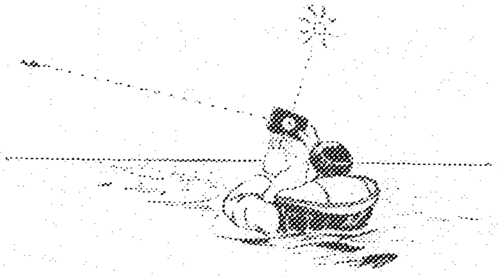


FLYING FAMILY

WHEN a big bomber or a punchy fighter thunders off the field to keep a date high over an enemy target several hundred miles away, many electric motors go along with it—but not just for the ride.

From the time the starting motors turn over the cold engines till, back over the home field, a combat-weary man presses a button and the retractable landing gear lowers from the plane's belly, electric motors are doing hard, exacting work.

These motors, seemingly delivering power out of proportion to their lightness, have taken over most of the tiring muscular jobs . . . like lifting and lowering the flaps against tremendous and varying wind pressures . . . like swinging around the gun turrets at the gunner's slightest signal. And thousands of these are G-E motors, being supplied in ever-increasing numbers for armament operation and for the actuating parts of planes.

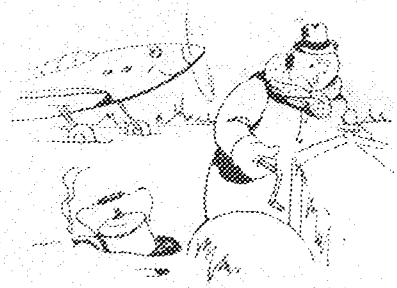


SOLAR SEARCHLIGHT

WHEN a dazzling point of light gleams on the broad seascape, and when suddenly that point becomes a blinding glare that persists in following your plane, chances are a man is adrift at sea and needs your help.

He is using one of the new emergency signaling mirrors, designed by General Electric in co-operation with the Coast Guard, the Bureau of Standards, and the National Inventors' Council.

These mirrors are already aboard hundreds of lifeboats and rafts. The shipwrecked sailor follows three simple steps, printed in large letters on the back of the mirror, to shoot a beam of sun-glare at a target—and that target may be a plane or ship up to ten miles away.



UPSTART

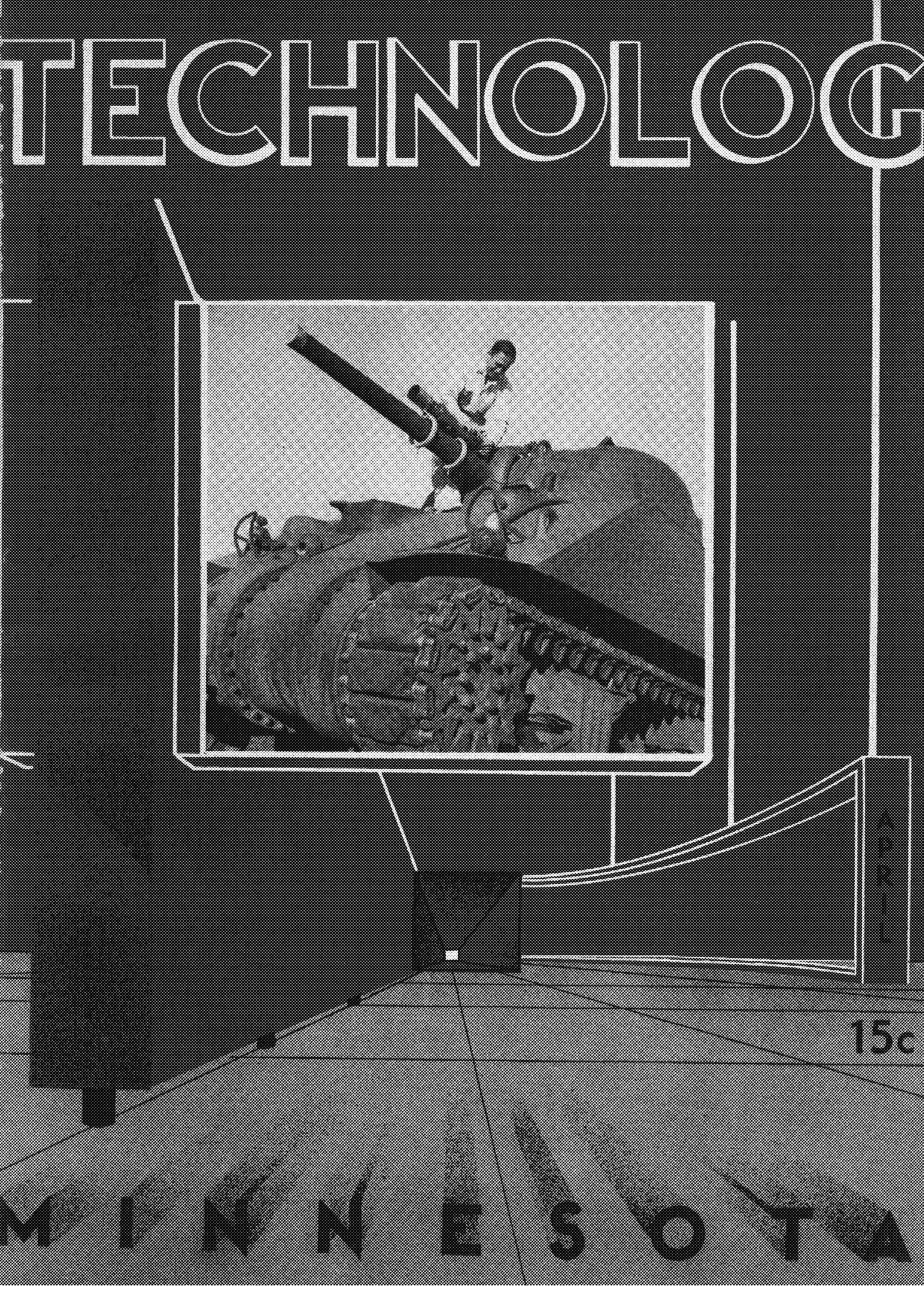
MAYBE you've wondered how the big Fortresses and Liberator bombers of our Air Forces—operating from the cold Aleutians, Newfoundland, and Iceland—can be started in such cold climates without a moment's loss of time.

One of the reasons is a small General Electric device—the starting vibrator for aircraft engines—one of the three hundred and more G-E developments for our fighting planes. This starting vibrator provides a very hot spark which helps aircraft engines to start instantly, regardless of weather conditions.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6.45 p.m. EWT, CBS.

BUY WAR BONDS

GENERAL ELECTRIC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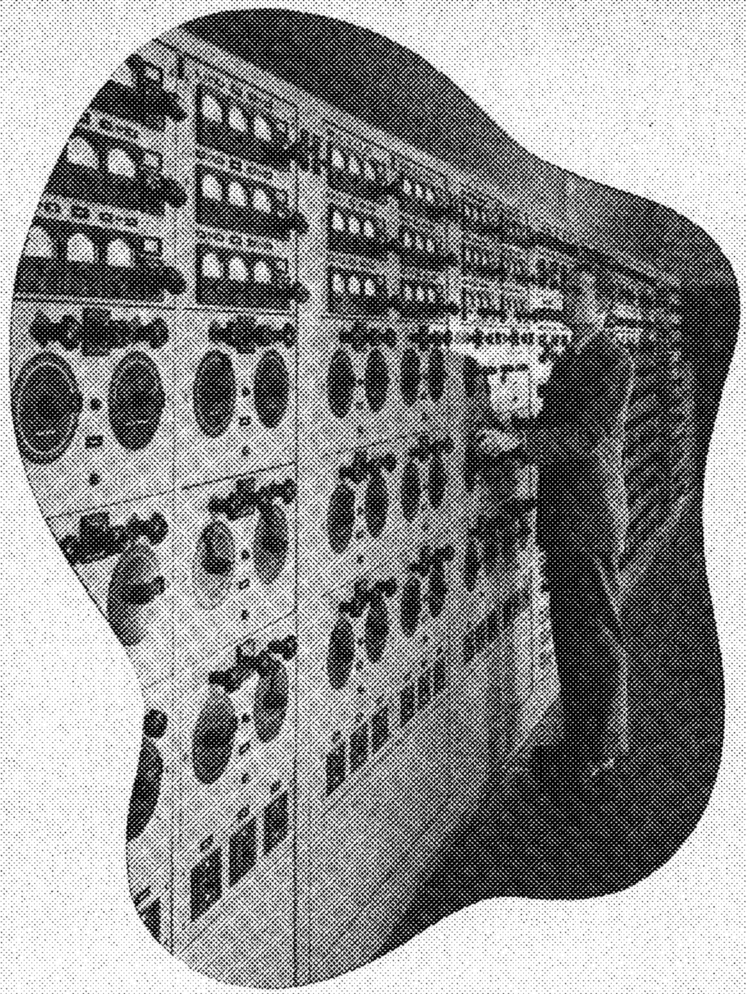

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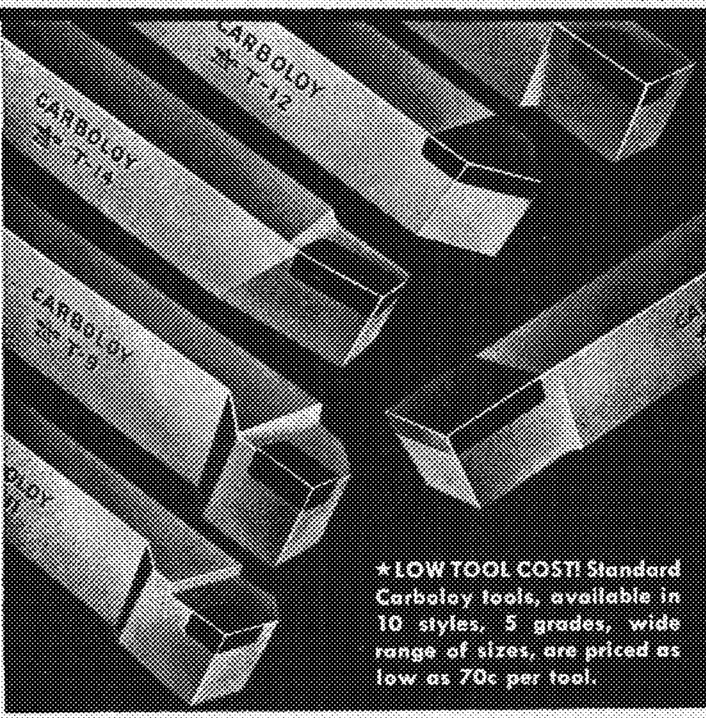
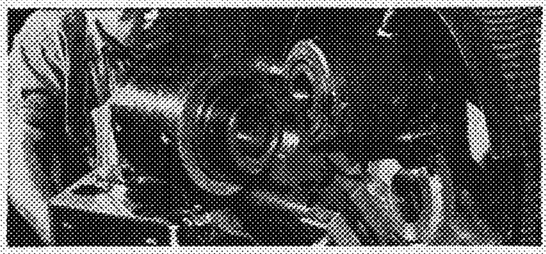
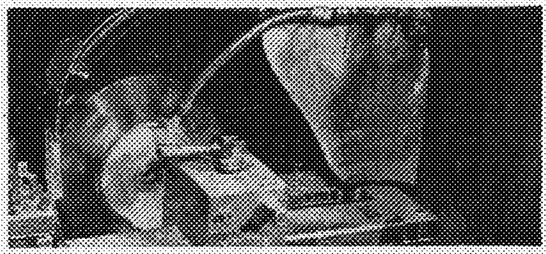
SET THE PACE ON AIRCRAFT PRODUCTION



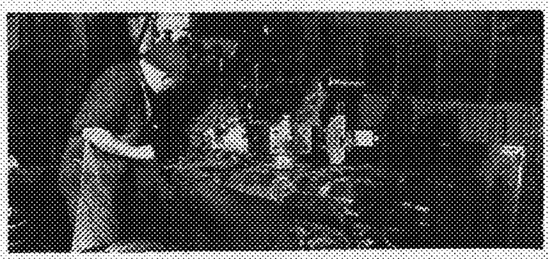
★ LOW TOOL COST! Standard Carboloy tools, available in 10 styles, 5 grades, wide range of sizes, are priced as low as 70c per tool.



★ HIGH FINISH! On this steel gear, Carboloy tools produce a finish that eliminates 80% of former hand-polishing needed.



★ EXTRA TOOL LIFE! Machining steel gears for superchargers, Carboloy increases tool life 2800% on eleven operations.



★ INCREASED PRODUCTION! Simply by changing to Carboloy tools, in place of ordinary tools, 86% machining time was saved on this job.

★ EXTRA OPERATIONS ELIMINATED! Tooling with Carboloy Standards made possible the elimination of 4 stations on turret—total of 19 tools saved.

IN the aircraft industry, on thousands of vital jobs, *STANDARD* Carboloy tools have set the pace on machining production! Cutting speeds stepped up as high as six times faster than with former tools! Tool life increased often as much as 20 to 1! Finish, on critical parts, so fine that 75% or more of hand-polishing time is eliminated! Close tolerances once believed "impossible" on mass production work, commonly obtained. Production of vital parts often doubled or tripled.

On aircraft manufacture—as well as in all other industries vital to war—*STANDARD* Carboloy tools have helped point the way towards new economies, new production peaks. These tools—at prices comparable to all other cutting tool materials—are available in 10 styles, 5 grades, for cutting *ALL* metals and non-metallics. Write for new catalog GT-175, just issued.

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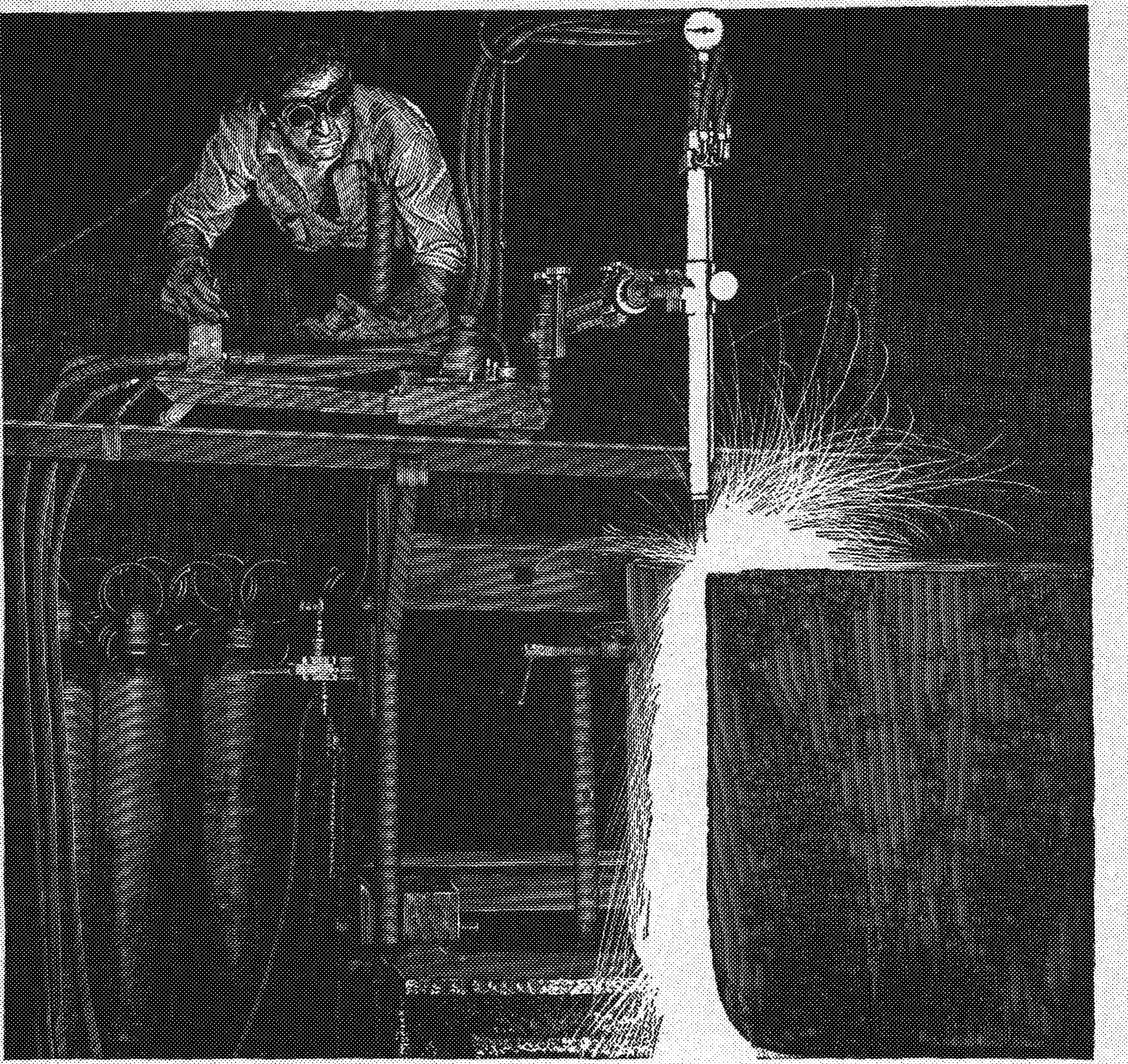

Cutting 1000 Hours Off an Ordnance Schedule

Under the piercing heat of the oxy-acetylene cutting flame, thick metals like this 32" alloy steel block are shaped into parts for heavy weapons faster than ever before.

For example, the flame cutting operation shown here saves more than 1000 hours machining time in producing one heavy part for ordnance use. Similar valuable savings in time and labor are being achieved on hundreds of other war production schedules by this method . . . cutting steel up to 51" thick on a fast, production basis.

Air Reduction engineers have pioneered in the development of many machine flame-cutting methods to speed operations in war and peacetime industry.

If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd Street, New York 17, N. Y.

★ BUY UNITED STATES WAR BONDS ★

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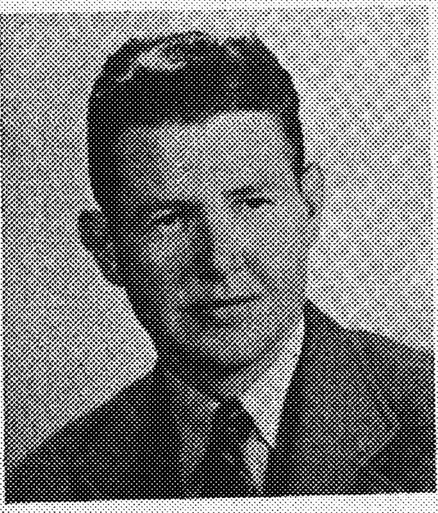
this month

BY HELEN HELLAND

R. L. Sullivan, author of the article on air transportation, has had enough experience in the field to know what he is talking about. He worked with TWA for three and a half years in Kansas City, Mo. At the present time, he is chief engineer for the Mid-Continent Airlines at Wold-Chamberlain Airport.

Mr. Sullivan is a native of "sunny" California, and has done much traveling around the country. That doesn't mean much nowadays though, with so much world traveling going on, he points out.



While in high school, he won letters in football, basketball, and track in one year. In college, he again won letters in those sports, but this time, it took him more than just one year. Incidentally, Mr. Sullivan is a graduate of the California Institute of Technology, and thinks that it is a mighty fine school.

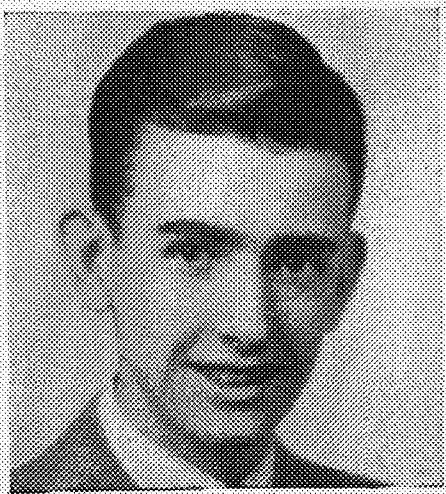
As for his hobbies, he lists photography and swimming. He is single, with no immediate prospects of matrimony. The scenery does look nice, though.

Robert Buckley, although born in South Dakota, has lived most of his life here in Minneapolis. He graduated from Southwest High School, and was Business Manager of the yearbook in his senior year.

While attending St. Thomas last year, he served as an assistant instructor in chemistry at Southwest.

At the present time, Bob is taking advanced chemistry here at Minnesota. He is a consulting chemist for a local company, and most of his spare time is devoted in a home laboratory which he maintains. He is a member of the ASTM and conducts tests for various people.

Bob also coached a basketball team



in the commercial basketball league last year.

As for women, he says that they are all right if they don't get in your way. We couldn't get along without them.

Orin Potter, drawing instructor in the Institute of Technology, writes about production illustration in "Seeing is Believing" in this issue. Mr. Potter has always been a Minnesota man. He was born in Brainerd "a long time ago." He graduated from the School of Mines at Minnesota, and also earned his Master's degree in Metallurgy here.

Before he started teaching at the University, he worked in a foundry. This type of work still interests him very

much. Mr. Potter has been teaching at the University for twenty-five years.

His four children may account for his participation in scouting, sports, and love of the great outdoors. Three of his children were attending the "U" at one time. He manages to attend all the football and basketball games with his family.

Reading is another of Mr. Potter's hobbies, but like most instructors, with more students and fewer assistants, he doesn't have much time to relax these days.

Although Mr. Ruszaj has been teaching young engineers about aeronautics for several years now, he still hasn't lost his love for model airplanes. His charming wife told us "that the house is just filled with them."

Mr. Ruszaj was born in Buffalo, New York, in 1915. He majored in aeronautical engineering at the U. of Michigan, but earned his Master's degree at Minnesota. He has now completed all his course work for his Ph.D.

The Oak Street Laboratory is the headquarters for his new class and special interest—problems of high altitude flying. One of his classes is assembling the recently obtained YP-37 in the Armory.

In his few spare moments, Mr. Ruszaj loves to hunt, swim and play golf. He is an active club member and belongs to many academic and honorary associations, among them Delta Chi, Tau Omega, and the National Aeronautics Association.

MINNESOTA TECHNOLOG

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The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is twofold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

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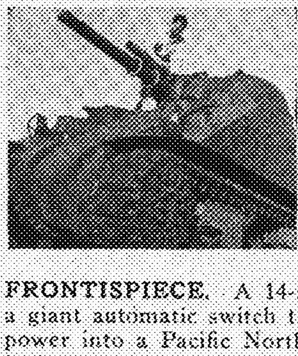


A ROBOT AIMING DEVICE maintains the gun barrels at a constant elevation and the target stationary within focus of the gunner's telescope. Courtesy Westinghouse Electric and Mfg. Co.

FRONTISPIECE. A 14-foot condenser bushing is part of a giant automatic switch that will guard the flow of electric power into a Pacific Northwest war plant. Courtesy Westinghouse.

Ushering In

THE AIR AGE

BY R. L. SULLIVAN
CHIEF ENGINEER, MID-CONTINENT AIRLINES

It is no secret that most of the airlines now operating within the continental limits of the United States are formulating extensive plans for postwar expansion, which include both domestic and foreign business. In the last three or four years, nearly all of the proposed commercial routes have become well-beaten paths, not only by military aircraft, but also by commercial planes flying in the service of the United States Government. There is little doubt that the experience gained by the airlines and by the manufacturers of transport aircraft will prove to be invaluable in setting up and operating peacetime air commerce on a world-wide scale. It is an established fact that large air transports can and will fly across oceans and continents on routine scheduled flights. With the practical introduction of multi-engine airplanes, the age-old fear of the mysteries of the sea has been largely dispelled, and transoceanic flights are no longer considered especially hazardous.

Civilians not Forgotten

The businesslike attitude and purpose of the airlines is emphasized by the amazing safety records which they have established year after year. Virtually in its infancy, the airline industry is maintaining standards of safety which are the envy of all other phases of transportation. And these records apply not only to commercial operations but also to the military routes being flown by the airlines, which is noteworthy in view of the fact that many of these routes skirt battle zones where enemy action is always a possibility and often a grim reality.

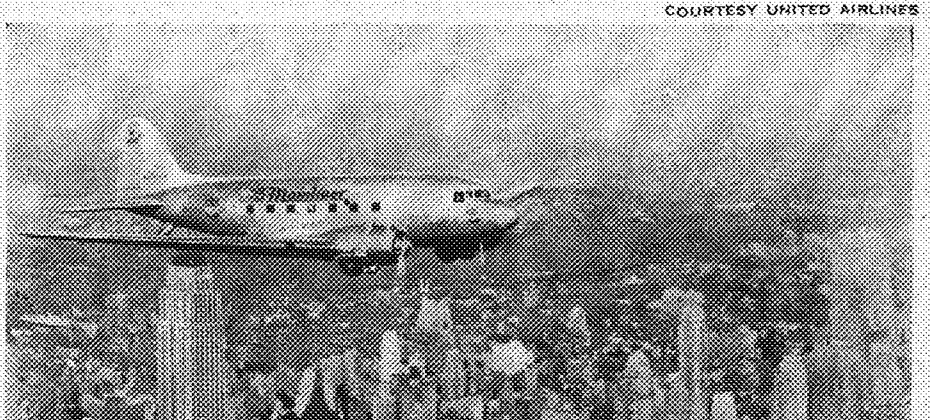
Even under the press of wartime shortages, the airlines have not forgotten the needs of the civilian population. Soon after the United States was drawn into the war, it became evident that the Army and Navy would need far more transport airplanes than the aircraft factories could produce if vital military supply lines were to be maintained effectively. Therefore, the airlines relinquished a large portion of their commercial fleets for use in military service. A recent report published by the Civil Aeronautics Administration states that on September 1, 1943, the sixteen major airlines in the United States were operating 54.01% of the equipment that they had in service in December, 1941. However, in spite of this drastic reduction in equipment, these same airlines were operating 81.70% of their prewar mileage. In order to make this accomplishment possible, without curtailing the service for which the airlines have become famous, it was necessary to develop more efficient methods of utilizing flying and ground equipment and parts, which were becoming increasingly scarce as the war progressed. In carrying out this program of more efficient equipment utilization, the airlines found that they could do many things which previously had been considered impossible or economically unsound. A prime example is the rise in operating load factor, which is the ratio of actual load carried to maximum possible load. Before the war a load factor of 45% was considered profitable, whereas most airlines are now operating with a load factor of 80% to 95%. Of course, this latter high figure means that many prospective passengers are not able to obtain reservations on the most convenient flight, which is an undesirable condition. Therefore, when the necessary equipment is available to the airlines, the load factor will be reduced considerably, though a concerted effort will be made to maintain this figure substantially above the prewar level.

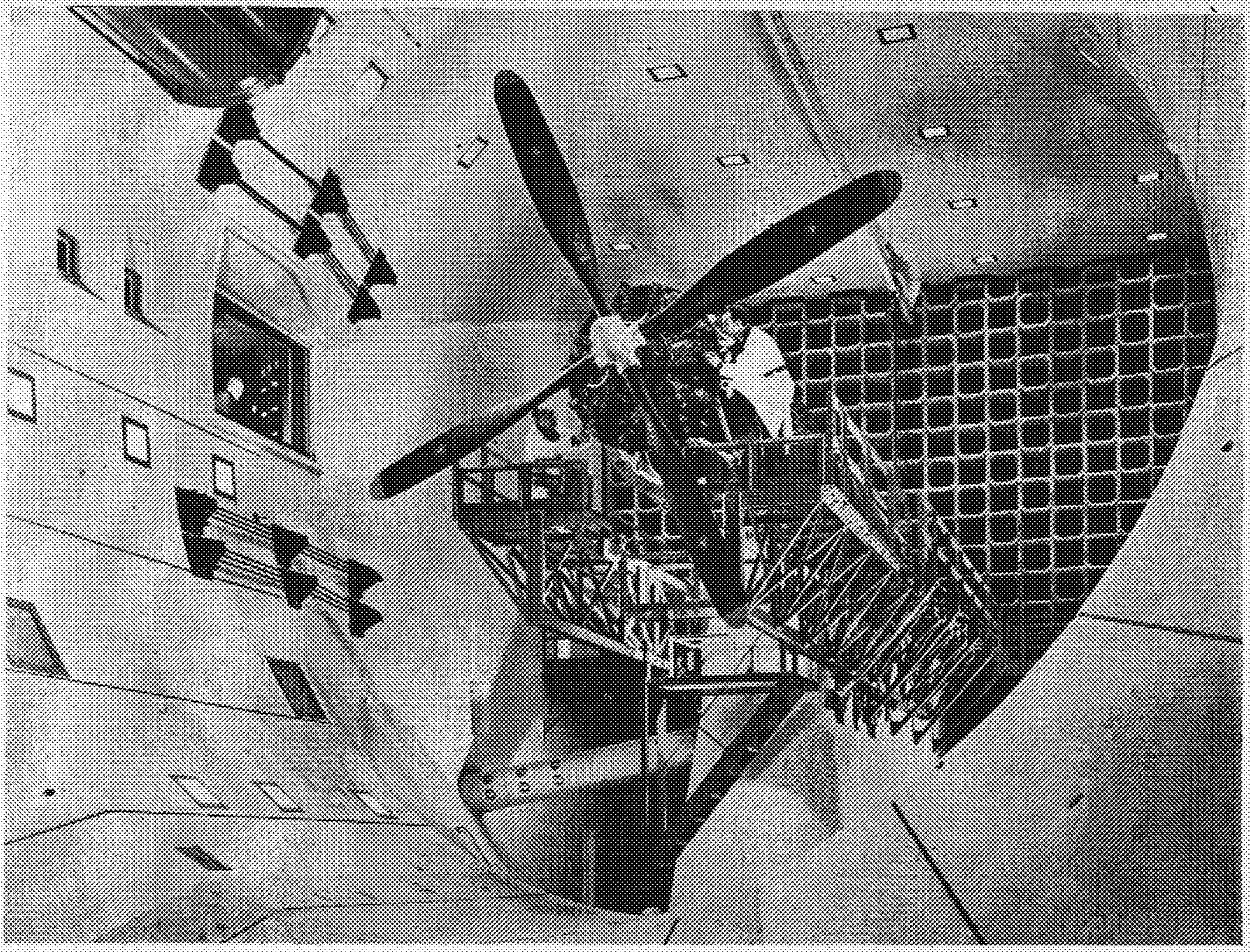
Passenger comfort and service have become practically synonymous with airline travel. Airline personnel have long been trained to regard the passenger as an honored guest, rather than merely as another fare, and the experience of the airlines indicates that such treatment is appreciated by the public. The comfortable furnishings aboard the airliners make any journey more enjoyable and the attentive services of the hostess places air travel in a class by itself. Services such as confirmation of reservations shortly before flight time, notification to passengers of schedule changes, service of complimentary meals in flight and availability of reading and writing materials to passengers are only a few of the many accommodations which patrons of airlines have learned to take for granted. And the airlines' plans for the future include even greater convenience and comfort for the air traveler, rather than a curtailment of these features in favor of a more commercial attitude.

As a result of the vast accumulation of practical and experimental knowledge gained by the airlines over a period of years, the outlook for air transportation is indeed quite dazzling. In its entirety the future defies the penetrating forecasts of the amateur and expert alike. However, of one thing the industry may be certain. There

ALTHOUGH MILITARY needs have forced airline companies to relinquish a major part of their equipment, planes such as that shown have managed to maintain a service nearly equal to that of prewar flying.

COURTESY UNITED AIRLINES





COURTESY CURTISS-WRIGHT AND AERO DIGEST

FUTURE AERONAUTICAL laboratories will develop new type power plants which will be more efficient and less costly.

will be no scarcity of opportunity for improvement of equipment and methods, for the past has taught the airlines that there must be radical changes in the aircraft and its maintenance and operation if prospective schedules are to be met. Military operations have opened many new fields and provided the solutions to innumerable maintenance and engineering problems, but these have yet to be adapted to commercial standards and restrictions.

Maintenance Minimized

Probably the most pressing need in the field of air transportation is for revolutionary changes in maintenance methods. The parts of the aircraft may be divided into three general groups: (1) the airplane, consisting of fuselage, wings and tail; (2) the power plant, consisting of engine or engines; (3) the accessories, consisting of instruments, radio and other replaceable parts. The lion's share of the total capital investment in the aircraft is represented by the first group, the airplane structure. Nevertheless, present maintenance procedures require that the airplane spend between one-half and two-thirds of its time on the ground, and this condition is mainly the result of the inseparability of the three groups outlined above. Thus it can be seen that one of the first steps in obtaining greater utilization of equipment will be the termination of the dependency of any one of the above groups upon the other two during servicing and overhaul periods.

As an example of needlessly lost time of valuable equipment, a comparison of the airplane and the engine should prove interesting. As approved by the Civil Aeronautics Administration, the maximum period allowed between major overhauls on a Douglas DC-3 commercial transport is between 5,000 and 6,000 flying hours. The approved overhaul period on most engines used on this airplane ranges between 500 and 600 flying hours. From these figures it is apparent that each engine will be removed and overhauled ten times for each time the airplane is overhauled. This means that the airplane will be needlessly held out of service at least nine times during this period, for the removal of an engine, installation of a replacement and subsequent ground and flight test consume much valuable time. The problem which presents itself is the reduction of ground time for the airplane; and the solution will be found in the simplification of engine change procedures and the reduction or elimination of time consumed in flight testing the engines.

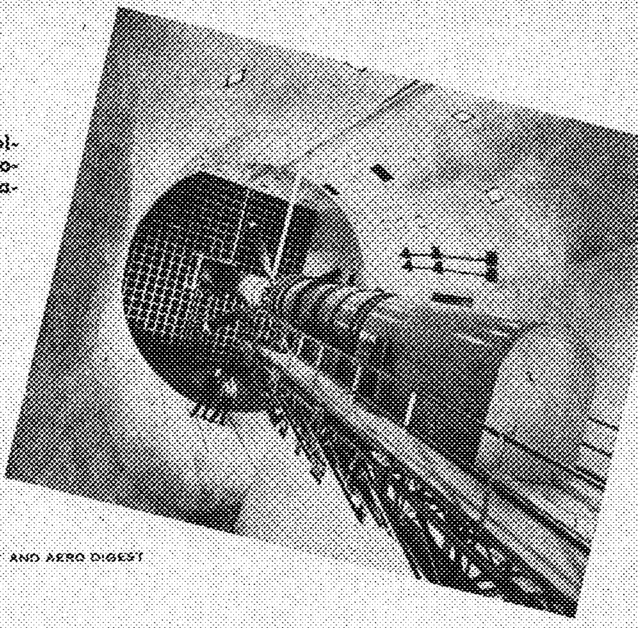
The first step toward accomplishing the desired result is the alteration of the engine installation in such a way that all cumbersome and inaccessible connections at the firewall are eliminated. This can be achieved by using quick couplers with automatic shut-off valves on all fluid lines, and quick adjusting pin connectors on all control rods and cables. Overhaul and test procedures must also be altered to fit the new conditions. The engine must be run through overhaul on an assembly line basis, with parts and accessories from all engines of a given model being completely interchangeable. This will reduce the number of spare parts required and will assure that no engine will be held up in overhaul because of the failure of any one special part.

Increased Air Time

The conventional practice of building up and testing overhauled engines without any of the accessories, controls or cowling must be replaced by a system whereby the overhauled and tested engine will be available for scheduled flight as soon as it is installed in the airplane. In order to accomplish this result, the art of engine testing, as now practiced by most airlines, will be virtually revolutionized. The testing procedures and equipment will necessarily become more complicated. The test cell will have to be large enough to allow the installation and full-speed rotation of a flight propeller instead of the test clubs now in use. The cell must be equipped so that temperature, pressure and humidity can be closely controlled over a wide range to similate all conditions to be encountered in flight. The engine cowling must be installed and the cell be so constructed that the airflow characteristics will be essentially the same as those produced in flight. The engine control room must contain not only all of the instruments and controls which are found in the airplane, but also numerous other items of test equipment to furnish the test crew with complete information regarding the operation of every section of the engine. An engine so equipped and tested with all normal operating equipment installed, will require no additional flight test subsequent to its installation in the airplane.

The procedure outlined above, as applied to engines, can be just as readily utilized to reduce the time required to change electrical and radio equipment, instruments and other accessories. Even wiring, conduit, tubing and control cables can be installed in such a manner that they will be readily replaceable. By thus simplifying all maintenance operations, a gigantic increase in the flying time of the airplane can be effected. The airplane will be on the ground only long enough for routine inspections and accessory replacements, and will be performing its primary function of transporting passengers and cargo up to 95% of the elapsed time between its purchase and retirement.

TESTING of new developments is going on today in modern laboratories.



COURTESY CURTISS-WRIGHT AND AERO DIGEST

And Finally—The Air Age

All of these changes, however, will require a great deal of experimental research and design work, as few details have yet been completed along the lines mentioned above. Such changes in maintenance procedures will be dependent upon the manufacturers rather than upon the operators, as the basic nature of the proposed procedures precludes any extensive modification after the equipment has been built. All such changes must be the result of a comprehension, by the manufacturer, of the problem of equipment utilization faced by the airline operator.

There are many other issues in postwar operations which will have to be settled by the operators themselves. Passenger and cargo handling has already been the subject of considerable discussion, as present methods are entirely inadequate to handle the increasing tempo of the business which is anticipated. The airplanes must be made more readily accessible to passengers, and equipment must be designed to facilitate the loading and unloading of baggage, mail and express, if possible, in such a manner that these operations are not visible to the public.

Postwar airplane manufacturing competition will assure that the airplane will be designed to fit the specific requirements of the operator. A completely new field of endeavor will be opened with the introduction of airline feeder systems. This type of operation will require an airplane of five to fifteen passenger capacity, which can land and take off from a very small field. It is quite possible that the helicopter will find its place in this type of service, rather than in the private field in which it has received so much publicity. Contrary to popular opinion and current advertising, the giant superliner of the air will not be in common use for the majority of airline schedules. An airplane of slightly larger capacity than the Douglas DC-3 will prove adequate for all flights of less than four or five hundred miles, while the giant dream planes of one hundred passenger capacity will be reserved for transcontinental and transoceanic operations. The Lockheed Constellation, which is designed to carry fifty-seven passengers and a crew of seven, is merely the forerunner of the long range airplane of the future. The development of the anticipated superliner will of necessity be slow, due to a lack of operational experience with such large aircraft. An experimental period of at least five years can be anticipated before production lines are set in motion on the more advanced luxury liner models.

In contemplating the future of airline operation, it might be wise to visualize three eras. The first will be an interval of planning, of converting existing models for peacetime use and of seeking and developing new routes. The second will be a period of rapid expansion, of utilizing new aircraft developed from designs now being formulated, of extension of routes and refinement of operational and maintenance procedures. The third will be the vividly imagined and long-hoped for air age, in which no design will be too radical and no imagination too graphic. It is to be hoped that this, also, will be an age of peace.

TODAY'S huge airliners are the forerunners of tomorrow's super ships.

COURTESY CURTISS-WRIGHT

Plastics a substitute for

ELEPHANT'S TUSKS

By ROBERT BUCKLEY

IN this period of astonishing industrial developments, probably no industry has undergone such a tremendously rapid growth as the plastics industry. It has been estimated that this industry, since the time Bakelite was first produced, has increased in size over 2,000 per cent. The cause has been a definite need and demand for plastic products.

Plastics originated in 1868 when a young American printer, John Wesley Hyatt, found a substitute for the billiard ball's ivory. There was a $10,000 cash award for such a substitute. He found that by treating cotton cellulose with nitric acid and then applying the right amount of heat and pressure, he could obtain a new substance capable of being molded into any desired shape. He called this material "Celluloid."

There are several different types of plastics, based mainly upon the origin of the basic materials used. Examples of some classes of plastics are for instance, the phenolic base compounds, which as the name implies, originate from phenol, an organic compound known as carbolic acid. Some common phenolic base compounds are Bakelite and Durez. The small plastic cups, spoons, and dishes that are known as "Beetleware," as well as the small discs that youngsters play with and are called "Plakies," are examples of the urea base plastics. Of course all plastic materials, like metals, are chosen for uses according to their properties. Phenolic base plastics burn very reluctantly and age has little or no effect upon them. Urea base plastics are useful due to the fact that they may be submerged in any common solvent without any harmful effect. They are likewise resistant to greases, oils, and organic hydrocarbon solvents, which make this type of plastic especially useful for cosmetic containers.

Some of the most important plastics being used in this war are plastics of the methylmethacrylic resin derivation. The contraction and expansion of the acrylic plastics with changes in climatic conditions are minimum. They are light weight and not very expensive, and they will not shatter if a bullet passes through them. Plexiglass and Lucite are two examples of this type of plastic. They are used quite extensively for gun turrets, enclosures, and windshields. Often though the windshields are laminated with glass. These transparent acrylic plastics were the only ones to pass the Army and Navy specifications for grade "A" enclosures, where good vision, weathering properties, toughness and ability to withstand shock at low temperatures are deciding factors.

Other uses for Plexiglass and Lucite are as radio antennas on airplanes, insulators in high frequency airplane radio equipment, shatterproof landing light covers, and as an aid in navigational lighting. As a radio antenna, the radio waves pass through the plastic more readily than the formerly used metals. They are also easier to fabricate than metal. As an aid in navigational lighting, a bent rod often pipes light around the wings of an airplane from the navigation lights. The lights are sometimes located where the pilot cannot see them. By piping the light, the pilot can keep a constant check on his lights at all times.

Many soldiers wear unbreakable and waterproof watch crystals. A slightly oversize crystal is fitted around the watchcase, and heat and pressure are applied around the edges by a machine, forming a permanently welded waterproof and dustproof face. So efficient is this kind of a seal, that when the sunken submarine, Squalus, was raised from the floor of the Atlantic Ocean after 112 days on the bottom, the only mechanical device in running order was the clock. Its acrylic plastic face had remained water-tight for nearly four months.

Crews of the United States Coast Guard and Maritime Commission vessels make use of a plastic-protected electric water lamp which is attached to life preservers and life rafts. The moment it strikes the water, a weighted base turns the lamp upright and automatically lights it. For a period of over ten hours the lamp serves as a signal for rescue craft.

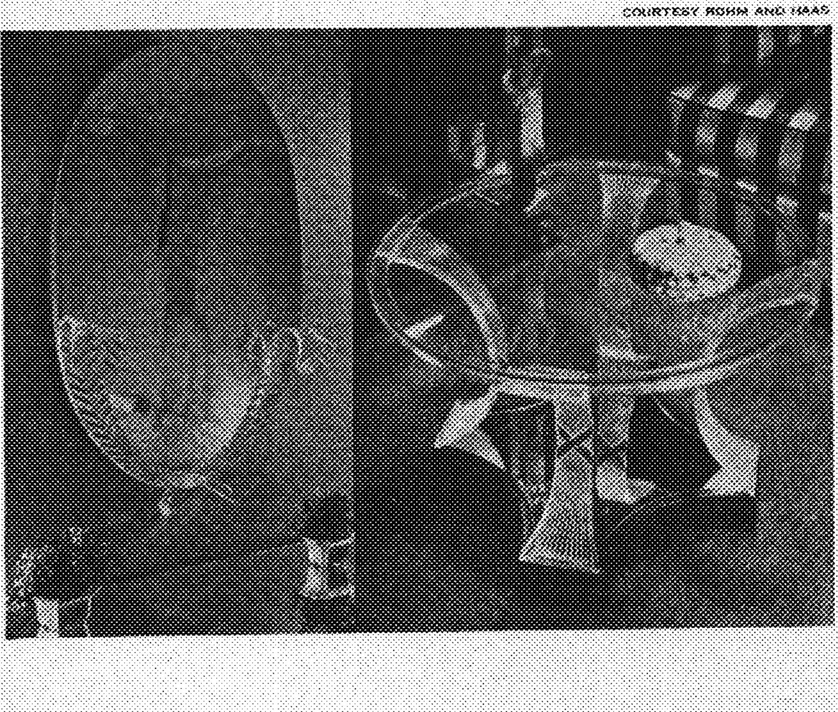
On the home front too, acrylic plastics find many wartime uses. In medical research laboratories, some of the ultracentrifuges used in studying diseases such as cancer and infantile paralysis have small Lucite or Plexiglass rotors spinning at 60,000 revolutions per minute. These rotors, in place of the metal ones, have reduced the material cost of some of these centrifuges from $1,000 to $5.

Arthritis of the hips is very disabling and painful, but thanks to skilled surgeons

(Continued on Page 223)

BESIDES BEING a valuable asset in industry, plastics are proving just as valuable on the commercial market as home furnishings, cosmetic containers, and knick-knacks.

COURTESY ROHM AND HAAS



Mighty Machines Pave

HIGHWAYS TO VICTORY

BY O. J. ELLERTSON

PIONEER ENGINEERING WORKS, INC.

This is the fifth in a series of articles in which the TECHNOLOG is presenting some of Minnesota's Industries at War. The purpose of these articles shall be to familiarize the University students with Minnesota concerns and the work that is being accomplished in our state.

THERE'S something dramatic about a big Cat pushing a superduper bulldozer through a wilderness, uprooting trees—moving thousands of tons of earth. It's drama because it's conflict—man-made, mobile power and tools in conflict with tough, force-resisting nature. Stories and pictures in current newspapers report mighty jobs undertaken by bulldozers, readying roads, pushing Italian mud, smoothing junglelands into usable air fields.

There's conflict of the same rough and ready sort between a jaw crusher and the rock and iron ore with which it contends—tough unyielding elements that defy division and disintegration. There's high drama going on in a jaw crusher—only it has no pictorial qualities. It just grinds away—the primary unit in a series of operations preparing aggregate, ballast or iron ore.

Crushers, Washers, Vibrating Screens are made by a Minneapolis firm, the Pioneer Engineering Works. And as the name implies they were one of the pioneers in the design and manufacture of portable machinery to produce aggregate for gravel roads and concrete highways.

The story of Pioneer Engineering Works is a saga of modern engineering equipment that was highly mobile when war began—and now is on the job wherever U. S. Army Engineers, Naval operations and the Seabees are pushing roads of supply or tapping natural resources. There are Pioneer units in Alaska, South America, Africa, China and Ireland.

Long before Pearl Harbor, Pioneer had developed the idea of making portable units—in fact their secondary roll crushers, Duplex crushing plants, and mobile crushing, screening and washing units helped build great stretches of highway from coast to coast.

As a natural growth, Pioneer created equipment for mining, foundry and other industries.

The organization broadened its services and more top-notch engineers were added to the staff. College-trained graduate engineers work at Pioneer to create better designs, more efficient machines and processes for the industries served.

Selected engineers go through intensive training to become familiar with the many operating services maintained by the Pioneer Engineering Works, Inc. After groundwork at the home plant many of them go into practical fields of operation—to see Pioneer installations on the Mesabe Iron Range where conveyor, feeder, crusher, scalper and washing plants handle iron ore.

Engineers get a practical tour of duty along a road construction project such as the Alaska highway from Dawson Creek to Fairbanks or the Pan American road from the Rio Grande to Buenos Aires and Rio de Janeiro in South America. Along these gigantic highway operations, Pioneer Gravel crushing, screening and washing plants help push forward vital supply lines to the opposite ends of the Western Hemisphere.

Engineers go to the quarries where Pioneer designed and built plants, crush, screen and convey raw materials.

From many such experiences on the job site, the Pioneer engineer is better qualified to specify, create and improve equipment as the need arises. This is their practical technique of perfecting knowledge by combining theory and application in a way to produce machines and methods capable of doing a job more efficiently and economically. Key men in the Pioneer engineering department are not, however, jacks-of-all-trades but specialists with full knowledge of both theoretical and practical sides of their specialty.

Recently two Pioneer engineers received a special certificate and a cash award from the Lincoln Welding Foundation for the design of welded base jaw crushers. These men are Ralph Heer, University of Minnesota M.E., and Wm. Eckley, University of Minnesota.

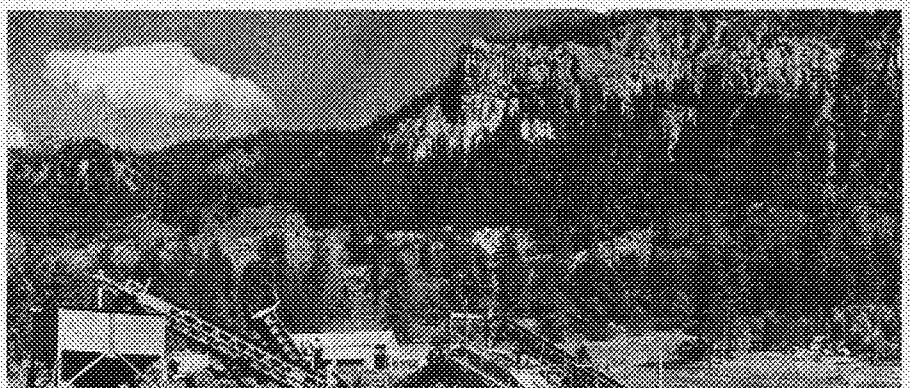
The story of Pioneer Engineering Works, Inc., in wartime is not a blood and thunder yarn of high adventure. Equipment designed and built by Pioneer help this country and other United Nations to—"get there first with the most."

In some operations the contribution is immediate and direct. The Alaska highway, for example, was planned to provide a safe inland short route from the United States to Alaska. And Alaska in the early stages of the war was viewed as a highly

(Continued on Page 232)

LARGE SIZE mobile gravel crushing, screening, and loading plants are being used in all parts of the world.

PHOTO COURTESY PIONEER ENGINEERING CO.



New Technique Proves

SEEING IS

THERE is an old saying, "There is nothing new under the sun." Production Illustraion is a new name for an old type of drawing. This name was coined by the aeronautical industry and as the name implies it may be defined as a pictorial drawing used to facilitate production. The use of pictorial drawings is not new. They have been used for many years by the architect for "Patent Drawings," for advertising and catalogue illustrations, and to a limited extent for shop drawings. There are records showing that many of the well-known artists furnished pictorial sketches which were used in the construction of some of the famous historical structures, Leonardo da Vinci (1452-1519) was one of the most famous artist engineers. Pictorial drawings were also used to aid war production by England in World War I. The aeronautical industry in this country revived the use of the pictorial drawing for production purposes, but its use has been rapidly spreading to other industries.

The war production program has greatly emphasized the importance of drawings in industry. Before production can proceed smoothly numerous drawings are necessary showing shape, size, material, and shop processes and procedures. Mass production would be practically impossible without their use. Drawing has often been referred to as "the language of the engineer" and the war program has certainly reaffirmed this. The shortage of draftsmen, in many cases, has greatly hampered production. To help remedy this situation an intensive training program to train draftsmen was set up at the beginning of the war emergency period. It is estimated that in the past three years that well over 100,000 persons have received training under this program and yet the demand for draftsmen continues. Many more persons have received training in drafting than in any other war training course. Here at Minnesota in the past three years up to January, 1944, 49 courses have been conducted in engineering drawing with 1067 students under the war training program of the ESMWT (Engineering, Science and Management War Training). This is in addition to the regular drawing courses given in the colleges, high schools, and vocational schools.

The aeronautical industry was one of the hardest pressed for the need of draftsmen. Many of these companies had art departments where artists were employed to make drawings for advertising and catalogue illustrations, but under the war program the need for advertising was at a minimum, and someone conceived the idea of using the artists to help the engineering draftsmen make the much needed drawings for the shop. The artist was not familiar with the conventional engineering drawing or the various engineering details of manufacture but he could make pictorial drawings. Under the supervision of the engineering department it was found he could make pictorial drawings which could be used in a number of places to facilitate production. This proved so successful that the country was combed for commercial artists and now thousands of them are being used for this purpose. Engineering draftsmen, in general, were not familiar with pictorial drawing and few of them had the time or inclination to learn how to make them. It has been found, however, that both the engineering draftsmen and the artist can be used to make this type of drawing with a little training and experience. Some companies prefer the regular engineering draftsmen, some the artist, but many of them are using both.

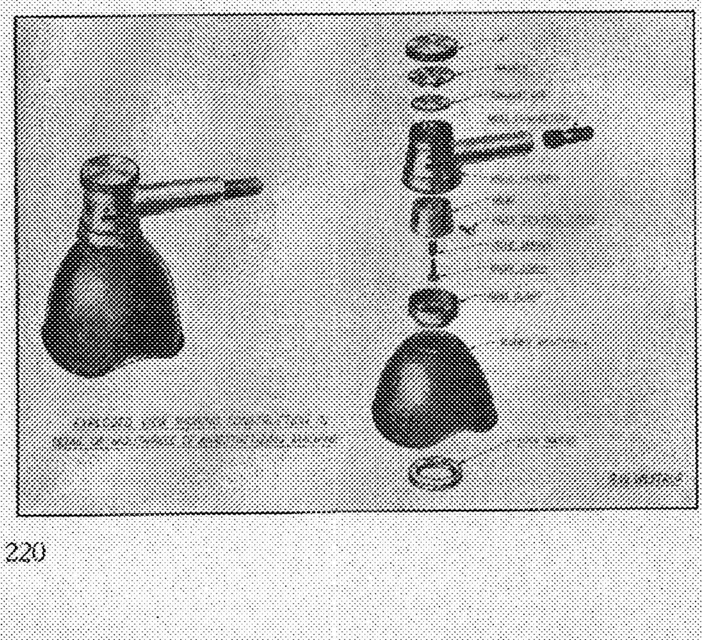
There are two reasons why the Production Illustration has met with such favor. First it is more easily understood than the conventional engineering drawing and second it can be made more quickly. It has been especially helpful to the thousands of unskilled workers now in the war industries who never before worked in a manufacturing plant. They can easily read these drawings with a minimum of preliminary instructions. Pictorial drawings showing certain information as to shop processes or procedures, in many cases, serve the purpose even better than the conventional orthographic drawing, and have the advantage that they take considerably less time to make.

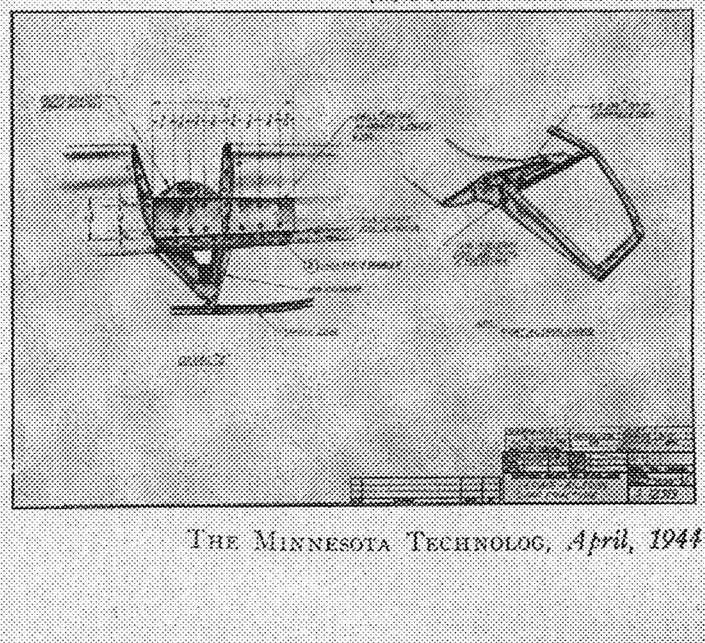
There is no danger, however, that the Production Illustration will replace the orthographic drawing completely, it will be used only to supplement it. There are many problems requiring accuracy of measurement and true shapes where orthographic drawing must be used. Some such problems are the laying out of true shape patterns for developed surfaces and templates, surface intersections, lofting, and the like. Also the dimensioned detail drawing, especially for complicated shapes, are best made in orthographic, as pictorial drawings are very difficult to dimension clearly. The pictorial drawing lends itself best for transmitting information for shop operations and procedures rather than for the details of shape and size description.

Some of the principal uses to which the

FREE HAND pictorial drawings such as those shown here are being used with huge success by various industries.

PHOTO COURTESY NORTHWEST AIRLINES





BELIEVING

BY ORIN W. POTTER

ASS'T PROFESSOR OF DRAWING

Production Illustration has been put are as follows:

1. Assembly drawings (exploded assemblies) for the assembly line.
2. Assembly drawings (exploded assemblies) for maintenance and repair crews.
3. Assembly drawings (exploded assemblies) for erection crews.
4. Drawings showing alterations as used in the aeroplane modification plants.
5. Design development drawings.
6. Production Breakdown Illustrations.
7. Detail shop drawings showing shop operations.
8. Detail pictorial drawings for submission to contractors for bidding purposes.

The most extensively used drawing of this type is the pictorial assembly called the "exploded assembly." This is a drawing of an assembly taken apart but with the parts so arranged that anyone can easily see how they go together. It has greatly facilitated assembly line production even for those who are familiar with orthographic drawings. The exploded assembly has also been of great value to maintenance and repair crews. They have been furnished by the war department to be sent with war equipment of all kinds going to the fighting fronts for use by the ground crews. The printed instructions may be given in different languages, if necessary, depending on where they are going, but the same drawing is used regardless of who is to use it. The exploded assembly is also used to give instructions for the assembly and installation of machinery and equipment which must be assembled at the point of use rather than in the factory. In other words the information necessary for the assembly or the taking of a machine apart for any purpose is best given by means of a Production Illustration drawing.

The alteration drawings as used in the aeroplane modification plants are principally Production Illustrations. These plants were set up by the government in a number of places throughout the country where various changes on aeroplanes can be made which have been found necessary due to experiences learned in combat duty or where installations of new features that have been developed through research can be made or where a ship may be fitted for certain climatic conditions or specific task. In this way changes can be made without interfering with the assembly line production at the factory. This work is always rush, and it has been found that the Production Illustration type of drawing serves the purpose best.

One of the big jobs in any manufacturing plant is the production planning. The size of the manufacturing units, how they are to be made and handled, and the equipment and tools needed must be determined. Production Breakdown Illustrations are pictorial drawings used for this purpose and with them the planning can start as soon as the details of design have been decided upon without waiting for the completion of the detail working drawings of the various parts. This has made it possible to get new designs into production much faster than formerly.

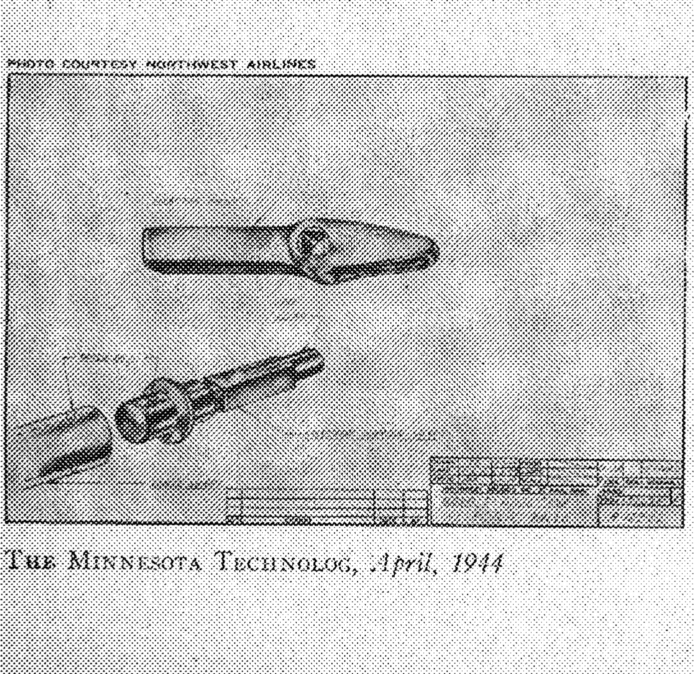
Pictorial shop drawings showing shop operations such as machining, bending, forming, riveting, welding, etc., have been used for some time to a limited extent, but the war program has greatly expanded this use.

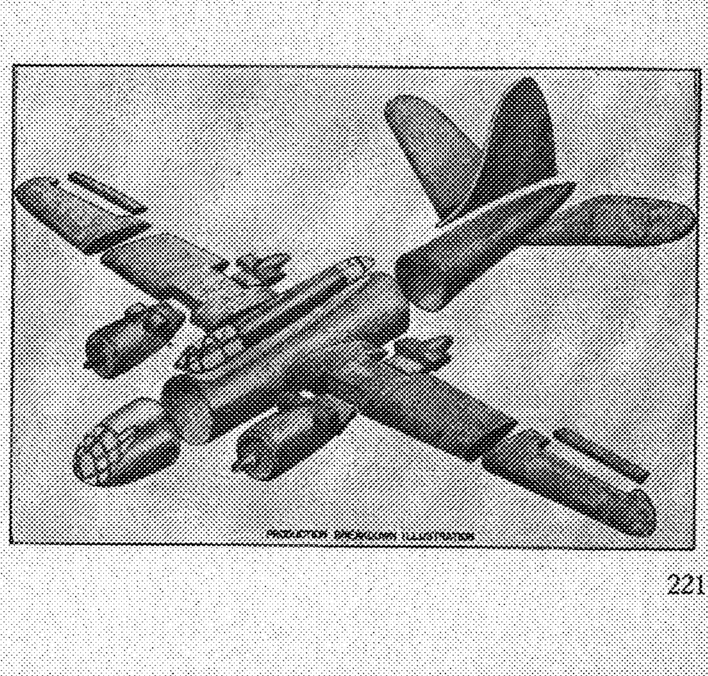
One of the problems of the War Production Board has been to make use of as much of the country's available production facilities as possible and thus reduce the building of new plants and the expansion of others. In transmitting information to the small shop operator, pictorial drawings have been used in a number of instances and they have proven very helpful.

Here at Minnesota we have been following the development in this field and last summer the first course in Production Illustration was given for the employes of the Northwest Airlines under the ESMWT training program. The details of the course were worked out and administered by the author and Mr. Ivan Doseff. Mr. Doseff has had extensive training and experience as a commercial artist and has been on the teaching staff of the Institute of Technology for a number of years. The combination of an artist and an engineer working together made an ideal arrangement for a course such as Production Illustration, which makes use of both art and engineering. Minnesota is one of the few schools in the country where training in this field is being offered. The results obtained thus far have been very gratifying.

Very little training in the making of pictorial drawings has been included in the curriculum of our engineering schools. This has been partly due to the limited time available in the drawing courses but probably mainly due to the fact the value of the pictorial drawing for engineering purposes has been overlooked. Now that the war program has reaffirmed the importance of drawings in general and also demonstrated the usefulness of pictorial drawings some consideration should be given to finding a place for pictorial drawing in the curriculum. The ability to make pictorial sketches would certainly make a a useful tool for the engineer.

PHOTO COURTESY NORTHWEST AIRLINES





Learn to

FIGHT NAVY FIRES

NAVY DEPARTMENT
PUBLIC RELATIONS OFFICE

FIRE fighting on the high seas gets top rating among the activities of the United States Navy; and fire fighting equipment for the forces afloat gets top priority preference. Groups of officers and sailors are attending the Navy Fire Fighter's Schools to learn more about the principles and technique of fighting fires in Navy vessels. And all this because now more than ever before in naval combat, fire is the greatest menace; every improvement in torpedo and shell adds to their capacity to cause damage and destruction by flame as well as by disruptive force.

When a warship is struck by a shell or a bomb or a torpedo, there is a high probability that a fire will result—a fire that will cause damage in inverse ratio to the speed and efficiency with which the ship's fire fighters go to work. These officers and sailors often have the fate of their ship and shipmates in their hands, and indeed, the fate of a fleet. The Navy is determined, therefore, that its fire fighters shall have the finest equipment and the best training for fighting fires at sea, and especially for doing so under combat conditions.

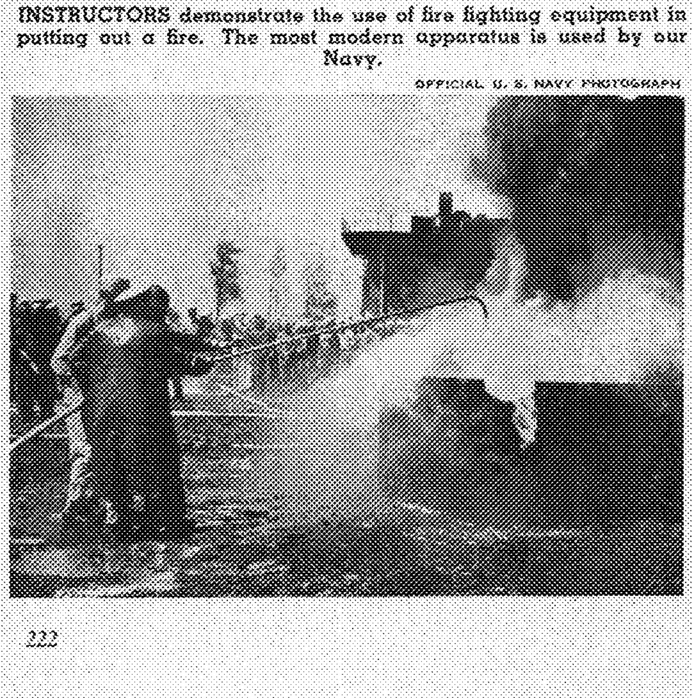
A majority of the students at the fire fighter's schools take the two-day course; and a smaller number take the six-day course. With the present facilities and those under construction, the schools will teach fire fighting technique to thousands of officers and sailors annually. Many of the students return to their ships and impart instruction to other officers and sailors who have had no opportunity to attend the fire fighter's schools.

At the schools the student officers and sailors find organizations for instruction in fire fighting functioning under the direction of Naval officers who have been members of fire departments in various parts of the country. These officers have had years of experience in fire fighting in cities and harbors, and they have made a study of Naval problems. They direct a course of study that has been prepared for the schools, by the Bureau of Naval Personnel, with the technical assistance of the Damage Control Section of Bureau of Ships. In addition to providing instruction, the Navy's fire fighter's schools serve on occasion as a proving ground for new equipment. After practical experiments in the schools and regular official tests, the Navy accepts and sends out to the fleets the latest improved equipment for meeting the wartime fire hazard at sea.

The installations for demonstrating the use of the Navy's equipment at the schools is immediately familiar to the officer and sailor students inasmuch as they consist chiefly of a land-based "mock up" of three compartments of a Naval vessel. Constructed of concrete and fire brick and steel, these compartments are models of the forecastle, boiler room and engine room of a typical destroyer. Everything except the machinery is reproduced, and in actual size. In addition to the simulated destroyer compartments, the schools have other enclosures for practice in extinguishing oil fires, and one for extinguishing gasoline fires. A shallow water tank is used for practice with shallow diving equipment. The tank also serves as a source of water supply when a portable pump, the handy-billy pump, is demonstrated.

INSTRUCTORS demonstrate the use of fire fighting equipment in putting out a fire. The most modern apparatus is used by our Navy.

OFFICIAL U. S. NAVY PHOTOGRAPH



The Navy Fire Fighter's School curriculum must of necessity be readily adaptable to the time any particular group of students can devote to a course, and this time varies a great deal. Whenever possible, the students are given a six-day course; but if an officer or a sailor cannot be spared from his ship more than two days, or if the ship is not to be in port for a longer period, a two-day course is provided.

The students who can remain for the six-day course receive a thorough training in the use of the Navy's fire fighting equipment and the Navy's equipment for the protection of the fire fighter. They learn about fire extinguishing agents used aboard Navy vessels—about carbon dioxide, chemical and mechanical foam, water, steam, fog and fog-foam. They learn also what they need to know about the fire means aboard Navy vessels, about hose and nozzles, hose evolutions, water pressure, and the capacity of hose and pumps. Further, they learn about the various measures that are made necessary in Navy vessels by the hazards of battle. Upon the completion of their course, the Fire Fighter's School students are familiar with the tools they must use, and likewise they are aware of the problems that may soon confront them under actual battle conditions.

In the conduct of the Navy's Fire Fighter's Schools, theory is subordinated to actual practice, so far as it is possible to do so. The students see motion pictures of fires and fire fighting in progress and attend lectures, they are given many opportunities to see real fires and to participate in the work of extinguishing them. They man the hose, and handle the Navy's all-purpose fog nozzles. They put out burning oil with low-velocity fog streams. They spread foam on oil fires. They release carbon dioxide on simulated electrical switchboard fires, and they turn steam into compartments, or they don asbestos suits and breathing apparatus and climb down hatches to apply water on fires in waste materials.

Classification of fires as A-fires, B-fires and C-fires does not long remain a matter

(Continued on Page 230)

Plans Under Way for

NEW WING FOR AEROS

BY NORBERT F. RUSZAJ
INSTRUCTOR IN AERO. ENG.

In this article, which is the second of two concerned with the new Mechanical-Aeronautical building, Mr. Ruszaj presents a few of the many ideas which will be incorporated into the Aeronautical division's building program to make our Aero Department one of the most outstanding in the country. Mr. Ruszaj is a staff member of the Aero Department, and has done quite a bit of work in formulating the plans for this new building.

WHEN the Department of Aeronautical Engineering was inaugurated at the University of Minnesota, its offices were located in the Mechanical Engineering Building, but with the increase in the number of its students and staff, the offices were shifted to the North end of the Armory. One classroom in the Armory was assigned to the Department of Aeronautical Engineering for their exclusive use in training approximately 500 students. Laboratory facilities are housed in a space approximately 30 ft by 100 ft.; in this space are crowded two complete airplanes, a welding shop, wood-working equipment, and a machine shop and countless components of aircraft. A space 6 feet square is used to house aircraft instruments worth about $15,000. Wind tunnels and a high-altitude chamber are, at present, located in the Oak Street Laboratory; a collection of aircraft engines formerly kept in what was originally a swimming pool in the Armory have also been shifted to the Oak Street Laboratary to permit setting up a purely Aeronautical Engineering design room. No space is available for the storing of stock or raw materials. All of these problems will be solved upon the completion of the Aeronautical-Mechanical Engineering Building when the Federal authorities will permit this type of construction. Then the cycle will be completed as the two departments will again be under one roof.

As previously stated in the TECHNOLOG, the Aeronautical-Mechanical Engineering Building will adjoin the Electrical Engineering Building and the Aeronautical section will occupy the East wing facing Northrop Field. This section will consist of four floors of laboratories, classrooms and offices. In contrast to the Mechanical section, the Aeronautical section will not have a basement, as such. The only items placed at subground level will be piping, air compressors, and refrigerators to be used for the proposed high-altitude research laboratories.

Of particular interest on the first floor is the high-altitude research laboratory, which will contain two pressure tanks, each large enough to hold five men. One tank is to be used to study the effect of pressure drop which occurs as altitude is increased, while the other is to be located in a cold room so constructed that the cold room temperature may be dropped to 60° F. below zero. The pressure in this tank can also be varied. The combination of the drop in temperature and the drop in pressure will more closely represent true conditions as encountered in the flight of an airplane. There are very few such laboratories in existence in the United States. In fact, the University of Minnesota is the only university offering such experimental work to undergraduate students. On the same floor is also located a complete instrument laboratory to be used in designing, constructing, and testing aircraft instruments. This room is to be made dustproof. It is hoped that the department will be able to obtain a Link trainer in operating condition to complete the instrument training the department anticipates offering in the near future. Space is also reserved for a wood and metal working shop where wind tunnel models may be constructed. It is desirable that this room be separated from the general shops because of the exactness necessary in this type of work. A separate metal working shop will house metal working tools for the construction of experimental designs. The metal shop is to be provided with a monorail so that heavy pieces of equipment may be shifted without use of too much manpower. Also located on the first floor is a structures laboratory where component parts of an airplane will be subjected to structural tests and where experimental designs in structures may be checked. Welding will be done in a separate room off the metal-working laboratory so that the fire hazard and corrosion due to welding fumes will be reduced.

On the second floor will be found the general offices, classrooms, and research laboratories. In these research laboratories, work on such phases in Aeronautical Engineering as hydraulic systems, ignition

(Continued on Page 234)

THE PRESENT SHORTAGE of room in the Armory will be alleviated with the coming of the new ME-Aero Building.

AS WE SEE IT

On Guard—Let's Plan!

The civilian student enrollment is still decreasing (see Tech News), and a further decrease is expected. Re-examination of all deferments has been ordered. As a result, many of our stuudents are being reclassified into class 1-A, subject to immediate military call. Other students are enlisting in our armed forces. This is happening at our University. It is happening at other Universities and colleges too. By now, there are thousands of undergraduate engineers in the service of our country. What is to happen to these men? Theirs is a job only half completed.

We here who are in a position to do something to help, must be ready at a moment's notice to aid these men when the time arrives. It is our duty to encourage these veterans to come back to school to finish their education for their own sake, and for the sake of a great nation. We are apt to list as our resources coal, oil, ores, water power and the like. Just as important a resource is the scientific talent that we possess. These men are a potential natural resource, and we must cultivate them.

However, what kind of an educational system will they be returning to? They are fighting for a better world to live in and come home to. What can we offer? What will we offer? Wars are bad, but during wars progress is made. Science is advanced. In Europe and Asia, thousands of towns and cities have been destroyed. After the war, modern planning can rebuild these cities with the utmost in science. Zone planning, efficient sanitation departments, and new homes can be provided. We will have flushed the earth of slums and bad living conditions.

So here too is a chance to improve the modern engineering education. It has often been suggested that an industrial training program be incorporated with the theory of the classroom. Such a setup would be of immense value to the undergraduates. They learn in school and practice in industry. They are "exposed" to the business and industrial world and have an opportunity to find out for themselves what they are best suited for. They see the practical side of life and are able to apply this experience to their theory with greater confidence. The chances for success after such an education of industrial and educational studies would be greatly increased. Such a plan could be organized and established. There are many noted companies in this area that would coöperate in such an endeavor and could prove as such a training ground. The possibilities are unlimited.

Also, the engineering curriculum must be able to keep pace with the times. New fields of study are opening. We must be ready in them. New subjects should be available to the present course of study. Courses in business, foreign language, and history may become of prime importance in future years. For returning servicemen, refresher courses must be available. There must be an effort to help and understand in the readjustment of these men's lives.

These are things we are likely to forget or else, just let them slide along. That is why it is necessary to bring these points into focus every so often. We cannot afford to lose track of our aims and objectives. The fact that the planning for the new Aeronautical-Mechanical Engineering building is going on now is a good and healthy sign. Other departments should be following this example. We are a great State University. We have a service to perform, and we must be able to assume these responsibilities for future education and research. We hope that the men who should, are keeping these objtives in mind and are doing their planning now.

A Patriotic Duty

On donating blood:

"Each donor of blood should feel a deep sense of satisfaction by making a contribution. The use of plasma quickly after a fighter is wounded constitutes the most important single advance in the surgical treatment of the wounded in this war.

"By the liberal donation of blood by their countrymen, plasma is made available to the wounded at the most forward aid posts. From these advance stations back to the rear every medical installation is equipped to administer repeated injections when necessary.

"In addition to the use of plasma for the wounded, other improvements in surgical procedures are available—anesthesia, sulfonamides, x-ray diagnosis, air transport ambulances, and a highly-trained surgical personnel in small motorized hospitals.

"These facilities account for the unparalleled results being achieved by the Medical Corps in the treatment of the wounded of this war.

"Donation of blood is a patriotic service to our country. That most Americans realize this is evident from the generosity of their donations."

Dwight D. Eisenhower

WAR TOWN BOON!

"Community" public telephones—some even in outside booth locations—are serving residents in war-born neighborhoods.

Many such telephones handle several hundred calls every month. It's a way more persons can use the available facilities, limited now by wartime material shortages.

The nation-wide resources of the Bell System are enlisted in maintaining dependable communication services—vital in war, essential in peace.

BELL TELEPHONE SYSTEM

War calls keep Long Distance lines busy . . . That's why your call may be delayed.

Elephant's Tusks

(Continued from Page 218)

who know how to fit "caps" of plastic over the ends of the bones, many long suffering victims of arthritis have been relieved of pain and have regained the use of their legs.

This war has instituted many research projects on plastics. Authorities in every field know that in order to conserve precious metals, there must be a substitute to take its place. Plastics have answered that call. They are inexpensive, may be obtained in light or heavy weights depending upon the intended use, and in some cases are resistant to chemical reagents. A very good example of a conto plastic lies in the fact that for a rather long period of time the United States Army was spending $180.00 per minute to shoot a machine gun, not in combat, but for training. Someone thought of the idea of using a plastic to replace the large amount of metal that was being used. Today, the cost of the same one minute of shooting for practice is only $6.00, due to the fact that plastic bullets are being used together with a compressed air gun. These pellets which cost less than one cent apiece can be used over and over again, after an occasional washing with soap and water. The pellets are used in a gun that is the actual size and appearance of the Browning machine gun. Pellet velocity and trajectory are to scale; hence the trainee learns to "lead" a moving target and to aim his gun by a stream of white pellets. At night, the bullets become fluorescent in the "black light" of an ultra-violet spotlight attached to the gun.

A Twin City plastic molder is now manufacturing what may be regarded as an excellent use for plastics in place of metals. It is a microphone which is slightly smaller than a fifty-cent piece. When worn properly, it is able to exclude most background noises. The size of the microphone is such that it may be worn on the upper lip. In use, it reminds a person of the old handlebar moustaches that Grandpa used to wear. It clings close to the lip of the user and is adaptable to all head sizes. One advantage is that they leave the wearer's hands entirely free. An important factor that had to be taken into consideration in the designing of an article such as this is that it was to be used in combat zones. Thus it had to be dustproof and moistureproof.

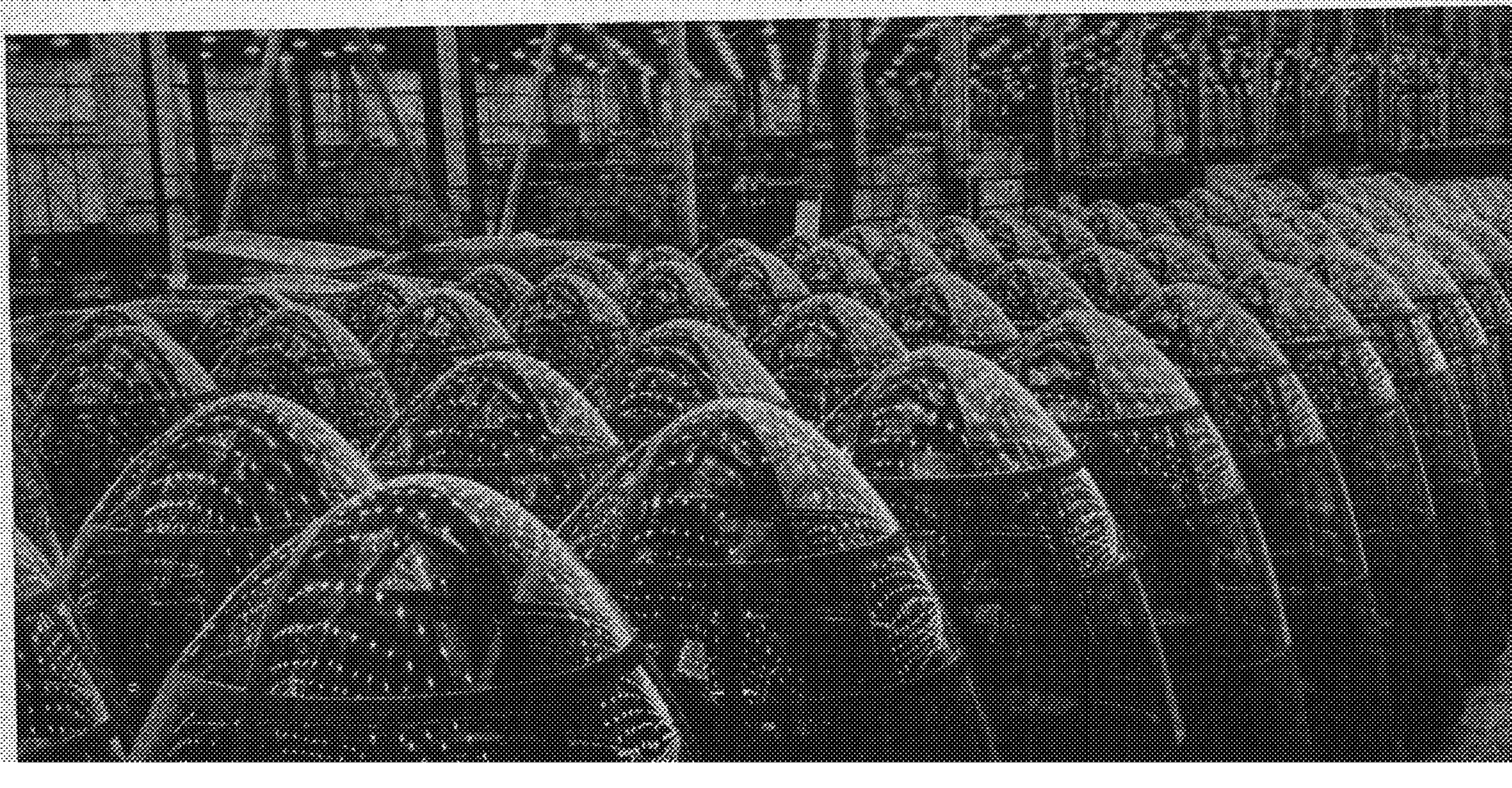
A very important process which the war has helped to not only develop but also to perfect is that of the hard chromium plating process. This plating process is often used on gears, shafts, dies and numerous other metal parts to either increase the metal part in size or to greatly increase their life. It has been said that a very thin film of hard chrome plate and a firm adhesion of it to the base metal will increase the life of the plated part to 5 or 6 times. One problem, however, that had to be solved was to find a material that could be placed in the hard chrome solution and cover the metal parts or cavities that were not to be plated, but the material so used could not be affected by the bath, which is composed mainly of chromium trioxide, (chromic acid) or not be plated itself. Technicians, who have used the acrylic plastics to insulate and cover parts not to be plated, state that they stand us indefinitely in the strong acid solution, and also that they retain their shape better than any other material used. Landing-gear struts for airplanes are not hard chrome-plated twice as fast, thanks to the protective tube of an acrylic plastic which is placed over the threaded end during the plating process. For a plastic to be able to stand up in such an acid solution which, to the chemist, has, when freshly prepared, a pH of .11, is remarkable indeed.

Plastics are important in plans for the postwar world. They should rightly be so. Nothing else equals the versatility of these synthetic products of a chemist's pots and kettles. Nothing else promises as much for rebuilding our war-torn industrial economy. Actually, many people have been thinking about our postwar world and seem to believe that our future homes, ships, automobiles, and other articles may be just ordered from a large grab bag of plastics. At the present time one would be rash to risk that anything is impossible, especially in plastics. However the enthusiastic leaders often mislead themselves. They feel that the unsolvable problems of the world from a standpoint of the wood, metal, and ceramic industries will be conquered with the chemist's new product, plastics. Many limitations in the molding and manufacturing of plastics, well known to the expert, are completely and wholly forgotten. But, even considering these limitations, the future of plastics is slated to be tremendous. Research is still open along the route of new plastics and their derivatives.

Plastics, the so-called "new automobile material" will have to wait its turn in the postwar car. Automotive engineers are convinced that no plastic yet on the market is suitable for structural purposes of the type that are encountered in the automobile, even though the present-day car uses plastics for accessories and small parts. Plastics do not stick to steel, and the process of casting in large molds is very slow. Obviously then, the plastics industry must grow, develop new methods of production and use, and develop entirely new types of plastics, if it is to fulfill its position and promises in the postwar era. The industry is small as industries go, but it contains the germs of substantial growth. It will bear close watching, but it is not the miraculous answer to universal needs. The sooner that general thinking is based on that fact, the sooner will be the practical possibilities of plastics. They have done a remarkable job and are seeing considerable service in this war. A greater and possibly more remarkable future yet awaits plastics and the industry. American ingenuity, research, and know-how are standing by. The call will come.

THESE LUCITE PLASTIC NOSES are awaiting use of the famous Douglas A-20 medium bomber. Lucite is being used quite extensively on aircraft, as it is the only transparent plastic to hold the "A" rating for enclosures under the Army-Navy specifications.

COURTESY WESTINGHOUSE



five minute forum on plastics

The promise of plastics, in the after-war years, holds so much for manufacturers and consumers alike that perhaps we should learn a little more about the nature of these new materials.

Of prime significance, chemically made plastics are unlike any structural material we have had to work with in the past.

Plastics are the product of chemistry. They are one of the outstanding examples of the chemist's ability to produce—out of coal, petroleum, air, salt, and other basic elements—totally new substances.

Important to an understanding of plastics is that they differ widely in their property characteristics.

For example, some plastics are extremely tough and withstand rough usage. This is true of Ethocel—one of the Dow plastics. Other types are pliable. Some have almost optical qualities in their clarity. Others possess excellent electrical insulating value. Some withstand heat and others extreme cold.

Among Dow plastics possessing some of these properties to a high degree is Styron—a plastic especially valuable as an electrical insulator and having many other uses where lustrous beauty or resistance to acids and alkalis are factors of importance. Saran, on the other hand, is notable for its tensile strength and flexibility, which make it widely used for such products as tubing, woven fabrics and rope. Ethocel, in a special formula, is especially strong and tough at extremely low temperatures.

JUST WHAT ARE "PLASTICS"?

The important point to remember is that the science of plastics is progressing rapidly. Already there exist many specialized plastics for specific applications. As our knowledge of both plastic compositions and the techniques for handling them increases, these new materials will undoubtedly become even more widely used than is now planned.

Dow Plastics include Styron, Saran, Saran Film, Ethocel and Ethocel Sheeting

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York Boston Philadelphia Washington Cleveland Detroit Chicago St. Louis Houston San Francisco Los Angeles Seattle

DOW

PLASTICS

Fighting Navy Fires

(Continued from Page 222)

of theory to the students in the Navy's Fire Fighter's Schools. They see fires of each class kindled and they participate in or direct the work of extinguishment. These fires are set in the simulated destroyer compartments in order to give the fires all possible resemblance to actual fires aboard Navy vessels. In these compartments all machinery spaces are indicated and passageways, vents and all other openings are reproduced; the students find conditions exactly as they would be in an actual destroyer with a fire in one or more of its vital compartments.

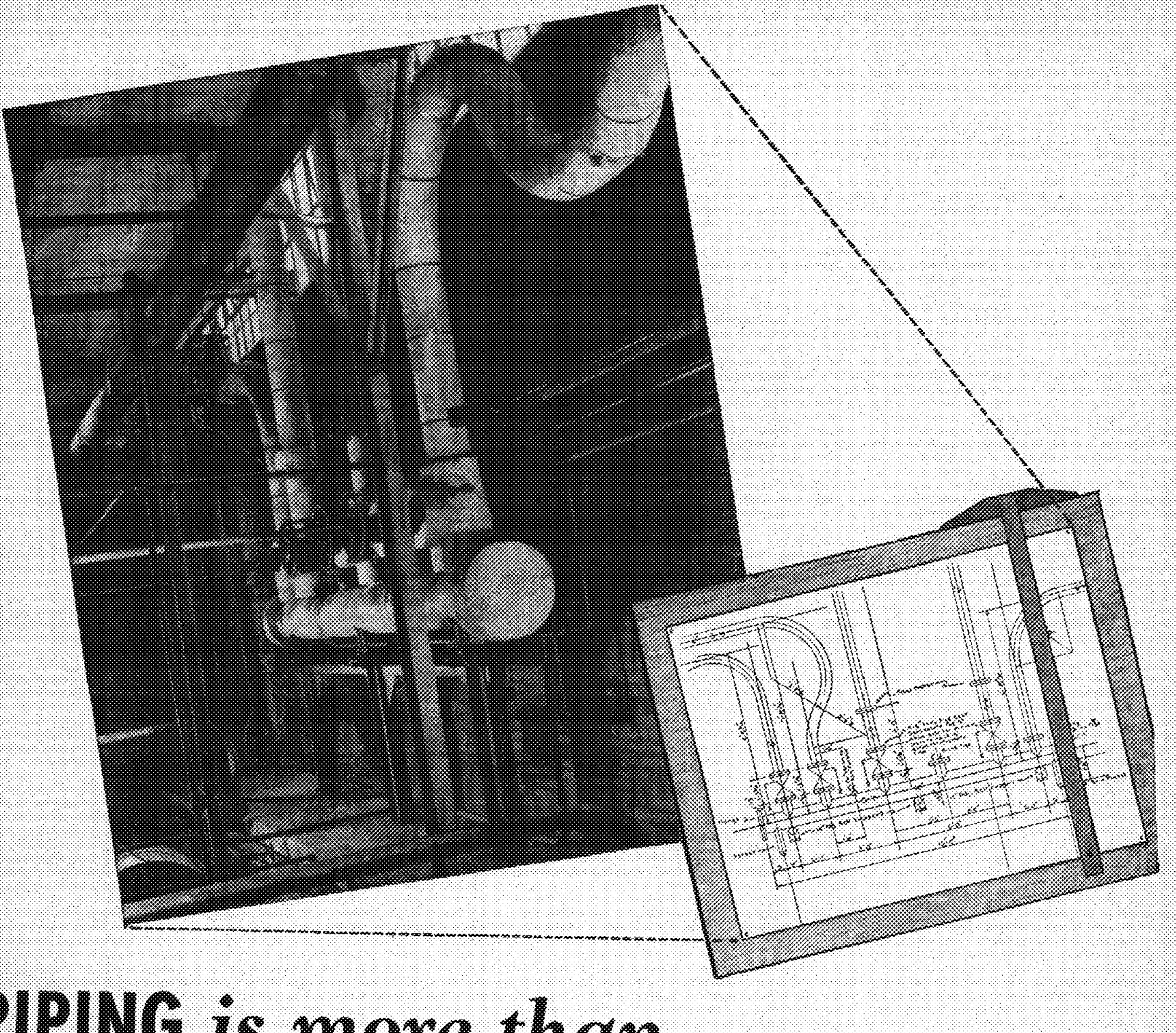
For the demonstration of Class-A fires waste material of various sorts, such as old mattresses, is piled in one end of the "forecastle" compartment. The pile is saturated with oil and ignited. The students detailed to extinguish this fire know their instruction that water is the indicated agent, since the burning waste will respond best to a wetting, bringing the temperature below the ignition point. The students do not need to recall an instruction, however, to realize that for this fire they must carry a hose line into the compartment in order to direct it upon the fire for the wetting effect that is indicated. They realize, too, that they must protect themselves against smoke and poisonous gases, and against the possibility of coming momentarily into contact with the flames.

In the next demonstration the bottom of the "boiler room" compartment is flooded with fuel oil, and oil is ignited. The resulting fire is a Class-B fire, one that is not ordinarily to be attacked with water, since water is likely to cause such fires to spread, although in certain circumstances water may be successfully used. The students need only to look down through the hatch to realize that for this fire they are not to go down into the compartment: the entire floor space is ablaze. The students remain at the hatch. One student applies fog through the hatch with an applicator in order to provide a cover and keep down the heat so that another students can stand at the hatch and apply a smothering blanket of foam. The foam quickly builds up a sufficient depth to extinguish the burning oil. And the fire fighters have learned how to put out one of the most difficult fires, one that they are most likely to encounter at sea.

With the Class A and Class B fires extinguished, another problems remains to engage the attention of the students: how to extinguish a fire in electrical equipment, a fire that is called a Class C fire. In the "engine room" compartment gasoline in a trough just below an electrical switchboard is ignited. For this fire the students know they must use an extinguishing agent that is a nonconductor of electricity. They extinguish the fire with carbon dioxide from portable fifteen-pound containers. Low-velocity fog would be their second choice for this fire; but they know that while the finely diffused fog is a poor conductor of electricty, it has a wetting effect, and therefore it would put the electrical equipment out of service, if it were still in service, and further it would cause damage by corrosion. Water, the fire fighter students have learned, must not be used on electrical equipment fires unless it can be applied in some way that will remove the danger of electrical shock.

In addition to the extinguishment of various kinds of fires, an important part of the training of the Navy's Fire Fighter's School students is that in which they learn what to do when the fire main in any section of a Navy vessel fails to work. The students learn how to resort to jumper lines that reach around ruptured sections of the main, and to set up and operate a portable pump, the handybilly pump. They use the pump to take water, presumably, from over the side, or they connect it to the fire main to boost pressure that has been weakened by rupture or unusually heavy demand. The tank used to supply water for the handybilly is also the experimental tank for shallow diving practice. The students learn how to don a diving suit and go below the surface, presumably for rescue or repair work.

In general, the procedure at the Navy's five Fire Fighter's Schools consists of lectures, motion pictures, and practical work with the Navy's equipment for extinguishing fires and for protecting the fire fighter. At the end of the six-day course examinations are held; the students are graded and their grades are recorded. They then return to their ships to participate in the work of fire fighting, when occasion arises, and to do so with a better understanding of the problems involved and the best means for solving them.



Victory Highways

(Continued from Page 219)

vulnerable point of invasion. Today it is just as important as a stepping-off place for a final blow at Japan.

The Alaska road is finished. During its construction some 16 Pioneer Duplex plants were operated by American and Canadian contractors. Simple, rugged, efficient, the Vibrator Duplex plants did a real job converting available materials into highway sand.

And now supplies and materials of war are rolling over the Alaska highway. It's a job that engineers and contractors can be proud of.

Although gravel machinery and heavy equipment for road making have always been a major part of the Pioneer operation —at the time the war started, Pioneer Belt Conveyors, Washing plants and other units were in use in mining operations on the Mesabe Range. War needs boosted the demand for Minnesota's iron ore.

Steel mills in the East processed Minnesota's ore into the country's first critical material—the steel for guns, tanks, ships.

Pioneer conveyors helped Mesabe miners produce more ore with less equipment and labor. New conveyor installations replace trucks and ore trains. New installations are equipped with Pioneer feeders, screens, crushers, and conveyors.

In the Minnesota mines the job was simply to get more raw materials out of the ground and into Great Lakes freighters faster than ever before. Dozens of other operations were different—mines and quarries were opened to tap new sources of critical materials. Often it was the ingenuity of Pioneer engineers and their specially designed equipment that kept needed materials rolling off on time and in sufficient quantity to do the job.

Portable crushing and screening equipment made it possible to start new operations quickly and economically.

Mobile Pioneer units were used in other fields of service, too, in the fast-moving Global War.

The Travel-Mix plant, that mixes aggregates with a bituminous binder for surfacing highways rolled out many landing strips for Flying Fortresses.

A tractor-propelled Cargo loader joined the Air Force's ground crew helping hoist the big loads into Cargo planes headed for Dakar, Dutch Harbor and the South Pacific.

So in many ways and in locations far from Minneapolis the products engineered by Pioneer have helped to push forward the wartime lines of supply.

Thus, one Minneapolis firm, the Pioneer Engineering Works, Inc., serves the war effort. It is one of thousands that devote time now toward keeping open the roads of supply.

Behind the Armies are machine shops, raw materials, and the ability to produce vast quantities of finished goods—just now, these are mostly goods for war—but the ability and the raw material will remain long after peace comes.

New Wing for Aeros

(Continued from Page 225)

systems, and de-icing equipment may be conducted. No longer will the password in the Aero office be "If you have no work to do, don't do it here!" Students will have ample space for study and consultations. One small room will be designed so it can be used for special design problems by the faculty.

The third floor will house additional office space, two medium-sized (30 x 60 ft.) design rooms to be used by the sophomore and junior students. Additional classroom space is also provided.

The major portion of the fourth floor will be devoted to a senior design room. Research rooms, classrooms and space that may be devoted to taking care of student organization needs are also provided for on this floor. The senior design roo mean double as a lecture room for large classes.

The South end of this wing will house an airplane laboratory; this laboratory will be large enough to house completely assembled airplanes which it is hoped will be available upon the end of hostilities, if not before. The acquisition of the first example of this category of equipment is almost "fait accompli" as the department at present is awaiting the delivery of a pursuit type airplane loaned by the U. S. Army to the department for instructional purposes. This laboratory will have a central well that extends up to the third floor with a small balcony at the second-and third-floor levels. To facilitate the movement of heavy equipment, monorails are to be installed at each level and spiral stairways will speed the movement of personnel from one floor to another in this portion of the building, without the necessity of leaving the shop itself.

Directly over the airplane laboratory on the fourth floor the space is to be devoted to a complete meteorology laboratory; it will provide for plotting equipment and forecasting equipment. This equipment will include complete radio and teletype service. Space is set aside in this portion for use by the meteorological section as a seminar room where periodicals and reference material will be kept for the use of the meteorological students.

Perhaps the most radical design feature of the Aeronautical section will be the design of the roof to permit the landing of helicopters on it. Access to the roof will be from the fifth floor of the central shop wing of the building. No attempt will be made to move the wind tunnels from their present location in the Oak Street Laboratory to the new building, due to lack of space and because the department feels that the expense involved in eliminating noise, vibrations, etc., from the installation is not warranted.

Every effort will be made to facilitate the work of the students and the staff. A prime requisite in Aeronautical Engineering is ample blackboard space for the development of equations, etc. Blackboards should be sufficiently large to permit the instructor to complete the derivation without having to erase some main point of reference, while the students should be able to study the work step by step without having to take down notes as fast as they are given, each student taking them down in his own peculiar type of shorthand. Plans are made for visual aids to education, a desirable method of assisting the instructor in "getting his material over" and in helping the student understand the work. Means of darkening classrooms, projection screens, and projection machines are to be provided. In some classrooms, special demonstration tables and desks are planned. The drafting rooms are laid out so that the best advantage can be taken of natural lighting, and when this is not sufficient, fluorescent lighting is to be available. Sufficient locker space is contemplated to take care of all Aeronautical Engineering students, even though the enrollment is expected to expand over the record enrollment of 550 students in prewar days.

Display cabinets will permit full utilization of models, charts and kindred items.

Whether the building is to be called the Aeronautical-Mechanical Engineering Building or the Mechanical-Aeronautical Engineering Building is not important, but what is important is that the functioning of each department in its prime "raison d'être"; that is, providing good engineers for the armed services if need be, or for the industry in the future will be greatly enhanced. Research, the high road to progress, will also benefit by the immensely improved facilities possible in the new building.

TECH NEWS

EDITED BY CHARLES AMANN, AERO. E., '46

Aero Dept. Gets Pursuit Ship

The Aeronautics Department recently acquired a fairly late model airplane for its classes to work with. The ship, a Curtiss YP-37, is in good condition except for the electrical system and the vacant instrument panel. It is now housed in the Armory, where it will be assembled and put in working order by students in aeronautical engineering.

The dismantled craft is being loaned to the University by the Army for educational purposes. It was sent here from Lincoln, Nebraska, by train and delivered to the Armory on a truck. This last leg of the trip brought several phone calls to the Aero Department asking if an airplane had crashed on University Avenue.

Looking Over the YP-37

The YP-37 is the stepping stone between the P-36 and the P-40. Only 13 models of the plane were built, however. Its chief disadvantage is the fact that the cockpit, which is placed far back in the fuselage to achieve proper balance, afforded very poor visibility for the pilot.

Several interesting and rather advanced features for the airplane of its day appear on the YP-37. Among these are hydraulically-operated landing gear, flaps, an electric constant speed propeller, and a turbo-driven supercharger, which was noticeably lacking on early models of its successor, the P-40. The YP-37 was also one of the first airplanes to use the in-line liquid-cooled Allison engine.

Otherwise the plane is quite conventional for a pursuit ship of a few years back. It has a top speed of a little over three hundred miles per hour and possesses a relatively short range, for apparently, no provisions were made for carrying an auxiliary fuel supply. Its two .30 caliber machine guns are located between the motor and the cockpit, quite far back of the fuselage, and are synchronized to fire through the propeller arc. The plane is quite large for a pursuit ship, having a wingspread of about 40 feet and a length of about 35 feet. Its weight is estimated at about three and a half tons. Although the YP-37 is no longer of practical military value for combat purposes, it will serve as an excellent working model for future aeronautical engineers.

Spring Enrollment Drops Further

The enrollment of civilian students in the Institute of Technology is still decreasing. Latest figures show that 490 civilian students registered for spring quarter classes. The enrollment during winter quarter was 734, while 897 students were registered for the fall quarter. Recent graduates and the selective service accounted for the decrease in enrollment this quarter.

As a result, all classes have become smaller, and in some cases classes have had to be combined. Where before there were many sections for one particular class there is now generally but one. Students cannot afford to fail or not register for required courses when they are offered, because it may be some time before those courses are offered again.

At the present time the students in the Institute are those on the deferred list, returning servicemen, coeds, those not yet eighteen, 4-F's, and 1-A's awaiting induction. It has been advised that those in the latter classification continue their schooling as long as possible and make the most of their opportunities while they are still here.

Louis P. Merandi, Aeronautical Alumnus, Wins Chamberlain Industrial Award for 1943

Louis P. Merandi, '36, was recently awarded the Chamberlain Award for outstanding industrial achievement for 1943. The award is made by the Chamberlain Company to certain individuals, who, "through administrative or technical ability have become the Uncommon Men of their industry."

Louis Merandi graduated from the University with a Bachelor of Aeronautical Engineering degree. While here, he worked with Professor Jean Piccard for one year on development and launching of a new type experimental balloon. He also worked two years with Professor Boehmlein on wind tunnel experimental work.

He went to the Lockheed Aircraft Corporation and worked with them for more than four years as a mechanic, inspector, and engineer. He worked on such planes as the Electra, Hudson, and P-38.

In 1940 he joined the Hughes Aircraft Company as an engineering checker. He became chief checker in 1941. In 1942, he added the duties of Educational supervisor, and began teaching a class of detail draftsmen. He began a training program of 150 men (engineers in other lines than aeronautical) to become Aeronautical Layout Draftsmen. Under the ESWMT program, 595 students have made use of these opportunities to upgrade themselves. All the instructors in the above courses were company employes.

More recently, Louis Merandi has added the duties of Chief Tool Designer for the company. He now lives in Burbank, California.

UNION CARBIDE REPORTS
first full-year's production of
BUTADIENE
for the Government's Synthetic Rubber Program
(INSTITUTE, W. VA. PLANT)

Night view of the immense butadiene plant at Institute, W. Va.

A LITTLE OVER A YEAR AGO* the first tank car of butadiene was shipped from the Government's large integrated rubber project at Institute, W. Va. This historic shipment came from the immense butadiene plant which was designed and built by CARBIDE AND CARBON CHEMICALS CORPORATION for the Government's Defense Plant Corporation—and is being operated by this Unit of UCC, for the Rubber Reserve Company.

FIRST YEAR'S PRODUCTION OVER THE RATED CAPACITY—that is the record of this huge 80,000-ton-per-year plant during its first twelve months! This has been accomplished in spite of the many inherent problems that had to be solved in starting a wholly new project of this magnitude.

Over 8/10 of a short ton of butadiene is required to make about one long ton of Buna S type synthetic rubber. Butadiene from this plant during the past year has provided more than 90,000 long tons of synthetic rubber for the Nation's requirements, both military and essential civilian. The delivery of this all-important ingredient also has made possible early production of synthetic rubber under the Government's program.

*The first tank carload of butadiene from Institute was shipped on February 18, 1943 — less than one month after Unit No. 1 of the four large butadiene-producing units had started operating. Subsequently, Unit No. 2 started producing in March, Unit No. 3 in April, and Unit No. 4 on May 25, 1943.

NOW HUGE BUTADIENE PRODUCER—although originally designed to produce 80,000 tons annual capacity, the Institute plant is now delivering butadiene at a rate of more than 100,000 tons per year. An identical plant using Carbide's process was put into operation by the Koppers United Company in September, 1943, at Kobuta, near Pittsburgh, Pa.

OVER 75% OF THE TOTAL PRODUCTION OF BUTADIENE for the Government's synthetic rubber program in 1943 came from the alcohol process developed by CARBIDE AND CARBON CHEMICALS CORPORATION.

In addition to the plant at Institute, Carbide made available plans for the large plant at Kobuta, which was built and is being operated for the Government by Koppers United Company.

CARBIDE AND CARBON CHEMICALS CORPORATION also has designed and built for the Defense Plant Corporation, and is operating for the Rubber Reserve Company, another large butadiene plant at Louisville, Ky.

▼

Business men, technicians, teachers, and others are invited to send for the book P-4 "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol," which explains what these plants do, and what their place is in the Government's rubber program.

BUY WAR BONDS AND STAMPS

UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street [UCC] New York 17, N. Y.

Principal Units in the United States and their Products

ALLOYS AND METALS
Electro Metallurgical Company
Haynes Stellite Company
United States Vanadium Corporation

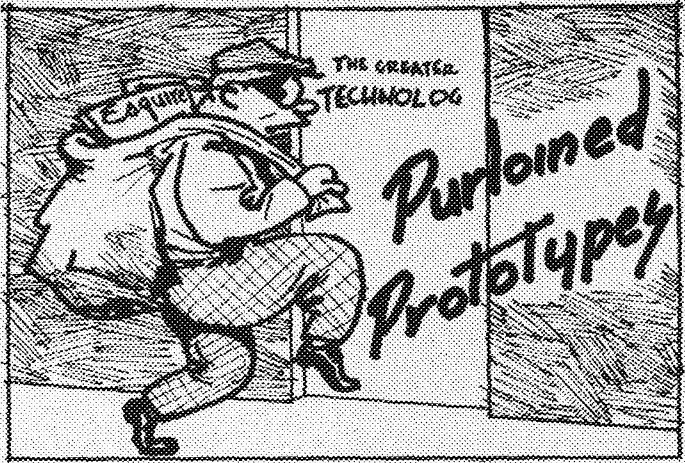
CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS AND BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

The material herein has been reviewed and passed by the Office of Rubber Director, the Rubber Reserve Company, the Defense Plant Corporation, and the War Department.



BY BOB REYNOLDS, A.E., '44

Wife: "Why do you always run out into the garden when I sing? Don't you like to hear me?"

Husband: "It isn't that. I just want the neighbors to see I'm not beating you."

* * *

Fashion note: The most popular shades this spring will be the ones left up in the girls' bedroom windows.

* * *

1941—What a man!!
1942—What? A man?
1943—What's a man?
1944—? ? ?

* * *

Gal: Did you ever sell brushes?

GI: No, why?

Gal: Well, you'd better get one and start selling. That's my husband at the door.

* * *

Mr. Coyle bought the only remaining sleeping car space. An old lady next to him in line burst into tears, wailing that it was of vital importance that she have a berth on that train. Gallantly Coyle sold her his ticket and then hurried to the telegraph office. His message read:

"Will not arrive until tomorrow. Just gave berth to an old woman."

* * *

Athlete: I've had my nose broken three times in the same place.

She: I'd think you'd stay out of that place.

* * *

The horse and the mule live thirty years,
And nothing know of wines and beers,
The goat and sheep at twenty die,
And never taste of Scotch or rye,
The dog at fifteen cashes in,
Without the aid of rum or gin,
The cat in milk and water soaks,
And then in twenty years it croaks,
The cow drinks water by the ton,
And when eighteen is almost done,
The hog when young is laid to rest,
And never knows a cocktail's zest,
The modest, sober, bone-dry hen
Lays eggs for nogs and dies at ten.
The lower animals are curst,
Because they lack a liquor thirst,
Oh, not for the lusty song
And noisy revel all night long,
Oh, not for them the merry quips
That freely flow from wine-wet lips,
From birth they play a tragic part,
And stop before they fairly start;
All animals are strictly dry,
They sinless live and quickly die,
But sinful, ginful, rum-soaked men
Survive for three score years and ten.

He: "I see dark spots in front of my eyes."
She: "Good, let's park in one of them."

• • •

It's getting hard for a girl to make a living these days with boys calling up and asking what nights she's free.

• • •

When Sue returned from a ride her mother noticed one of her shoes was muddy. "Why is your right shoe muddy and not your left," she asked.
"I changed my mind," she replied.

• • •

Nowadays, when they kiss and make up, she gets the kiss and he gets the makeup.

• • •

Girls when they went out to swim
Once dressed like Mother Hubbard;
Now they have a better whim—
They dress more like her cupboard.

• • •

And then there was the little moron who took the cap off his knee to see if there was any beer in the joint.

• • •

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

• • •

"Should a father of fifty get married again?"
"No, that is enough children for any man."

• • •

Engineers are often baffled by the fact that some girls with streamlined figures often offer the most resistance.

• • •

POME
I like an exam
I think they're fun
I never cram
I never flunk one—
I'm the professor.

• • •

Flattery is soft soap, and soft soap is 90 per cent lye.

• • •

E.E.: "Grab the end of that wire."
M.E.: "All right, I've got it."
E.E.: "Feel anything?"
M.E.: "No."
E.E.: "Well, then, don't touch the one next to it. It's got 50,000 volts in it."

• • •

What has more fun than people do?
Rabbits.
Do you know why?
Because there are more rabbits than people.
Do you know why?
Because rabbits have more fun than people do.

• • •

"I wonder who this telegram is from."
"Western Union, I recognize the handwriting."

• • •

"We had a bad explosion at the house the other night. Somebody told Dad the new maid was dynamite, so he decided to investigate. As soon as he touched her, she exploded. Mother went through the roof, grandma hit the ceiling, and Dad went all to pieces."

• • •

Small Boy: "Mother, must I wash my face again?"
Mother: "Certainly, Willie, why do you ask?"
Willie: "Oh, I thought I could just powder it like you do."

• • •

The difference between a model woman, and a woman model is that the former is a bare possibility and the other is a naked fact.

• • •

She: "A rich man wants to marry me, but I don't love him, and I don't know how to tell him."
Girl Friend: "Introduce me, I'll tell him."

• • •

There are times when they are alone and they sit togetherlikethis,
But when the damsel's father comes home, he always finds them like....................this.

In the last issue of the LOG, the space occupied by this column was written by Eugene Andrews. He wished me luck with the magazine (thanks a lot, Gene) but didn't mention anything about himself. Gene graduated from the N.R.O.T.C. the last part of February and received his commission as an Ensign at that time. The last day of February he married the former Beverly Shores. That same week he put out his last issue of the TECHNOLOG and left on his honeymoon. Just a short while ago he reported for active duty at one of our large naval bases. Gene did a swell job in putting out such nifty issues of the LOG and it was really a pleasure working with him. Good luck.

• • •

At least one student at the University has found fame through the TECHNOLOG. He is John Lindsley, Physics, '46. In the May, 1943, issue of the TECHNOLOG he wrote an article on "Esperanto, An International Auxiliary Language." Shortly after the article appeared *Science Digest* asked for permission to reprint the story. A little while ago, we received a letter from *Correct English* asking for permission to use excerpts of his article. Both requests were granted. Moral to the story: if John can do it, why don't you try, too?

• • •

We recently received a news bulletin from the E.C.M.A. (Engineering College Magazines Associated). Among the news items of the bulletin was this choice remark: "Whoever designed the TECHNOLOG is something of a surrealist. It would be out of place on any other book." The staff is still trying to decide what that last statement could mean. What do you think? Incidentally, Maurice Breslau, Arch. '44, designed that cover for us. He does all the art work required for the magazine and has been doing a great job.

• • •

Taking over the managing editor's position for this issue will be Chuck Amann, erstwhile future Aero and Navy V-12 candidate. Chuck has been with the staff ever since he was a freshman. He's really been doing a fine job, and our thanks to him. Keep up the good work, Chuck.

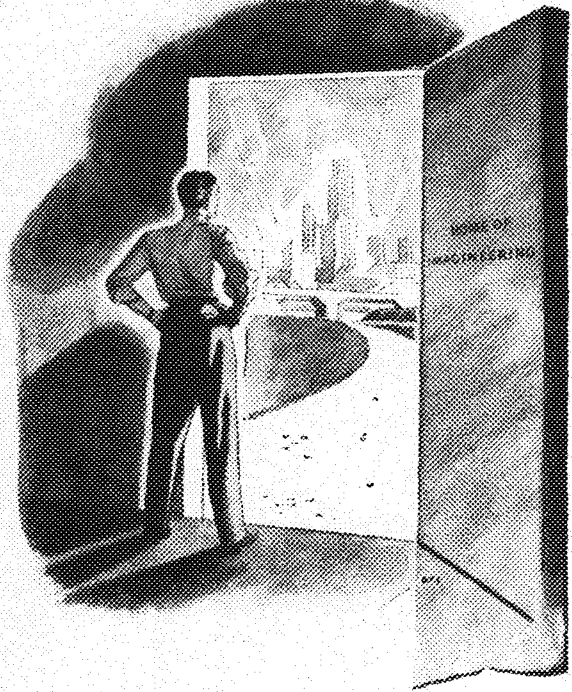
• • •

Now that spring is on the way, let's stimulate a little interest in some springtime sport, namely, kittenball. Why can't some department teams be organized, and team play started? Might as well have some fun this quarter, as long as we're here.

• • •

Some of the LOG staff members who still have some blood flowing through their veins have been giving it to the Red Cross regularly. That's just another way we feel we can help. Besides, you can never tell when you'll be needing that blood back again. We're trying to do our part. Are you?

H. S. B.



Your Tomorrow Began Yesterday

Yesterday someone did something that will make tomorrow better.

We do not mean to be Pollyanna. We are totally engaged in the grim business of producing for war. But it is still hard, realistic fact that the good things of tomorrow are being planned today, were planned yesterday. Jobs, for instance. Your future job.

This is one reason why we enjoy working with aluminum. It's full of possibilities for making new things, and making old things better. The future of aluminum is exciting.

There is now much more aluminum and it costs less. It will be usable in many more places. Alcoa has been imagineering in aluminum for 54 years and we have good reason to feel the postwar future of aluminum is something for a man to want to have a part of.

Look what aluminum can do to help patch up this shattered old world. It's the wings of the Air Age. It is going to tie remote peoples together and help bring about understanding.

Aluminum's strength with light weight makes things easier to lift, less expensive to move. It offers another spurt of growth to all forms of transportation.

Alcoa Alloys in brilliant colors promise a new splurge for beauty. Think what you can do to brighten homes and hospitals, stores and schools with a metal that is easy to work, resistant to corrosion, light, strong and capable of being dyed practically any color of the rainbow!

We have seen a lot of good imagination engineered into plans utilizing Alcoa Alloys. We have done some Imagineering of our own, too.

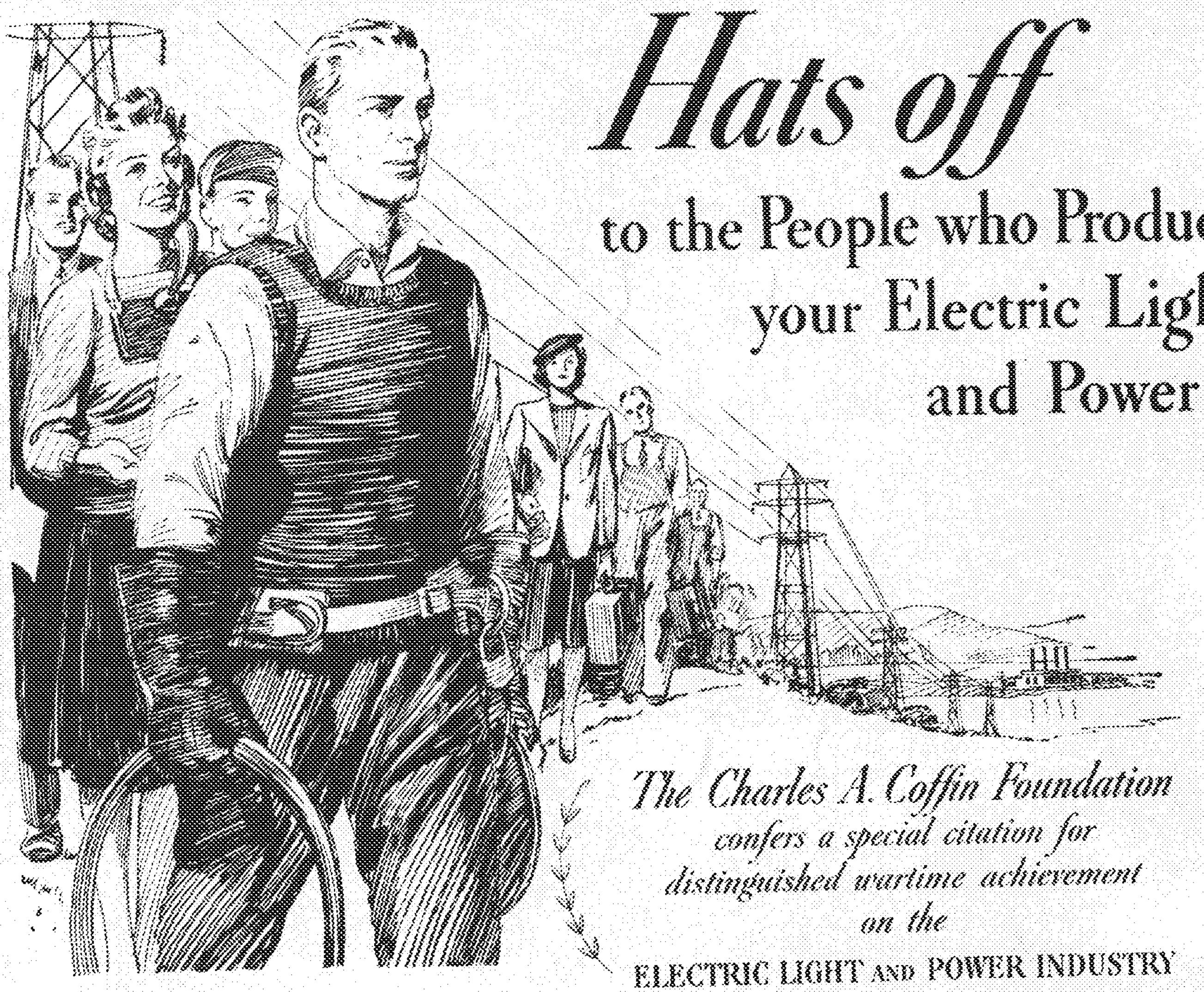
These plans are today's blue-prints for tomorrow's jobs. Many of you younger men will be needed to turn them into action. In fact, we hope some of you will want to help put across the ideas we have been cooking up here at Alcoa.

ALCOA
REG. T.M.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.



Hats off
to the People who Produce your Electric Light and Power

(3)

The Charles A. Coffin Foundation
confers a special citation for
distinguished wartime achievement
on the
ELECTRIC LIGHT AND POWER INDUSTRY

"Faced with unprecedented demands, the Electric Light and Power Industry has met every war-production requirement without delay and without impairment of its peacetime services to the public. This achievement merits the appreciation not only of American industry but of the entire nation." — FROM THE CITATION

THIS CITATION is richly merited—for here is a branch of industry that has done a remarkable war job that has not been generally recognized.

If electric power should fail, or if it be too little or too late, the disastrous effects would startle all America. Vital machines would be motionless. Millions of homes would be cold—and an eerie blackout would descend over the land.

But electricity has not failed. Rather, in 1943 twice as much power was produced as in the year before the war—with the minimum of new facilities—and despite large losses of skilled employees to the Armed Services.

In the words of J. A. Krug, Director, Office of War Utilities of W.P.B., "Power men—public and private—should be proud of the job that has been done in providing power supply. Power has never been too little or too late."

We of General Electric, who have built a large part of the electric equipment which generates, distributes, and uses the electric power of America, take pride in the way this equipment is standing up under the strain of "forced draft" wartime operation.

Many of the men and women responsible for this remarkable record are your neighbors—the manager or meter reader who lives across the street, the girl in the accounting department who is in your bridge club, the lineman with whom you bowled last night. A word of appreciation from you to them will lend added significance to this well deserved citation. *General Electric Company, Schenectady, New York.*

Invest in Your Country's Future—BUY WAR BONDS

GENERAL ELECTRIC

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

TECHNOLOG

15c

MINNESOTA

KEEPING UP WITH *Electricity*

BROADCASTING TIN. "Flowing" tin plate by induction heating is now accepted practice in the industry. Frequency used in the first installation was 200,000 cycles per second—and the equipment was salvaged from a discarded broadcasting unit! Incidentally, this first installation is still in daily use.

IT'S A MATTER OF SPEED. Radium gives out 1,200,000 times as much energy as the same weight of coal burned with oxygen. Even if we had plenty, however, it would probably be a poor substitute for coal, since it releases energy only one-eightieth as rapidly. Nothing that scientists have been able to do has had the slightest effect in speeding up the process.

THE SUN IS STILL SLOWER, releasing energy by a process which involves the transmutation of elements and takes between six and seven million years.

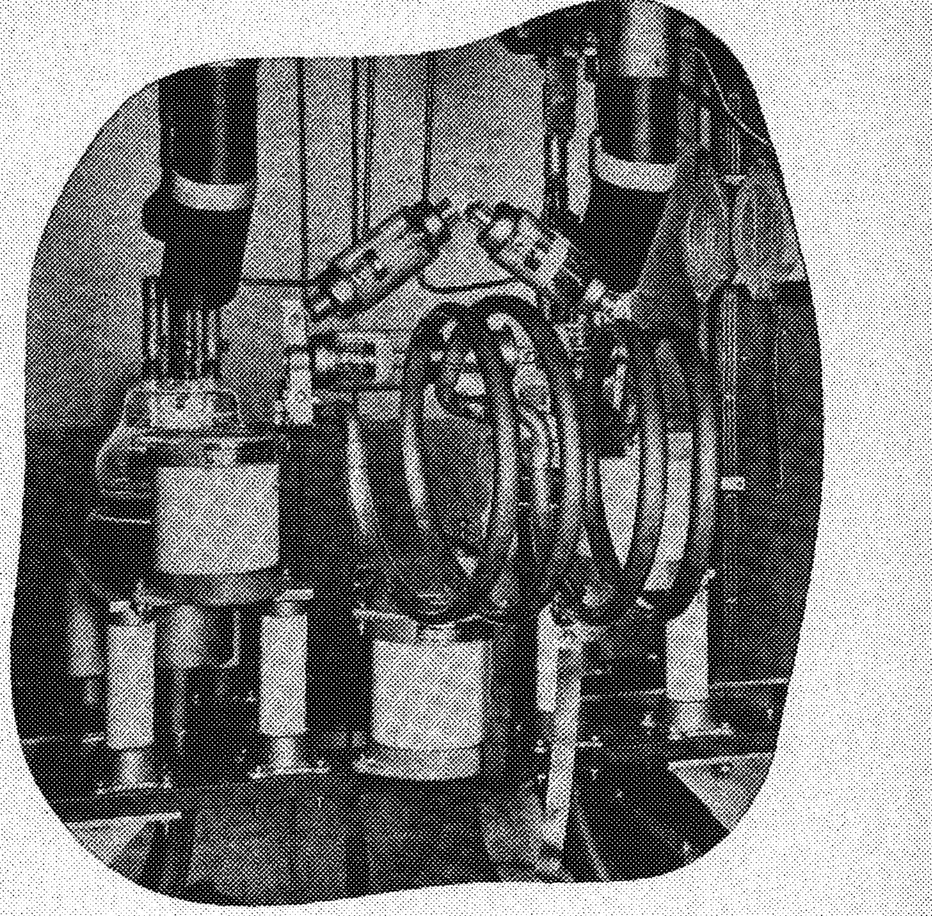
WOMAN'S WEAPON. One reason that electric irons aren't being made is that the thermostats used to control their temperature are busy on land, sea and air. They're guarding against motor trouble in tanks, fire danger in planes, overheating in gun equipment on battleships.

PEAK FLATTENERS. Resistance welders have speeded up production in thousands of war plants, but they have imposed enormous on and off single-phase loads on power circuits, often building up impossible peak demands. Capacitors are proving to be the answer, correcting the power factor to approximate unity.

THE HIGHER, THE FEWER no longer applies in radio vibrators. At high altitudes, vibrator contacts literally "boiled away" in ten hours, hence this type of radio was seldom used in airplanes. New-type vibrator, using Westinghouse-developed materials and techniques, has a life expectancy equal to that of the plane.

• • •

The above items are condensed excerpts from articles in the WESTINGHOUSE ENGINEER, a bi-monthly engineering review. Regular subscription price—$2.00 a year. *Special price to students—50¢.*



Plastics, plywood and electronics

This is a Westinghouse laboratory set-up for research in dielectric heating—internal heating by high-frequency radio waves. Together with induction heating—surface heating of metals by high-frequency radio waves—this process is daily finding new applications in industry.

One outstanding use of the principle of high-frequency heating is the Westinghouse development of flowing of tin on steel strip. Other important applications are in the bonding of plywood and the curing of plastics.

Dielectric and induction heating effect important savings in time and materials with attendant benefits of better control and more uniform results.

High-frequency heating is an example of electronics at work, another phase of Westinghouse leadership in electricity. Westinghouse Electric & Manufacturing Co., Pittsburgh 30, Pa.

WESTINGHOUSE PRESENTS: *John Charles Thomas, Sunday, 2:30 p.m., E.W.T., NBC. "Top of the Evening," Mon. Wed. Fri. 10:15 p.m., E.W.T., Blue Network.*

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

this month

BY HELEN HELLAND

High school journalist and gymnast, lover of good clothes, and also good women, politician de luxe, as affiliated with the Commonwealth party—all this is part of the enviable record of Bob Fulton, Author of the Month.

Bob came to the "U" from Humboldt

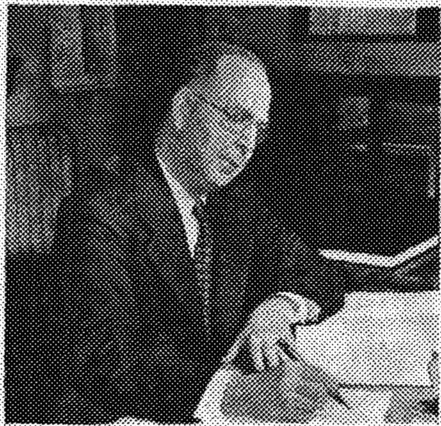
High in West St. Paul to take part in the accelerated program. He is enrolled in chemical engineering.

As a member of Acacia fraternity, Bob is noted for winning the Iron Cross of that organization. This is really a marvelous accomplishment and he deserves a lot of credit for his fine work.

He can usually be seen around campus in his own car, a '35 Dodge of which he is very proud. (That is, proud of it as long as the tires hold out.)

Mr. Quigley, author of "What Price Peace," is quite an authority on world politics, and the holder of many degrees. He got his first degree from Hamline University in 1911. He then went to Oxford on a fellowship. Returning to this country, he went to the University of Wisconsin, where he earned his Doctor's degree. In 1932, he received an honorary Doctor of Laws degree from Hamline.

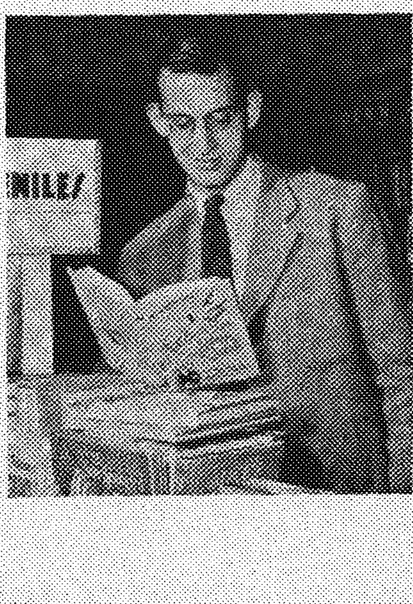
He has been at Minnesota since 1920, but his teaching experience includes one year at Princeton, and two years at a university in Peking, China. In fact, Mr. Quigley has been to the Far East three times. In 1930, he went to Japan on a Guggenheim Fellowship to study the government of Japan. As



a result of this trip, he wrote a book on "The Japanese Government and Politics." He is the author of two other books on the Far East.

As for his private life, Mr. Quigley discloses that he is married and has three children. One of his favorite hobbies is fishing. The other hobby is "trains." They fascinate him, and he tries to learn as much about them as he possibly can.

The new face haunting the TECHNOLOG office this month belongs to none other than that man about campus, Ivan Doseff. Although born in St. Paul, Ivan has lived most of his life in Minneapolis, and graduated from Marshall High in that city with honors. While there, he served



as contributing editor on the student newspaper.

At the present time, Ivan is taking a business course here at the "U." He is an active of Sigma Nu fraternity, and is a member of both the football and wrestling teams. He is also known to be a great humorist, writing that famed humor column in the TECHNOLOG.

As for hobbies, he includes all forms of sports, but his favorite whim is a sports scrapbook. When asked about women, he merely said that he is "occupied."

Ralph White is the promising author of the article on Penicillin, appearing on page 247. This is his first writing venture for the TECHNOLOG.

Ralph is a sophomore in chemical engineering, and some day hopes to enter research in that field. However, his plans

may have to take a rain-check, as the Army may teach him an entirely new profession.

He is a St. Paul boy, and graduated from Wilson High. While there, he played clarinet in the band and orchestra and took an active interest in a number of other organizations.

Ralph's hobby is music, preferably the classics. He doesn't go in much for swing. He plays the piano and the phonograph with "about equal proficiency."

As for women, he isn't going steady at the present, but he says that any woman who doesn't smoke or wear blue jeans rolled knee high is eligible.

MINNESOTA TECHNOLOG

The editorial policy of the TECHNOLOG is to present material for technology students which it is hoped will strike a happy medium between the superficial and the highly specialized.

The purpose of the TECHNOLOG is twofold: first, to put in the hands of TECHNOLOG subscribers highly worth-while and interesting reading material; second, to offer technology students an invaluable opportunity to get writing, selling, and working-with-others experience.

Entered as second-class matter April 9, 1925, at the post office at Minneapolis, Minnesota, under the Act of March 3, 1879. Office, 17 Murphy Hall, University of Minnesota. Telephone, Main 8177, Extension 514. Subscription rate, $1.50 per year. Advertising rates upon application. The TECHNOLOG is published monthly, October through May, by the students in the Institute of Technology of the University of Minnesota.

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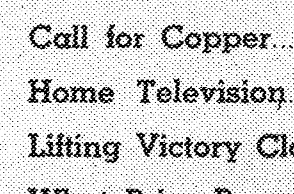


THE GIGANTIC MARTIN MARS is a blazing trail for the Navy as a pioneer in air transport. Courtesy Glen L. Martin Co.

FRONTISPIECE. Floodlighting the 555-foot Washington Monument at night. Courtesy Westinghouse Electric and Mfg. Co.

The Miracle Drug

PENICILLIN

BY RALPH WHITE

CHEM. E., '47

Because of the war a deep interest in the new drug penicillin, has been aroused, both among the public and in medical circles. Much is still unknown about this new discovery, and new uses are constantly being found for it that will lead to a more healthful postwar world.

IN the history of modern medicine, certain events stand out as epoch-making. Pasteur's discovery of the germ, Paul Erlich's synthesis of the potent arsenicals used against social diseases, and the discovery and synthesis of the sulfonamides are notable among them. Now it appears that another event is destined to rank as even more important—the discovery of penicillin. There is a real romance behind this magic drug: its unique discovery, its difficult production, its strange properties, its amazing therapeutic values. Its future may prove to be the opening of an entirely new and unexplored realm of "miracle drugs."

Just fifteen years ago in St. Mary's Hospital in London, a hitherto unknown physician observed a phenomenom which foreshadowed a new era in the field of medicine. The man was Dr. Alexander Fleming, and the phenomenom occurred when some of the plates of staphylococcus colonies in his laboratory became contaminated with some mold—the common green type found on moldy bread and cheese. This was not an uncommon occurrence, but apparently Dr. Fleming was the first to notice a peculiar condition: the germ cultures around the spots of mold were obviously undergoing lysis, that is, they were being destroyed. The thought occurred to Dr. Fleming that if this mold, *Penicillium Notatum* by name, could kill staphlococcus germs on a culture plate, it might be effective against other bacteria—disease-causing bacteria. And so he performed a number of tests. He found that it was not the mold itself that affected the germs, but a yellow liquid which the mold produced. He named this potent liquid "penicillin." For his tests, he produced it by growing the mold on a meat-extract broth for six or seven days, and by then filtering it from the broth. The results of his experiments, which Dr. Fleming published in the *British Journal of Experimental Pathology* in 1929, indicated that he had discovered a number of penicillin's basic properties, and was aware of its terrific inhibitory effect on certain organisms.

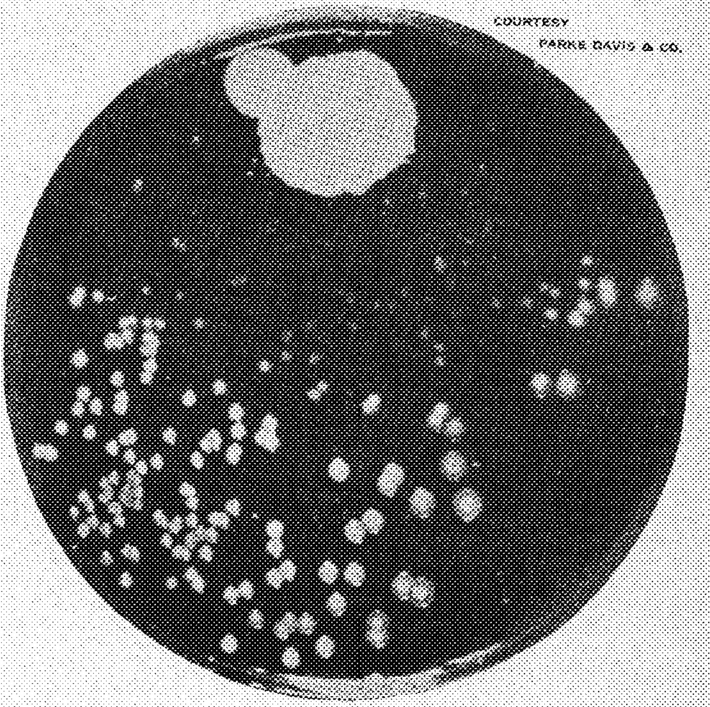
During the following decade, nothing spectacular was done in the way of research on penicillin. But in 1940, Dr. M. E. Florey and his group of "Oxford workers," under pressure of war needs, set about to re-investigate its possibilities. Not only did they succeed in formulating most of its properties, but they established a standard unit of assay, the Florey, or Oxford unit. (The Florey unit is that amount of penicillin which, when dissolved in 50 c.c. of meat-extract broth, just inhibits completely the test strain of staphyloccus aureus.) After testing the new drug on animals, they tried it in hundreds of clinical tests on patients. The results were so amazing that penicillin's reputation for incredible therapeutic power was almost immediately established.

Dr. Florey was greatly impressed by the results and saw the vast possibilities of such a powerful drug. So in the summer of 1941 he visited the United States and aroused such interest that, after a conference with members of the National Research Council and representatives of several pharmaceutical houses, plans were laid for the immediate production and clinical investigation of the drug. Today, studies are being carried out in the United States at the College of Physicians and Surgeons, N. Y., the Mayo Clinic, the University of Minnesota, the National Institute of Health, Evans Memorial Hospital at Boston, and almost all large pharmaceutical houses.

Production today has not been definitely standardized in either England or the United States. However, the present methods of production are all based on the same fundamentals. In order to get a maximum output of penicillin, a high potency strain of *Penicillium Notatum* mold must be selected for the "stock culture." To prevent a spontaneous loss of potency, an aqueous suspension of the mold spores is mixed with sterilized sand, and dried. This "soil-

THIS IS a photo of the culture-plate on which the anti-bacterial action of penicillin was first noted by Alexander Fleming.

COURTESY PARKE DAVIS & CO.



spore" mixture constitutes the "master culture," and it can be preserved indefinitely in a refrigerator. To provide subcultures for manufacturing purposes, a loopful is spread over the solidified surface of Sabouraud's agar. After incubation from four to six days, the surface becomes covered with green spores. These spores inoculate dozens of Roux bottles containing more agar. These cultures, in turn, furnish enough material for several hundreds of flasks containing liquid medium. (Some companies use the "deep" or "submerged" method in preference to the "shallow" or "surface" method described. In this process, the medium is contained, not in flasks, but in large tanks or vats similar to those used in the brewing industry. These are inoculated and the process then continues as in the shallow method.) This medium consists of a solution of sodium nitrate, potassium hydrogen phosphate, potassium chloride, magnesium sulfate, ferrous sulfate, lactose, and water.

The flasks are incubated 7 to 14 days at 24°C. Twenty-four hours after sowing, fluffy, gauze-like growths appear. They spread over the entire surface, become more voluminous and on the third day throw up white, cottony, vegetative patches. These gradually cover the surface and form a thin mat which, on the fourth or fifth day, turns bluish-green. The growth can now be described as a continuous, compact, often-corrugated, dark greenish-blue felt whose upper surface cannot be wetted by water. The undersurface is wetted, and is brownish-yellow and slimy. During the process penicillin is gradually exuded into the medium, and at the bluish-green stage, its yellow color can be discerned.

The amount of penicillin obtained depends on a great number of variable factors: the potency of the culture, the nature and amount of medium used, the hydronium ion concentration (pH), and the presence of foreign material such as "trace elements" (especially zinc), or bacteria. The last factor explains the need for the absolutely sterile conditions under which production is carried out. Throughout the growing period, the pH of the solution spontaneously rises and falls. This must be controlled, since below a certain pH level, another antibacterial substance, *notatin*, is formed at the expense of the penicillin yield.

At the peak of production, the medium is filtered from the mold. A clear liquid broth is then extracted by the use of suitable organic solvents such as amyl acetate. The penicillin thus extracted is converted into a water solution of the sodium salt. This orange-yellowish solution is dried to a light orange-colored powder which is distributed in ampuls containing 10,000, 100,000, or 1,000,000 Oxford units of penicillin. Until needed it must be stored in refrigerators, since it slowly deteriorates at room temperature. (Liquid preparations are very unstable and hence are not used.) When it is to be administered, it is dissolved in either sterile distilled water, a saline, or a 5 per cent glucose solution.

The following figures indicate the progress made in production in the last three years. In 1941, 100 liters of culture were necessary to produce one gram of 25 per cent pure penicillin. By 1943, strains had been so selected that 100 liters yielded 10 grams of 88 per cent pure penicillin, enough for 100 standard doses. The first gram produced in the United States cost $6,000 to produce; now it costs about $60 a gram.

Strange Properties

Penicillin itself is a strong dibasic acid, extremely soluble in organic solvents such as ether, alcohol, acetone, etc. It is hygroscopic, that is, it absorbs water from the atmosphere. Its salts, in general, possess these same properties, with the exception of the barium salt which is neither soluble in ethyl alcohol nor is hygroscopic. This accounts for the general use of the barium salt for chemical purposes. Oddly enough, the alkali and alkaline earth salts are readily soluble in ethyl alcohol but quite insoluble in methyl alcohol at room temperatures.

Penicillin's most notable property is its extreme instability; and this seems somehow to be connected with its unusual biological properties. It is inactivated by treatment with acids, bases, boiling, or even by standing at room temperatures for some time. In each case actual chemical changes occur with the formation of new groups. These new compounds are being studied at the present time.

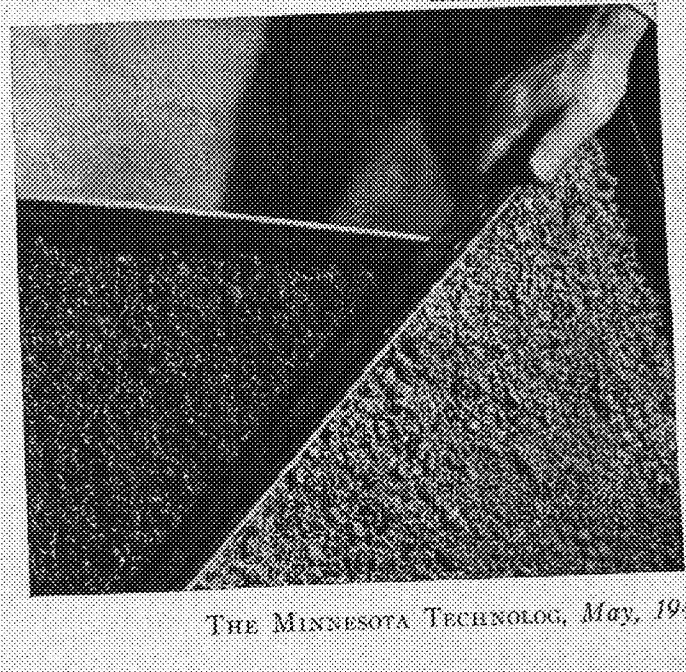
Before it will be possible to attempt the synthesis of penicillin, it will be necessary to establish its empirical formula and determine its constitution. And in order to accomplish this, absolutely pure penicillin in a crystalline form will be a prerequisite. At present no such samples exist. Abraham, Chain, and Holliday made an important step towards this goal when in March of 1942 they obtained a barium salt which appeared to be "homogeneous." Their product had an activity of 500 Oxford units per mg. But in November of that year, some other English workers reported they had obtained penicillin of a strength of 750 units per mg. by the use of a new "chromatographic technique." Since then, other researchers have reported penicillin salts of a much higher activity.

Various formulæ based on the analyses of these impure preparations have already been set forth. They seem to indicate that penicillin is similiar in structure to the aromatic, or coal tar chemicals. The English workers have suggested $C_{24}H_{32}N_2O_{10}Ba$ for the barium salt and $C_{24}H_{34}NO_{11}$ for the acid. The American workers Hobby, Meyer, Chaffee, and Dawson have proposed $C_{14}H_{19}NO_{5}$-H_2O. The nitrogen content of penicillin is remarkable because few of the many other materials obtained from molds are nitrogenous. The percentage of hydrogen is unexpectedly low. All penicillin preparations lose CO_2 on heating—the more pure the product, the more CO_2 is lost. The complexity of its molecule, and its instability may indicate that the synthesis of penicillin will remain a distant hope for some time to come.

A LABORATORY technician is subculturing the mold from which penicillin is derived. Clinical application of the penicillin principle has opened a new therapeutic era.

PENICILLIN is a therapeutic agent of paramount interest today. Investigation of this relatively nontoxic antibacterial weapon has revealed many of its useful characteristics.

COURTESY PARKE DAVIS & CO.



Dr. Fleming, in 1929, was aware of the tremendous potency of penicillin. In his first elementary tests he found it was more or less selective in its action. It was very effective against gram-positive germs, while germs of the gram-negative group were unaffected. (These germ groups are so-called because they give a positive or negative reaction to a certain staining test, named the "gram-test" after its inventor.) The germs of the gram positive group include the spreaders of such horrible afflictions as septicemia, osteomyelitis, gas-gangrene, tetanus, anthrax, and plague. The pneumococci, staphylococci, and streptococci germs are also gram positive. Concerning the latter two, Abraham and Chain have stated: "The bacteriostatic power of penicillin against streptococci and staphylococci is as great as, or greater than, the most powerful antiseptics known."

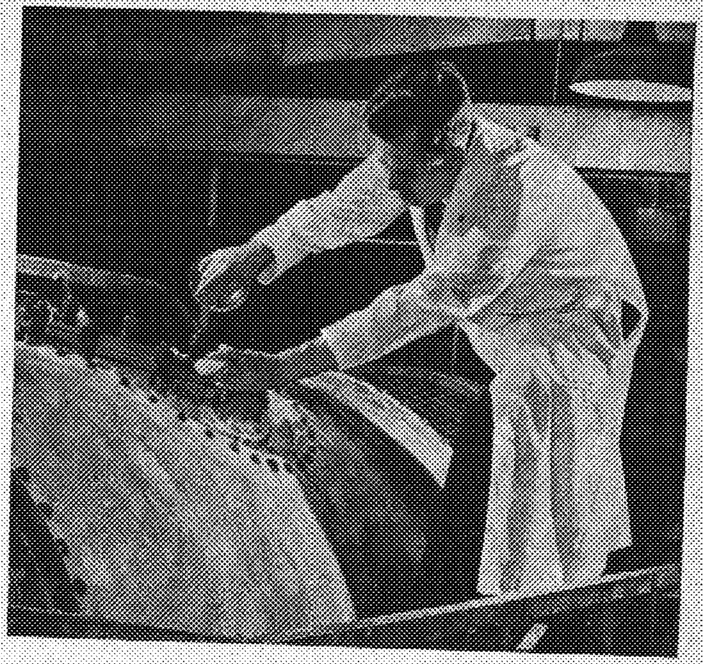
Chain and Florey in 1940 demonstrated the antibacterial action of low-grade penicillin. They found that it inhibited the growth of certain bacteria at a dilution of one part penicillin in 1,000,000 parts of solution. The amazing thing is that penicillin "exerts no direct immediate, bactericidal action"— it *does not kill the germs*—it is not an antiseptic. The exact nature of its action has not as yet been precisely determined, but the belief is general that in some way penicillin affects the metabolic rate of the organisms, and thus, by interfering with their intake of "food," prevents them from multiplying. This belief is apparently borne out by the fact that penicillin is effective only if multiplication occurs.

Later experiments (1942) with the highly purified penicillin developed in that year brought even more amazing results. It was found that this product could completely stop the growth of staphylococcus germs at a dilution of one part in 30,000,000. This same product could also partially inhibit the germs at dilutions up to *1 in 160,000,000*. This indicated a strength more than four times greater than any of the low-grade preparations then in use.

After penicillin had proven itself so effective on germ cultures, the next step was to try it on living animals. Robinson made experiments with penicillin on mice and compared its action with that of the sulfonamides. He found that the protection it afforded is much greater and more permanent than that of the sulfa drugs, especially against streptococcal, staphylococcal, and pneumococcal infections in mice. In another experiment he studied the effect of penicillin against tuberculosis in mice, and found it had no effect. Results were equally disappointing in test against the virus of epidemic influenza.

Hobby, Meyer, and Chaffee performed similar experiments on mice. The rodents were injected with large doses of hemolytic streptococci (the dread type that destroys the red blood cells). Results of the test showed that "1.5 mg. of penicillin is sufficient to protect mice against 1 c.c. of a whole culture containing at least *1,000,000 lethal doses.*"

When penicillin had proved to be of definite value in the laboratory and on mice, it was put to the final test in the clinic. The results of the treatment of diseases in humans far surpassed all expectations. It proved to be extremely effective against gonococcic, pneumococcic, staphylococcic, and hemolytic streptococcic infections. (Some types of these diseases have never yielded to treatment with sulfas). A host of other diseases responded to treatment with penicillin also. It is the only drug known to be effective against staphylococcic septicemia.



LARGE SCALE penicillin production in progress is shown above. The photo illustrates innoculation of sterilized medium with a suspension of spores of the mold Penicillium notatum.

The usual method of administration is by intravenous injection, although intramuscular injection seems to be favored in England. Since penicillin is excreted rapidly and in high concentrations, it is necessary to maintain a high concentration of it in the blood. This is accomplished by letting the penicillin solution constantly flow into the bloodstream at a rate of about 15 drops per hour. It may also be administered locally, subcutaneously and as an ointment. When given by mouth the drug is ineffective since stomach acids destroy its activity.

Chronic gonorrhea can be cured in ten days by the use of sulfa drugs. But penicillin effects a cure in from 24 to 72 hours. It is quite effective against cases where the disease is completely resistant to treatment with the sulfonamides. Sulfa-resistant pneumonia can be cured in three days by penicillin. In 55 cases of osteomyelitis (dread disease of the bone marrow) treated with the drug, 48 completely recovered, some in two or three weeks. Penicillin is also effective against blood diseases, eye infections, massive burns, meningitis, cellulitis, and carbuncles.

Advantage over Sulfonamides

Of utmost importance in treating war wounds is penicillin's effectiveness in the presence of pus, serum, or other "tissue autosylates." These have an inhibitory effect upon the sulfonamides, but not on penicillin.

Since penicillin has such an adverse effect on germs, might it not also have some undesirable effects in the body? In order to find the answer to this question, experiments were first made on mice. It was found that a highly purified salt of penicillin had no effect, although impure products sometimes caused death. This seems to indicate that penicillin, unlike the sulfa drugs, is less toxic when it is highly purified, even though it is then more antibacterial in its action. Results of its use in the clinic are equally favorable. In a number of cases described in the *American Medical Association Journal*, toxic effects were rare. Fleeting attacks of headache, itching skin, flushing of the face, muscle pains, and other effects occurred occasionally. But apparently this was due to some toxic substance in the drug which was carried over from the purifying process. After removing these substances by filtration, no reactions occurred.

A few weeks ago the director of the Office of Civilian Penicillin Distribution said that there would soon be no shortage of penicillin for civilians. This announcement came shortly after the WPB made the drug available for civilian use through a depot supply system. Up to that time, the armed forces had first claim on all that was produced. The difficulties inherent in its preparation, and the small amount produced had made the drug almost as rare and costly as radium. There appears to be new hope for greatly increased output, for the Corn Products Research foundation has announced that the "enrichment" of the mold with corn steepwater (a by-product of corn refining available in almost unlimited quantities) increases its yield of penicillin many fold. Another encouraging announcement comes from the bacteriologists at the University of Minnesota. A short time ago they reported evidence that plants and trees may contain substances similar to penicillin. They pointed out that higher plants produce either juices or odors which can kill germs.

As for the future, it is likely that the modern chemist, with his powerful methods of isolation, analysis, and determination of properties, will not be too long in preparing pure crystalline penicillin. Accurate analysis of this substance would follow, and then, with the determination of its structure and formula accomplished, synthesis might follow rapidly. Not only would synthetic penicillin be a blessing to mankind, but there can be little doubt that this field of chemotherapy, just now starting to be explored, may result in the discovery of a whole new series of chemotherapeutic agents—allies of mankind in its continual struggle for freedom from disease.

Want A Versatile Metal?

CALL FOR COPPER

BY ROBERT FULTON
CHEM. E., '47

COPPER, man's oldest and most useful metal, both in war and peace was withdrawn from the field of commerce after the treacherous attact by the Japanese on Pearl Harbor. It is now being used exclusively for war armament. Because of its resistance to corrosion and weather, high conductivity, and its combination of strength, ductility, and malleability, copper is essential in the construction of all types of battleships, merchant ships, tanks, airplanes, trucks, jeeps, machine and tommy-guns as well as ammunition. Never before in the history of our country have the copper mills been geared to such mass production. Some idea of the necessity for this metal in war production can best be gleaned by sighting some statistics on its uses. For instance there are more than two million pounds of copper and its alloys in a battleship while destroyers, cruisers, submarines, and other types consume the metal in about the same ratio to their size. A giant bomber contains about a thousand pounds of copper and brass, and its machine guns, which fire three hundred rounds of ammunition a minute, consume about one hundred and fifty pounds a minute, while fifty fighter planes need seven tons of this semi-precious metal for one minute of combat.

CHIPPING and grinding is an important process for these Bronze propellers used on Liberty ships.

COURTESY U. S. MARITIME COMMISSION AND COPPER & BRASS ASSN.

Two Mining Methods

There are two principal methods of mining copper from the earth. The first is by underground mining. This method is used in the mines located on the Keweenaw Peninsula of Michigan, which were the first copper mines developed in the United States. Here the American Indians mined copper for many years although it is not known today which tribes worked the mines or why they abandoned these workings long before the white man arrived. In these rich veins pure copper varies in size from small particles to large masses containing several hundred tons of metal. Shafts go down into the earth in some cases to a depth of over a mile. The ore is hoisted in special skips. After hoisting, the ore is crushed and sent to the concentrating mill, where gangue or waste is separated.

The other chief copper producing states in this country are Arizona, Montana, Utah, New Mexico, Tennessee, and California. The most common type of occurrence is in sulfide ores, where the copper is combined with a high percentage of both iron and sulfur. In some cases the copper occurs in oxide ores which result from the action of the atmosphere on original sulfide ores. This type of ore is treated by a leaching process instead of by concentrating.

The second method of mining is by means of an open cut, where the ore deposits occur near the surface. Mining operations consist in cutting benches into the ground where huge electric shovels remove the broken material after blasting. The largest open cut copper mine in the United States is located in Bingham, Utah. The mountain which is two and a half miles long and a half a mile high dwarfs the huge shovels and trains on the forty odd terraces, making them look like toys from across the canyon.

This simple method of open cut mining in Utah has produced billions of pounds of cheap copper—more than was used since the cave man picked up the first nugget.

After ore leaves the mine it is treated in various ways to separate the metal from the other minerals. If the ore is low grade in copper it is concentrated in order to eliminate a large part of the lighter minerals. In this process the ore is crushed and then ground to a pulp of fine particles. This pulp is mixed with oils and chemical reagents and then sent to long box-like machines where the solution is agitated so as to form a froth of bubbles on top. The metal particles remain in the froth and are floated off, dried and loaded into railroad cars. This material is known as concentrates.

Concentrates and high-grade ores are treated by a smelting process to recover the copper in metal form. Usually the material is roasted in specially constructed furnaces to eliminate excess sulfur. The main process consists in melting the charge in long, flat reverberatory furnaces where the lighter minerals flow off from the top of the molten material in the form of slag. The heavy metals including mostly copper and iron are drawn off intermittently in

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Looking forward to

HOME TELEVISION

BY ELLIOT BARON

E. E., '46

IN order to gain a better view on the ultimate possibilities and limitations of a commercial television system, let us first acquaint ourselves with its development and operations through previous decades.

Strangely enough the fundamental concept of scanning a picture made up of electrical impulses was first recorded and patented over fifty years ago by Dr. Paul Nipkow, and the apparatus required to perform this scanning function still bears his name, the Nipkow disk. The scanning of these pictures is quite simple, and merely consists of rotating a disk perforated with a single spiral of holes near its perifery (Nipkow disk) in front of a strong source of light. The individual beams of light thus produced as each aperture moves in front of the light source are projected on a screen where they trace out a series of streaks one below the other with such rapidity that to the human eye it appears to be one complete frame or raster of projected light. Now, if we change the intensity of the light source the proper amount, and at the proper interval and in correct sequence, we will have a definite steady pattern of light and dark cast on the screen, thus a picture.

Mechanical Scanners

From these crude beginnings have come many developments, improvements and adaptations, but all depend on this fundamental principle of scanning for their operation. In fact the Nipkow disk (later termed mechanical scanning) method of scanning underwent intense development, and appeared to be the most promising method of creating a raster of light for the producing of a picture until about 1930, when finally scientists and engineers gave up in despair of producing high definition images with mechanical scanners.

About this time a new device called the cathode ray tube was being developed for use in electrical measuring instruments, and experimenters looked to it as a possible solution to their problems. The ancestry of the cathode ray tube begins in the year 1878 with the generation of the first cathode rays by Sir William Crooks. Later came Karl Braun, and the electronic tube named after him, the Braun tube.

The Braun tube was the first real cathode ray tube, and it was developed through Braun's knowledge of electrons, being attracted by a magnetic field. Roughly, it consisted of a heated cathode at one end of a long conical evacuated glass tube, an anode close to the cathode with a small aperture in it, and a fluorescent screen at the opposite end of the tube. Now when a high potential is placed between the cathode and the anode, electrons will be attracted from the hot cathode to the anode, in a fashion similar to that in the ordinary vacuum tube. However, during their travel between the cathode and the anode these electrons attain extremely high velocities, so that many of them will continue right through the hole in the anode forming a thin pencil of electrons which strike the fluorescent screen at the opposite end of the tube.

Use Cathode Rays

Upon striking this screen the electrons give up their energy in the form of a small spot of light, which has a shape conforming to the cross-section of the electron beam. This stream of electrons emerging from the aperture in the anode is known as the cathode ray or beam. It can be deflected from a straight path by the influence of a nearby electric or magnetic field at right angles to its axial direction, and its intensity can be varied by corresponding variations of the anode voltage. Now immediately, we see here a device which will produce an easily modulated spot of light, the beam of which can be made to sweep across a screen thus scanning a frame or raster of light for the production of television images.

The early Braun tube underwent a great deal of development, and was later named the cathode ray tube. Although the cathode ray tube was developed to a fairly satisfactory degree by 1924, it was not until the before-mentioned failure of producing high definition with mechanical scanners became imminent about 1932, that the cathode ray tube was considered in earnest as a scanning device.

At this stage of television development cathode rays came to the rescue with a modulated beam of electrons which could be controlled and deflected entirely by electronic means. This cathode ray apparently

(Continued on Page 260)

A BATTERY of powerful lights illuminate this scene being televised in New York with equipment built before the war.

PHOTOS COURTESY RADIO CORPORATION OF AMERICA

American Hoists are

LIFTING VICTORY CLOSER

BY R. H. McCORMICK
AMERICAN HOIST & DERRICK CO.

This is the last in a series of articles in which the Technolog has presented some of Minnesota's Industries at War. The purpose has been to familiarize students with some of the work that has been accomplished in our state by Minnesota concerns.

IN the early eighties a small business was established on the banks of the Mississippi River at Saint Paul, Minnesota. Its product was equipment to supplement human muscle—hoists of hand power, horsepower, and steam, and booms of sturdy timber from the forests that then covered northern Minnesota. Its name is American Hoist & Derrick Company. From such a modest beginning, the firm has grown steadily through more than six decades of designing and building various types of hoisting equipment for handling materials with hook, magnet, and bucket. Its long history is a saga of accomplishments.

Now an immense plant stretches for blocks along the river. In its modern buildings, using the latest equipment and methods, 2,000 men are working day and night. What they are making is no different from the peacetime products of the company. A lot of it in the last few years has gone, and in increasing quantities is still being sent, to the shipyards for the Navy and Maritime Commission, to the large construction projects, to the vital industries, and to overseas ports of the United Nations.

All along the coasts ships are being rushed to completion at an astonishing rate. American Revolvers by the hundreds have given new meaning to mass production in the building of ships.. These Revolvers are huge revolving hoisting machines mounted on a heavy structural frame that travels on rails. Prefabricated sections of a ship, weighing up to seventy tons, are picked up, swung into position, and accurately lowered into place. The operator comfortably seated in his cab seventy to eighty feet above the ground has complete view and easy control of his load at all times.

These giant material handlers are mounted also on barges, docks and aboard cargo vessels for speeding the loading of the much needed supplies aboard the ever-increasing number of ships.

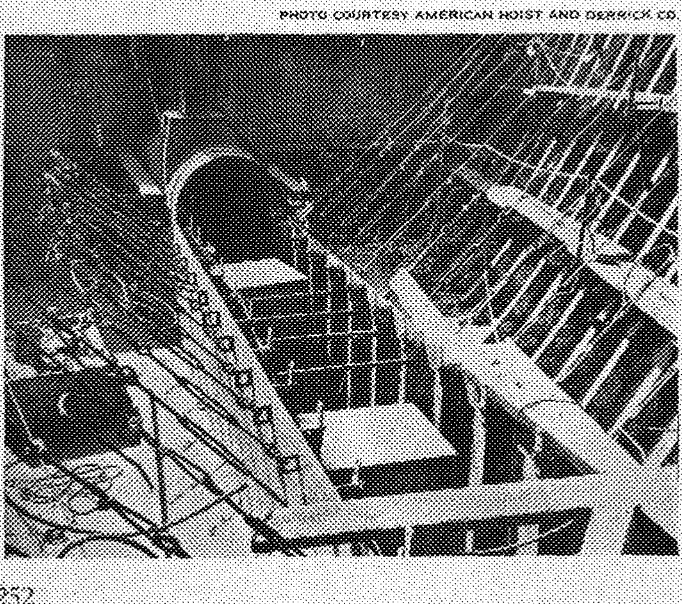
Similar to these Revolvers but smaller in size and capacity is the American Locomotive Crane which travels on railroad tracks. They are made in several sizes up to those capable of handling fifty tons. They are used in large plants and on docks for handling materials with hook, magnet, and bucket, for pushing cars, and in shipyard service.

American Steel Derricks are made in several styles and many sizes for wrestling with heavy loads. They are used on construction jobs, and in material yards. A ready application was found for American Derricks on a variety of lifting work at ports of embarkation and on barges. Large, standard American Derricks capable of lifting 300 tons and also special types of American Derrick construction like Gallows Frames are used for erecting of the tall towers for oil distillation and butadiene plants for synthetic rubber projects.

All such derricks are operated with one of the powerful American Hoists. These hoists in all sizes, styles, and types are the outgrowth and development of the early products of the company.

CROSBY CLIPS on wire ropes are holding shaft tunnel plates of a Liberty Ship until welding is complete.

PHOTO COURTESY AMERICAN HOIST AND DERRICK CO.



Special modifications of a hoist are represented by the greater part of the marine deck machinery furnished by this concern to the Navy and Maritime Commission in their shipbuilding programs. This type of equipment comprises both electric and steam powered cargo winches, steering engines, and anchor windlasses. They are mounted on deck of the ship for handling cargo, large, massive anchors and chains, and for warping or maneuvering the ship aside the docks.

The little wire rope clip, known for over sixty years as the Genuine Crosby Clip, has seen about every type and class of service involving the use of wire rope. Millions of these clips are taking their part in fastening the ends of fantastic amounts of wire rope used in shipbuilding, vital construction, and materials handling all over the world.

American Wire Rope Blocks and Sheaves, too, are a familiar fixture in the use of wire rope in hoisting machinery.

Nor is this the first time that his company's products have strengthened the nation's fighting arm. In the last World War, the Hog Island Shipyard, the most spectacular achievement in ship construction of its day, had 500 American Electric Hoists and 500 American Derricks serving its fifty shipways. Furthermore, a large number of the ships turned out at this and other yards to transport troops and supplies to Pershing's forces were equipped with American Cargo Winches, Anchor Windlasses, similar to those used today. In fact, the company's nameplate on the marine deck machinery has made the words, "St. Paul, Minnesota" familiar in every port of the world.

Every product of this company has played important roles in numberless peacetime achievements. They have helped to build the Panama Canal, and many huge dams for irrigation and power that have been constructed in the last 40 years. They have been on the job in the erection of such famous structures as the Lincoln Memorial at Washington, D. C., the San Jacinto battle monument, many of New York's and Chicago's towering skyscrapers and a host of other construction projects. When the war is over and limitations on equipment are lifted, American products will contribute to increased speed and efficiency in materials handling by progressive peacetime industry.

CUT COURTESY WESTINGHOUSE

After Victory . . .

WHAT PRICE PEACE?

BY HAROLD S. QUIGLEY
PROFESSOR OF POLITICAL SCIENCE

This is the last in a series of postwar articles in this volume of the Technolog. We have tried to present a view of what we may expect and see in the future. In the past, postwar economics, education, slanguage, and aviation have been discussed. Now we bring to light some pertinent facts that face us if we are to have a "Postwar Peace."

EVERYONE wants peace: family peace, municipal peace, national peace, international peace. But peace is hard to get. It can't be bought with cash. It is not merely the absence of war. It is not a political structure, not an economic system. It is a condition of harmony, like colors or sounds in accord with one another. It is confidence and good will in dealings between people and between peoples.

How do we get peace within a family? By ridicule of each other's ideas? By glum retirement from the fire-side circle? By each of us going his own way? By favoritism? By heated argument? No. We get it by mutual consideration, by forethought of each other's interests, by talking things over, by resisting impulses to angry retorts, by agreement upon priorities of expenditures, in short, by cooperation.

We do not need to go into the argument between the philosophers and the chemists here. They disagree upon *why* people act as they do. Our point is that families can and do manage to live in peace, though some of them fail. We know the conditions of family harmony. Can we transpose them to the so-called family of nations?

Are you thrilled by the "Hiawatha"? Have you ever stood on a village station platform and watched that colorful train come down the track at eighty miles an hour, its white plume flying, to rush smoothly past in all the pride of its magnificent power? What a difference between that vision of strength and the same train standing silent in the yards! The difference is that in one case the "Hiawatha" is using the power furnished by oil or coal; in the other the fires are drawn and the cylinders empty.

Today the footsteps of a few remaining officials arouse echoes in the great palace built for the League of Nations on the shore of Lake Geneva. Like the "Hiawatha" in the railway yards, the League building is silent, inanimate. Whether it will return to life depends upon what the nations do to provide it with power. An international organization, like the "Hiawatha," is useless without power.

Oil or coal furnish power for the "Hiawatha." What is the source of power in an international organization? Like the "Hiawatha" it must have fuel. Fuel for an international organization is like fuel for a city or a state or a national organization. What fuel is consumed by the mayor and council of Minneapolis? It is the needs of the people of the city: education, streets, water, protection from crime and fire, parks, etc., etc. Out of their consideration of our needs, the mayor and council develop policies and provide methods and agencies to execute the policies. The policies are the power that drives the city, just as the steam is the power that drives the "Hiawatha."

Many influential people today are mistaking the instruments of power for power itself. They are confusing a police force with policy. This is like mistaking the "Hiawatha" for the steam that makes it go. What would be the use of our city police if the only power possessed by the mayor and council were that of maintaining a police force and of executing the criminal law of the state? Suppose that Minneapolis had no public schools, no water supply, no publicly-maintained streets, no parks. Suppose that the law prescribed that crime would be punished, but failed to provide for the lighting of streets, the relief of the indigent, the care of insane persons, fair business practices, and funds to maintain these services. Without legislative power a city government would be a police force in a vacuum, a "Hiawatha" without steam.

Now let us get back to the matter of harmony. Steam is explosive if too closely confined. A locomotive won't run grease. Policy-making in a city c sults from discussion and compro

(Continued on Page 2

The American Republics

LOOK TO THE FUTURE

BY J. A. PAUZE
GENERAL ELECTRIC COMPANY

NATURE has linked the countries of the Western Hemisphere together by physical ties; they are also linked with the common ideal of freedom. Yet these two links are of little practical value to the peoples of the New World without a third—the one we have been hearing about so much lately—economic solidarity.

It is not a new idea. It's a long-cherished dream of Pan-American patriots who have labored hard and long for its achievement. And, if and when it comes, it will introduce something new into the world; the first big step toward political unity among groups of nations.

Many agencies are helping to bring this ideal nearer to reality. Through the products and the engineering of these agencies, the southern neighbors of the United States are being aided in their efforts to develop their own natural resources and establish sound economic relations with their neighbors.

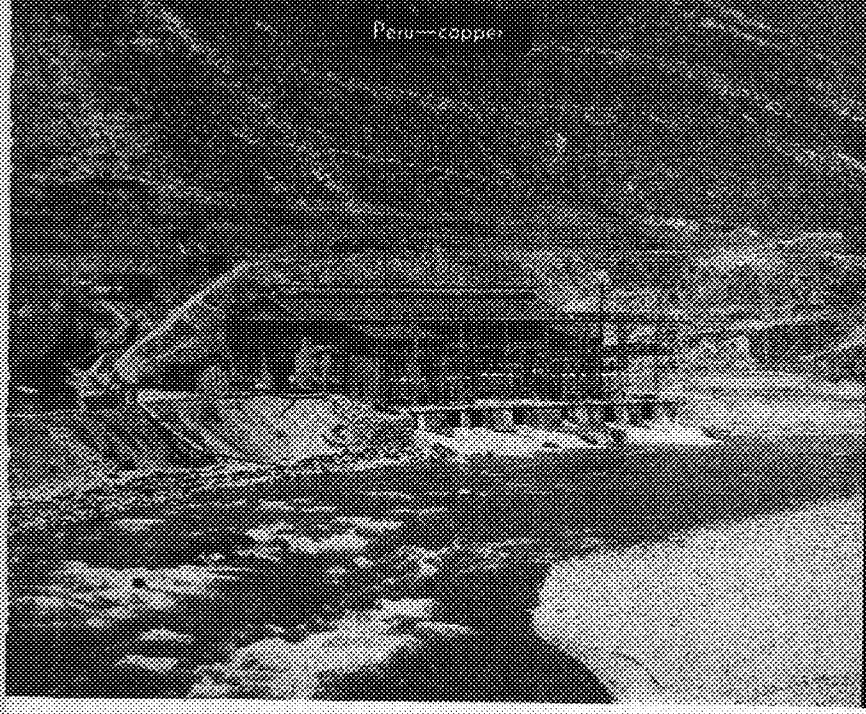
There are 20 nations in Latin America, not including U. S., and foreign possessions in this hemisphere. Together they make up a total population of some 125,000,000 people, living in an area of over 8,000,000 square miles, whose economic potentialities have scarcely been tapped. In 1940, before U. S. war activities restricted the flow of southern shipments, they imported nearly $30,000,000 in U. S. electrical goods alone.

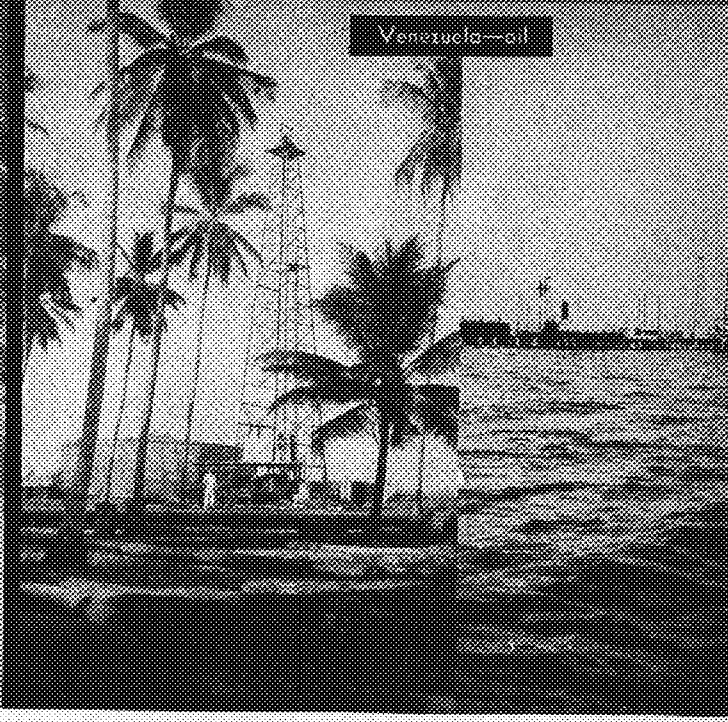
Latin America today compares roughly with the United States two or three generations ago, before the period of greatest industrial expansion. While the chief interests of our southern neighbors have been agriculture and mining, there is taking form an industrial economy, a transition which is being accelerated by the war.

The war has forced Latin Americans to a realization of their dependency on other countries for supplies which, in many cases, are potentially available within their own borders. Their iron ore, for example, is of little value to them except as a medium of exchange, and the war is making it increasingly difficult to transport ore to market. On the other hand, they need iron and steel as raw materials for their growing manufacturing industries. So they are installing steel mills to convert their ore into usable materials.

Latin America is rich in essential commodities—meat and textiles in agricultural Argentina, iron in Brazil; rubber, quinine, and hemp in Colombia; nickel in Cuba; oil and minerals in Mexico; oil in Venezuela; tin in Bolivia, copper in Peru; nitrates in Chile. Electricity is essential to the development of these natural resources, and international collaboration will speed the development of skills and techniques needed to put electricity to work and operate the many industries yet to be established.

Economic development in Latin America, spurred by the war and turned for the present to the uses of war, should carry on in the postwar period to a glorious development of Pan-American civilization and collaboration.





COURTESY GENERAL ELECTRIC CO.

Of growing interest to the engineer are the inter-American relationships, both as war measures and as permanent activities. Today coöperation is concentrated on support of the United Nations in their struggle to eliminate Axis aggression. When this objective has been reached the Americans will be free to raise their living standards. Inter-American coöperation is built on the good-neighbor policy which ten years ago President Roosevelt outlined at the beginning of his administration.

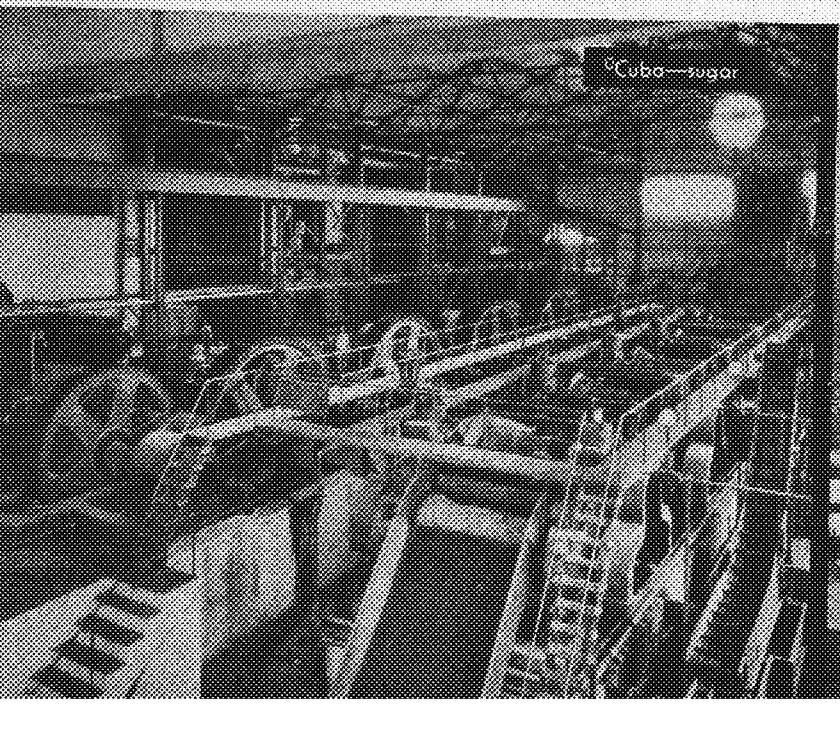
The work of the Office of the Coördinator of Inter-American Affairs is based on this policy. This organization was formed after the fall of France in 1940. Latin America was facing the problem of loss of foreign markets on which they were so dependent. The United States realized this and did its best to help. Our imports from these stricken South and Central American countries increased in 1941 to almost a billion dollars; double the pre-war level.

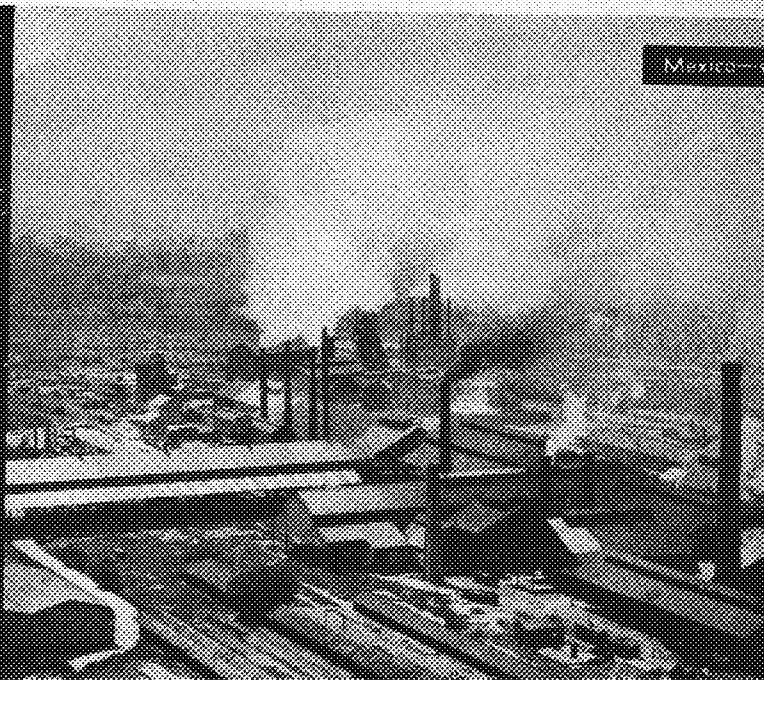
Before the war the Inter-American Development Committee was created to collaborate between private industries and the 21 American governments to foster new industries and trade. The U. S. Export-Import Bank is another important agency coöperating in the promotion of the general policies of this country along these lines.

After Pearl Harbor the inter-American program went into high gear. Projects for the development of strategic materials, improvement of transportation and communications, and expansion of food supplies were undertaken. These are for war needs; but they are forerunners of a better economy. What is being done is not just temporary—it will probably continue at a greater rate and on a basis such that eventually governmental aid will be unnecessary.

The days of the pioneer in engineering are not over by any means. There are real frontiers in South America; hydro-electric resources have just been tapped, only two million kilowatts in operation out of a potential 80 million or two and one-half per cent utilization as compared to the 76 per cent in the United States. Current professional publications are full of articles on future developments in Latin America, ranging throughout the engineering and industrial fields—communications, transportation, power, manufacturing, sanitation, irrigation, highways. And in this development the engineer will play an impressive and important role; but whether it is in foreign relations, inter-American trade, or engineering endeavor, coöperation will be the keynote to success.

—EDITORIAL





Greetings! So

HOIBY GALLIVANTS

BY IVAN DOSEFF, JR.

ILLUSTRATED BY MAURICE BRESLAW

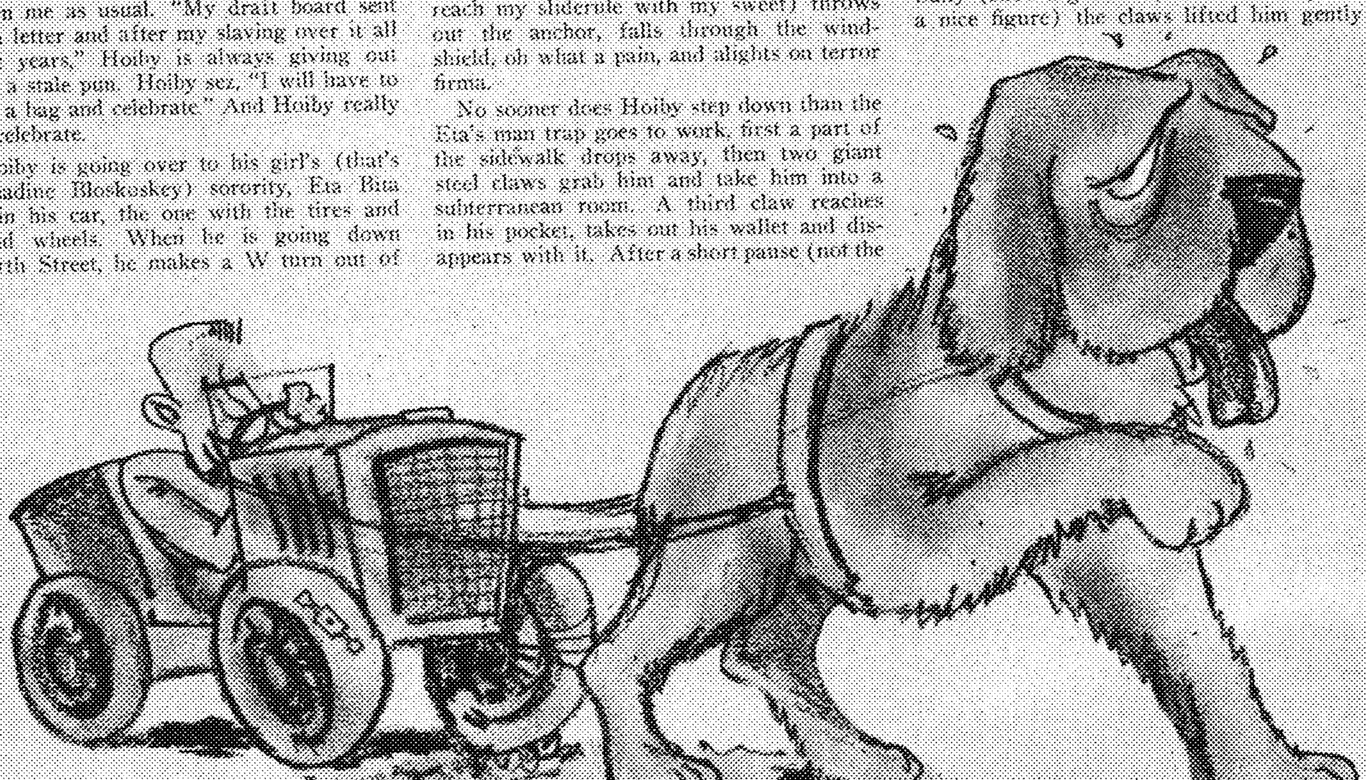
ME and Hoiby Floosh M.E. '52 had just finished voting for Hoiby's friend Joe Scutosh who was running from the Board of Regents on the Varnishing American ticket (his father is a painter) when Hoiby says to me, "Hank," as the dog said when a lawnmower ran over his tail, "It won't be long now." "What won't?" I sez pulling a stray coed off Hoiby, and thinking that finals had snuk up on me as usual. "My draft board sent me a letter and after my slaving over it all these years," Hoiby is always giving out with a stale pun. Hoiby sez, "I will have to snag a bag and celebrate." And Hoiby really did celebrate.

Hoiby is going over to his girl's (that's Bernadine Bloskoskey) sorority, Eta Bita Pi, in his car, the one with the tires and round wheels. When he is going down Fourth Street, he makes a W turn out of sheer epervescence (My English teacher please take note). As a local gendarme sees this little maneuver my friend Hoiby is very much behind the A ball. Hoiby is very nice to this bull, and Hoiby gives the flatfoot a scorecard with the names, weights, heights, ages, telephone numbers, and speeds of all the S.L.A. Freshman coeds, and also the names, weights, and boxing and wrestling abilities of their boyfriends in the armed services. The cop lets Hoiby go and Hoiby is again rolling down Fourth Street when all of a sudden he remembers that he has no money. So he goes to his friend Art Esion's house, he knows Art Esion well, to borrow some money. Art (P.O. 7188, Ezee terms) lends him 3 simoleons only requiring Hoiby's most precious possession—his 14 buck sliderule—as security.

Well, Hoiby is again on his way to see Bernadine, and is merrily singing, "I came here to torque for Joe," as he rolls down University with the car hitched onto Rollo, his Saint Bernard. Two gallons of gas is only enough for five recitations a week. Hoiby reaches the Eta Bita Pi house (My what long arms you've got! the better to reach my sliderule with my sweet) throws out the anchor, falls through the windshield, oh what a pain, and alights on terror firma.

No sooner does Hoiby step down than the Eta's man trap goes to work, first a part of the sidewalk drops away, then two giant steel claws grab him and take him into a subterranean room. A third claw reaches in his pocket, takes out his wallet and disappears with it. After a short pause (not the one that refreshes) the claw comes back with his wallet, with only his serviceman's address book missing. He puts it back in his hip pocket. Then he hears a sepulchural (spelling to be found in Golden Gate Abridged Dictionary) voice say, "Where there's life there isn't much hope, but he may be 4F so give him the test anyway."

So these here two claws lift him up and put him on a scale and the voice says, "133 pounds, six feet tall, eyes brown, hair green (I said he's an engineer). Then the voice asks him, "Do you have a car?" so Hoiby says, "Yeh, but my motor may get drafted for the K-9 corps any day now." The voice says, "Have you got any unattached boy friends?" Hoiby says, "Yes, the lucky guys!" The voice says, "What are their names?" Hoiby says, "I won't tell!" Board of Publication rules prohibit our describing torture. Anyway five of Hoiby's best boy-friends are now going with Eta Bita Pi girls. Then this happy little session tells Hoiby that he isn't worth bothering with, in peacetime, but this is an emergency, and the voice says, "At least you look like a man, with both eyes," and with this parting Sally (she's a good kid, a little homely but a nice figure) the claws lifted him gently



onto the sofa in the parlor (bachelor's last stand), and disappeared into the wall.

Hoiby hoisted his size 13 brogans upon the arm of the sofa and is just laying his head down on the other arm when a siren starts blowing and girls of all shapes, sizes, and descriptions swarm into the parlor. They react toward him like all girls do toward engineers—they rush right for him (Eds. note: Don't stretch this story too far or people won't believe it.) Two girls are trying to put his arm around both of them at once (known in military circles as disarming) when delightful, dainty Bernadine trips downstairs in her size 11's and falls flat on her face. Bernadine picks up

(Continued on Page 263)

AS WE SEE IT

For Them,—And For Us

On May 17, 1944, the winners of the Pabst Postwar Employment Essay Contest were announced. The winning essay was about a plan for postwar employment. The second place essay was about the American economic goal, and so on down the line. Whether or not these plans will ever be used and applied is not known, and right now is not as important as another fact that has been disclosed in regards to the contest.

This national competition to stimulate constructive thinking on the critical problem of employment after the war created the greatest public response to a major adult essay competition in American history. The interesting thing to note is that the largest single group of entrants were serviceman. They all made one point very emphatic—they want jobs, good jobs, in the America for which they have been fighting. They are depending on the home front to work it out before they get home. As one Marine sergeant explained, "The time for postwar planning is now, not when the war is over, otherwise I'm going to put a 'to let' sign on my foxhole and take in borders."

These are signs of the times. The GI's want a better postwar world and are telling us so! We sent these men and women off to fight for a better world. What are we doing to make it so?

Now is the time to lay our concrete foundations for a better postwar world and America in general, and a better Minnesota in particular. The Minneapolis *Star-Journal* recently reported that Minnesota rural education ranks fortieth in the Union. Already we have a beginning from which we can start. Improvements involving jobs for all should be the theme of our planning.

Among the suggestions offered by servicemen for making jobs available to all, is to get new inventions off the shelves, setting up of industry production quotas, slum clearance. Also that America become domestically self-sufficient and do away with imports and exports, uniformity of prices, creation of annual minimum wages in all industries, highway construction, overseas employment with the Armies of Occupation, reduction of taxes, incentive taxation and the expansion of television into an avenue of employment for millions.

We have a golden opportunity now to do something about *our* postwar world, both for servicemen, and for ourselves. Let's do something about it, for them and for ourselves!

And So, Adieu . . .

This is the last TECHNOLOG for the school year, and with it, the staff sends their best wishes for a happy summer and "vacation." We want you to know that we have had as much fun producing the magazine, as we hope you have had reading it. We have tried to give you a student publication that is interesting and informative. We hope we have succeeded.

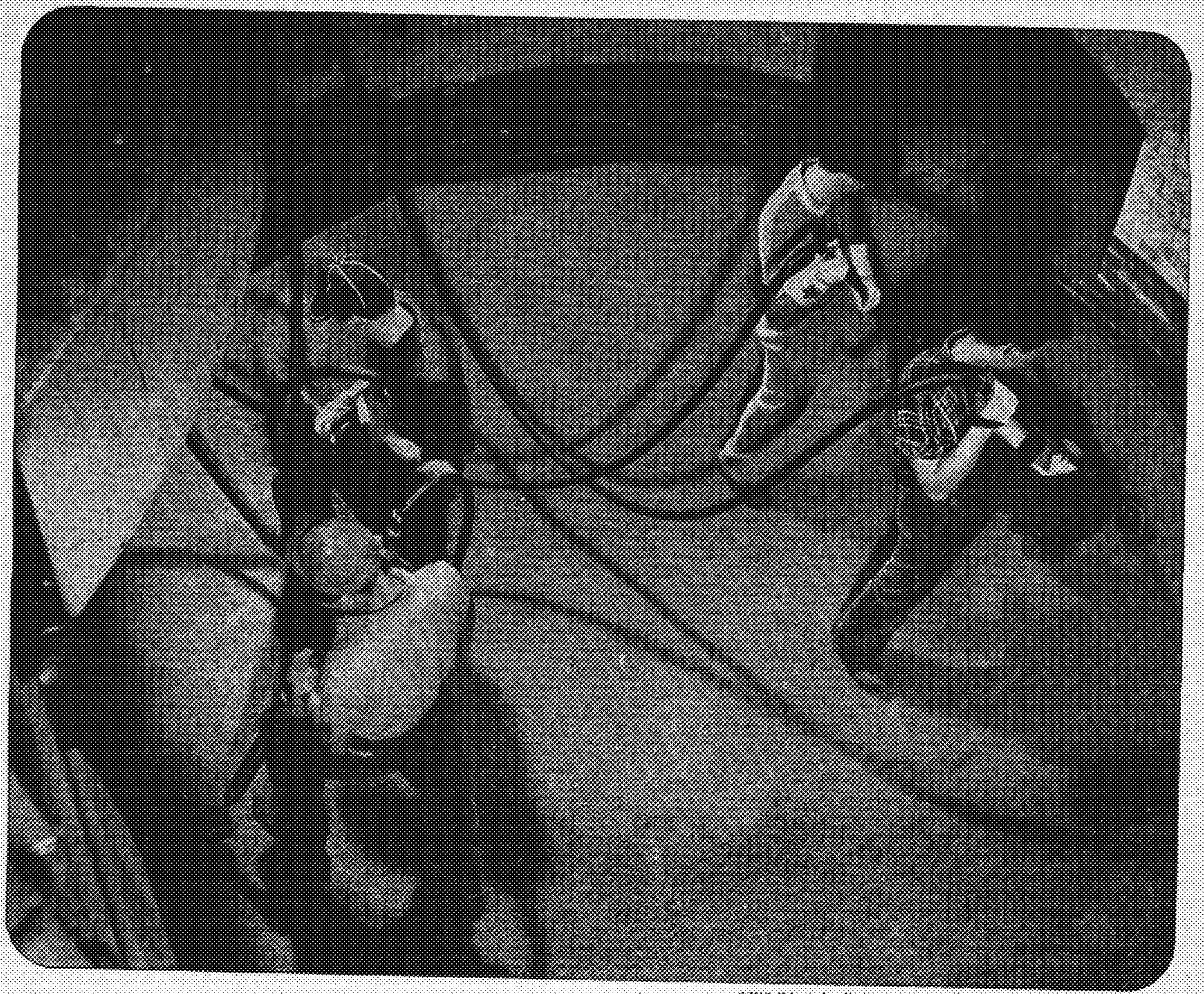
This last year has been a trying one for the TECHNOLOG. The drop in engineering students has cut circulation. The services have called on many of our staff members. Accelerated courses have enabled others to graduate ahead of time. All this has added to the responsibilities of those who remain. But those who do remain will make certain there will always be a TECHNOLOG. We were faced with the horrible thought that we might have to close down, if the registration in I.T. dropped too low. But after considering all angles of the matter, it was decided to continue as usual next year. The TECHNOLOG is more than a publication . . . it is an institution.

Next year we will be celebrating the silver anniversary of the LOG. Twenty-five years, a quarter of a century of service. We want you to celebrate with us whether you are here or not. The LOG is YOUR magazine, and we want you to feel that, because "the LOG has carried the spirit of the institute which makes every Minnesota engineer feel that his school is the very best."

Hector, Our Protector

The TECHNOLOG office now has a new mascot. "Mona" (our pin-up girl, but be careful where you put that pin) kept us all happy for a while. She is gone, but now, thanks to our managing editor's creation, we have "Hector, our protector" to bolster our morale. Hector is a strictly home-grown Minnesota Gopher who has implicit faith in all engineers, and whose favorite publication is the TECHNOLOG. He maintains a constant smile and is always ready with a cheerful hello. He serves as an incentive to the staff when there is work to be done. He brings us luck and keeps a constant vigil over us. He is our protector.

Long live Hector!



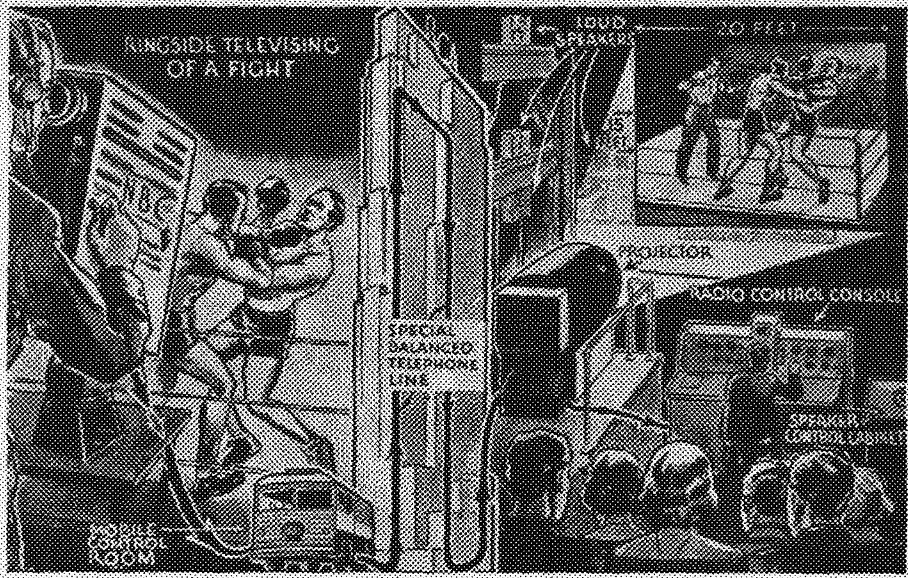
OWI Photo by Palmer, in an Allegheny Ludlum Plant.

Home Television

(*Continued from Page 251*)

had no appreciable inertia and none of the other defects which characterize mechanical devices, such as friction, wear, etc. It would respond instantly and accurately to the slightest change of the control voltages, and in short seemed ideal for television purposes.

This was the advent of the cathode ray tube into the field of television, and out of the realm of an experimental plaything. Along with this advance came the development of a cathode ray picture tube by Dr. Vladimir K. Zworykin of R.C.A. Dr. Zworykin has termed his new picture tube the iconoscope and has since developed it to a highly satisfactory degree.



PHOTOS COURTESY RADIO CORPORATION OF AMERICA

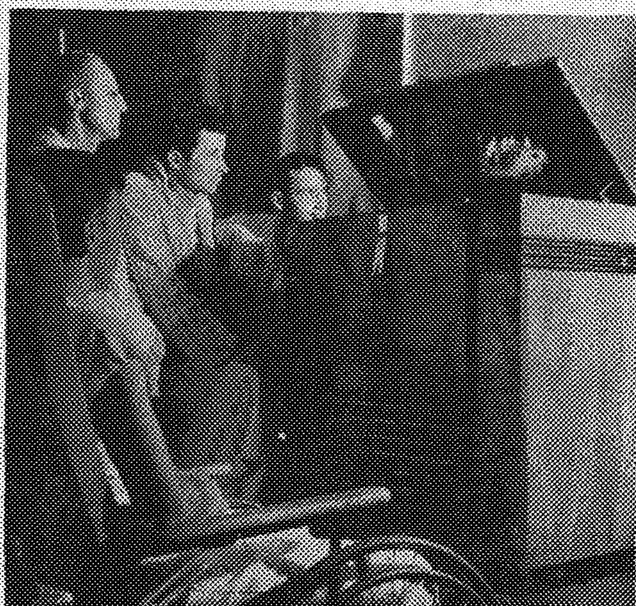
THE MECHANICS of televising a sports event. A mobile control room is always near by. This will bring to our homes every event of importance.

The Iconoscope

The iconoscope is very similar to the cathode ray tube in operation, except that the cathode ray is unmodulated, and its sweeping or scanning action is applied to a photoelectric mosaic upon which the subject to be televised is focused. As the beam sweeps across the surface of the mosaic, it sets free from its surface a series of minute electrical impulses, which correspond in intensity to the magnitude of light striking that portion of the mosaic at that particular time. Then from this mosaic we receive a series of electrical impulses in the proper sequence and magnitude to form a series of accurate picture elements. These impulses are then transmitted through the ether by high frequency carrier waves in a manner closely resembling that of the ordinary sound broadcast. From the atmosphere the modulated carrier waves are intercepted by the receiving antenna, converted back into electrical impulse picture elements, and reassembled into the whole composite picture by the cathode ray tube of the receiver.

From this point on, television has been steadily progressing through utilization of higher and higher carrier frequencies, till at the present time, television images are broadcast with definition and clarity comparable to the motion picture. However, there still remains one important limitation to television broadcasting, from which, so far, no escape has been found. This is the actual coverage in area of the television broadcast station.

TELEVISION RECEIVING sets have been installed in Army-Navy hospitals in the New York area so that service men can see televised programs.



At the present development of television it is necessary, because of extremely wide side band frequencies, to transmit programs on the ultra high frequencies. These radiations have a distinct quasi-optical characteristic and are not reflected back to earth from the upper atmosphere as are the lower radio frequencies. Therefore, due to the curvature of the earth intervening between the transmitting and receiving antennas at large distances, television reception is usually limited to a radius of about fifty miles from the transmitting antenna. However, this is an adequate coverage for densely populated areas, and it does not seem likely that this limitation will seriously hinder the future development of television.

So far, we have seen the progress of television technique from the early Nipkow disk to the present day iconoscopes, from poor indiscernible images to images comparable with the cinema, in short, from a laboratory curiosity to a practical enterprise. At this point the reader may ask then why not television now?

The answer to this rests in the fact that we do have television now, and on an entirely satisfactory and commercially practicable basis. But because the war took hold of the world just as television was being introduced to the public, the Federal Communication Commission deemed it advisable to withhold it from the public until we once again have the time and material to permit its exploitation.

At a Minimum

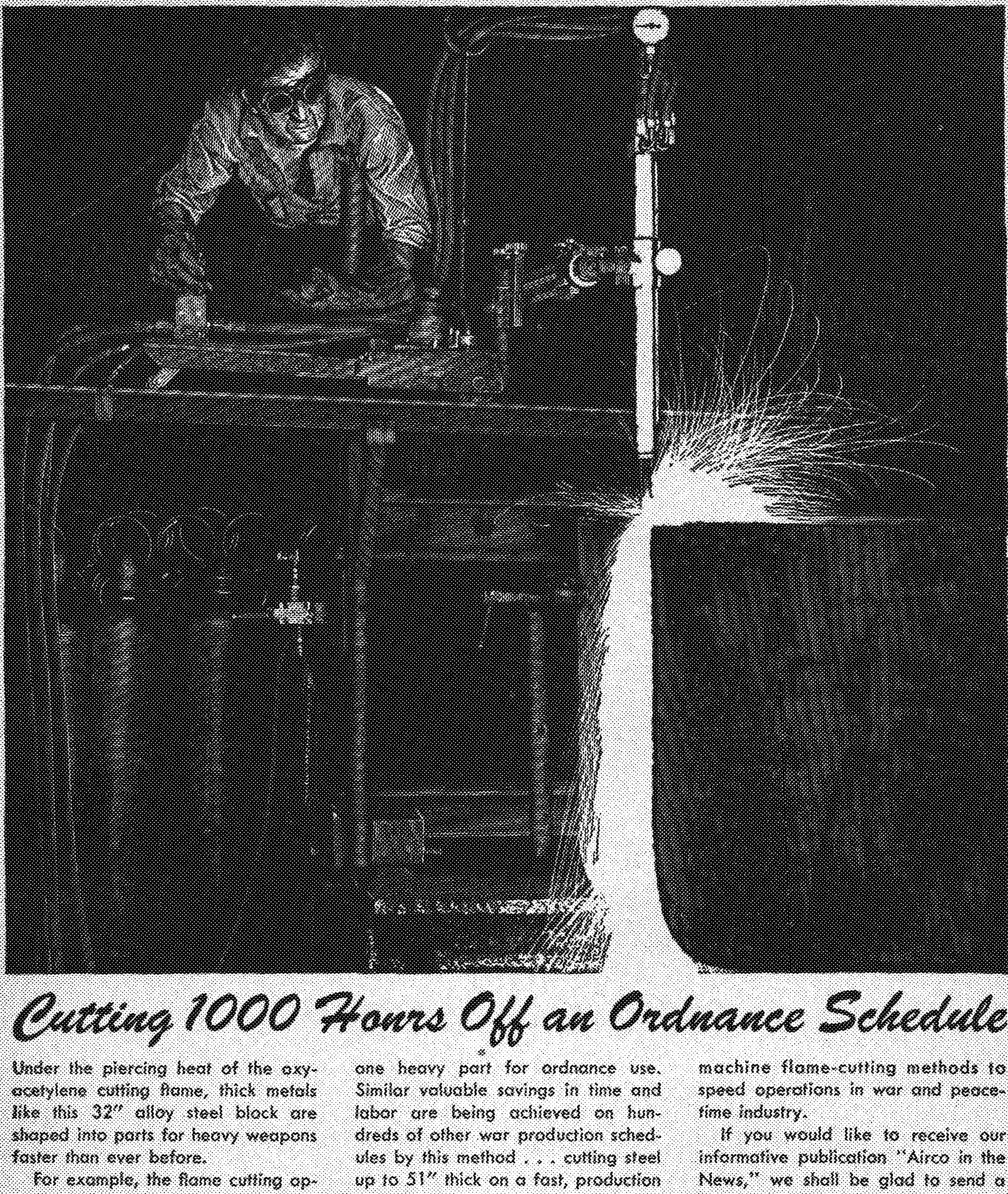
Evidence of this lies in the fact that the F.C.C. authorized television to go on a full commercial basis in July, 1941, with the transmission standards set at 525 lines of definition and 30 frames per second. At this time, however, there was an extreme scarcity of receivers, and not likely to be any more, due to priorities, scarcity of material, etc.

Due to the poor response of the public, caused by the war, to the advent of television and other difficulties, the Defense Communications Board issued a recommendation that there be no further construction of television apparatus for public service, and many stations that were operating on a commercial basis were transferred to an experimental status, the result of these changes being that at the present time television broadcasting, although existent, is at a minimum.

First Application

Probably the first application of television in warfare that enters our minds is that of observation. Engineers of the N.B.C. set out to develop a workable aerial television system. By March of 1940 they had

(*Continued on Page 262*)



Cutting 1000 Hours Off an Ordnance Schedule

Under the piercing heat of the oxy-acetylene cutting flame, thick metals like this 32" alloy steel block are shaped into parts for heavy weapons faster than ever before.

For example, the flame cutting operation shown here saves more than 1000 hours machining time in producing one heavy part for ordnance use. Similar valuable savings in time and labor are being achieved on hundreds of other war production schedules by this method . . . cutting steel up to 51" thick on a fast, production basis.

Air Reduction engineers have pioneered in the development of many machine flame-cutting methods to speed operations in war and peacetime industry.

If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd Street, New York 17, N. Y.

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Home Television

(*Continued from Page 260*)

developed new lightweight television cameras; mounting these in airplanes they flew over the city of New York transmitting the video signal from the airplane, where it was picked up atop the Empire State building, and rescanned with great clarity and detail. It has been acclaimed of great strategic value and is being used all over the world today.

The same principle was utilized by the engineers of the Allen B. Dumont laboratories to televise the front line maneuvers of the U. S. Army during field practice.

Another use of television which is of exceeding importance in both war and peace, deals with the use of infrared light for televising the subject. Infrared light has the quality, through its comparatively long wave length, of piercing fog or mist; which would ordinarily make distant observations by the human eye impossible. This principle was first used by John L. Baird, in 1927, and labeled by him, noctovision.

By this principle, many ingenious devices have been constructed which make possible the viewing of all types of subjects at comparatively large distances, and under extremely adverse conditions such as nighttime, fog, smoke, etc. It is believed by many experts that devices of this kind are being used on airships during bombing raids, to enable the airmen to see their objective by the infrared radiations from a hot smokestack, boiler, etc.

Not Today, But Soon

It is safe to make the statement that television is not "just around the corner," but will be given to the public as a completely successful and revolutionary form of entertainment which will bring untold benefit into the American home in years to come.

Our present concepts of business and social life will change. Photogenic qualities of our famous stars will change, make-up artists' techniques will change; the whole profession of acting and producing will change, and another coming possibility for television which is yet in the laboratory is color. Take notice of your surroundings, and you will realize that almost everything constituting our present pattern of life was once considered as incredible or impossible, and yet today our very existence might depend on it.

Visualize the speed and profoundness with which radio has changed our lives and how it controls great armies and determines the fate of nations and we realize then what television might bring.

Call for Copper

(*Continued from Page 250*)

an impure form known as matte and sent to converters. These converters are large barrel-shaped vessels. Compressed air is blown in through valves and then some silica is added. The other consituents are eliminated as oxides and silicates, leaving copper metal which is cast into bars, cakes, ingots and other shapes for shipment. When the copper leaves the smelter it is over 99% pure, but does contain minute quantities of gold, silver, and other impurities. Some of these act as impurities when copper is used to conduct electricity. From the smelter, copper is usually sent to a refining plant. Here it is melted and cast into plates called anodes which are suspended in long tanks containing a solution of copper sulfate and H_2SO_4. By an electric current the anodes are gradually dissolved in the solution and the copper is redeposited on a series of plates called cathodes. The cathodes are practically pure copper and are melted in a furnace and cast into wire bars or ingots, or other shapes convenient for fabrication before being shipped.

During the past fifty years constant improvement in the methods of recovery and reduction of copper has made possible the economical production of the metal from low-grade ores. This in turn has vastly increased the available ore reserves throughout the world. Smelting plants are widely distributed throughout the country, many being located in the mining districts so that long distance shipping of ore is unnecessary. On the other hand most of the refineries are situated on the Atlantic seaboard so that economical water transportation is available. In addition, this makes the refined metal readily available to the principal consuming areas of the Middle Atlantic and New England states.

Used Long Ago

The uses of copper in many old and famous structures throughout the world are many, such as Hildesheim Cathedral in Germany which has a copper roof many centuries old. Examples such as these give eloquent testimony to the durability of copper roofs that are properly constructed. In this country the oldest copper roof is that which was applied to Christ Church in Philadelphia over two hundred years ago.

Today many large buildings, churches, museums and schools employ copper and its alloys for roofs, plumbing lines and architectural ornamentation. These materials are most economical for permanent construction. In the home there are many uses for copper and its alloys. Besides copper wiring for lights, radios and other electrical appliances, the average home has hardware and lighting fixtures of brass or bronze, bronze or copper screens, copper cooking utensils and numerous other accessories.

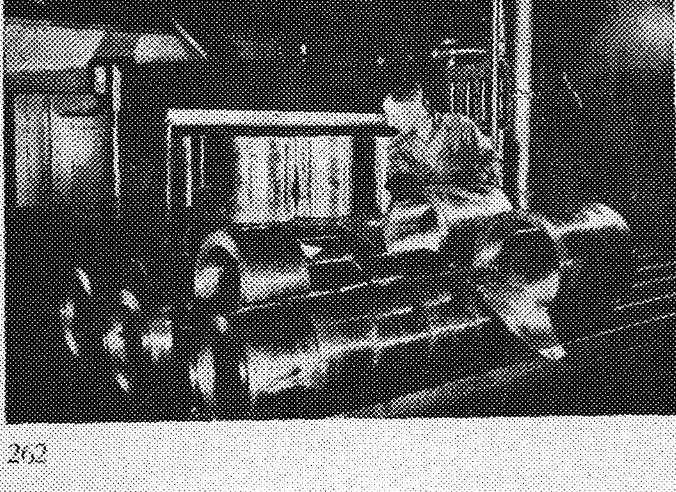
Serviceable

From the time copper was first discovered by prehistoric man on down through the flight of centuries it has been used to make implements of war. Perhaps the first such use of copper was for spearheads attached to long poles to serve as lances. Later it was used for ammunition, guns, and for armor.

Practically every industry today is making equipment for the war. These range from the great automobile plants on down to those formerly manufacturing compacts and lipsticks. Millions and millions of pounds of copper and its many alloys are being used each month in these plants carrying out the greatest war program in all the history of the world. Looking forward to the time when the present war demands are over, the copper industry is continuing its efforts to improve its products and to extend further the field of their usefulness. In war, rearmament, and in peace, copper and its alloys are proving to be one of man's most useful metals.

THESE ROLLS of strip brass are being annealed so as to make them ready to be worked: that is, rolled to thinner gage for making munitions for the armed forces.

COURTESY S. W. I. AND COPPER & BRASS ASSN.



THESE WOMEN are inspecting brass cartridge cases for use by the United States armed forces in the 40 mm. Bofors rapid-fire anti-aircraft guns.

COURTESY COPPER & BRASS RESEARCH ASSOCIATION

Hoiby Gallivants

(Continued from Page 256)

her meat cleaver and lunges at her loyal sisters, just as one of them looks up just in time to become a song: "A Woman's a Two-Face," etc. Another sister also becomes a song, "I Ain't Got Nobody." Wool, to make a long story shirt, Berny picks up Hoiby, picks her way through the debris, slings him on her shoulder and takes him out to the car? which stood? in front of the sorority. Bernadine took a bone out of the trunk, fed Rollo, and is wrapping bailing wire around the left rear tire, when Hoiby regains consciousness and put his arm back in joint again (Hoiby's arm, like Hoiby always goes out in the joints) and they start downtown to take in a show at Hoiby's favorite theater, the Crystal. They are having a little motor trouble as Rollo always goes through parks, and the amount of Stop and Go driving is terrific, but Rollo eats Friskies, the same dogfood that Lassie, the Wonder Dog, eats. (Go to your nearest dealer, tear off his top, and mail it together with 10 cents to P.O. 7188, and we will send you one slightly used ice cream cone.) So he finally gets downtown in only 5 hours, 42 minutes, 4 seconds and 2/5 of a second. They decide to see the double feature at the Crystal, "Where Are Our Children?" "Gone With The Wind." Hoiby buys two tickets at twenty cents apiece, Indigent Engineers take note, the Crystal theater is within easy walking distance of Delaney's, Frolics, Curly's and other dispensaries of liquid refreshment. Hoiby and Bernadine go in to see the show, and they stagger out four hours, 2 features, 1 comedy, 1 cartoon, 1 newsreel, 1 March of Time, and Coming Attractions later.

After they have been imbued with new blood, two quarts each, they meandered over to Joe's Jip Joint, where they heard Nels Nelson and his Bananas, the Music with apeel. After doing the Big Apple, getting pie-eyed, and mincing steps they decided to go home as Hoiby had to take his army physical later in the day. They woke up Rollo, gave him a bone and started out for the Eta Bita Pi house where they arrived two hours later. (Nuff said, but even the TECHNOLOG has a censor???) but don't get any ideas, Rollo was running away from the dog catcher.

Hoiby takes an hour nap and gets up at eight o'clock to go to the Fort for his physical. He takes out his pipe, the one that holds two packages of tobacco, and has a built-in steam whistle for use at intersections. It cools him down. He digs out the hay and fills it with cornsilk. Then he goes to the Fort. Out at the Fort he had a typical inductees day, he waited four hours in the hot sun, got into the building to find that it was the wrong one. After several hours of fiendish searching he found the right building and he reached the door just as it was being closed for the night.

The next day he was lucky, as he had to wait only three hours before getting into the medical building, he first disrobes, then went through an amazing number of tests, the amazing thing is that he passed at all, being an engineer. Hoiby's only trouble was in the mental test, he was asked if he was illiterate, and he said yes, because he thought it was something good. He was finally passed, and the officer asked Hoiby what branch of the services he wanted to be in, and Hoiby said, "The Marines, on account of my eyes get tired easily." Hoiby is always saying, "on account of," on account of the fact that he's taking accounting as an elective. After that quip the officer gave him the horse laugh and told him that he could loaf for a few weeks because he was such a well-bred boy.

Well, the next day Hoiby is over in the Green Goblet guzzling gallons of jingle juice with guys and goggling at the gorgeous girls gallivanting around, when Hoiby says to me, "Hank," as the man said when he changed his name, "It won't be Long now." "What won't?" I sez lifting Hoiby out from under the table where he had gone to retrieve his address book that he had gotten back from the long limb of the law that he had given it to. My departing for parts unknown as a half a buck private (Hoiby was an engineer). Hoiby said, "I will to get a girl and celebrate."

Hoiby is going over to his girls. (Ed Note: what the H**l is going on, we may be hard up for space, but even accepting this article was too much . . .).

What Price Peace?

(Continued from Page 253)

evolution of the modern locomotive and the modern city government has been a long process of experiment and experience. We haven't stopped trying to improve on both because of breakdowns and disappointments. We haven't reduced the size of locomotives because we were afraid of explosions. We have expanded the scope of home rule in cities in spite of graft and mismanagement. Engineering and democracy both have had confidence in themselves.

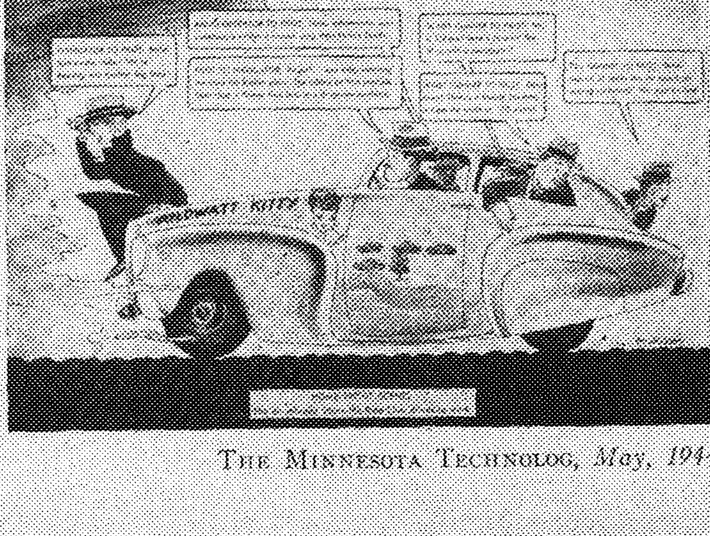
Both engineering and government have been driven to new heights of accomplishment by the demands of a civilization constantly increasing in complexity. Imagine attempting to handle Minneapolis-Chicago traffic with the wood-burning enginettes of the Civil War period; or to run Minneapolis with a town meeting of all the citizens. Every generation has done what the previous generation would have thought was impossible. And though people were at first afraid of fast trains and of giving new functions to government, they have found in both cases that necessity led to satisfaction.

International organization is another term for international government. Internationalism is the harmony between peoples that is essential between parts in locomotives, members of families, and officials in cities and nations. To realize it in practice requires the same recognition of necessity, the same willingness to compromise and the same reality of power. We have reached the point of recognizing the necessity, and we have shown some inclination to compromise. But we still refuse to transfer power from the nation to the international community.

Today we find support for an international police force coming from the people who supported the League of Nations. They believe (1) that it is possible to get agreement upon such a force and upon nothing more; (2) that if we have such a force there will be no need of anything more. In this writer's opinion, they are wrong on both counts. The experience of the League of Nations proved that more than fifty states were willing to let the League deal either judicially or diplomatically with any sort of dispute that might arise. But they refused the League the police power without which it was incapable of carrying out its judgments and recommendations. They will continue to regard the police power as the last, not the first, prerogative of sovereignty to be surrendered.

But even if this were not the case, it has been shown above that police power without legislative power is futile. Police power, in the narrow sense of its exponents, is only an instrument, a locomotive without steam. If we are to think of international government realistically, we must think of it as a complete government, complete within its field of action. This may be large or small. No argument is made here on the point of size, nor even on the point of present practicability. What is attempted is to show that the heart of government, be it city government or international government, is the power to determine policy, the power to make law, the power to realize harmony among conflicting interests. Cold engines do not move trains; brass buttons do not make a city government; an international militia is not enough to ensure peace.

COURTESY WESTINGHOUSE



TECH NEWS

EDITED BY CHARLES AMANN, AERO. E., '46

Quarter to Start on June 12

All Engineers Are Urged to Return

Wednesday, June 14, will mark the first day of classes in the University of Minnesota's third full scale summer quarter. As has been true for the past two years, students now registered in engineering will be expected to continue with their education right through the summer months. At present there are somewhere between a hundred and a hundred and fifty students enrolled in the Institute of Technology who will not graduate before the summer quarter. In addition to those from this group who will not be called into military service, approximately one hundred entering freshmen are expected to attend Institute classes this summer.

Nearly all of the courses which are taught at the present time will again be offered for the summer quarter. However, if the enrollment for any course is insufficient, that course may be cancelled. Under normal conditions about a dozen students are required before a course is taught, but it is possible that because of the abnormal circumstances this rule will be waived for the duration. At the present time Institute classes are being held in which the enrollment is less than this critical figure. At any rate, it is highly advisable to attend school this summer because the courses which you need may not be offered again next fall.

It is also possible that if enrollment is not high enough this summer, civilian students may be mixed in with navy classes, for there is no immediate indication of a drop in the navy quota. Complications arise, however, for the navy operates on a semester basis, while up to this time the University has used the quarter system. Nothing definite can be said on this point though, for such planning is still too far in the future.

One interesting feature of the summer quarter is that some courses offered are to be covered in only half the quarter, which ends July 22. This is especially true of the mechanical engineering department and the school of chemistry.

The draft is hitting the teaching staff, as well as the students. About a dozen vital members of the teaching staff have been granted leaves of absence. Difficulties in obtaining more instructors in mathematics and electrical engineering have been encountered. However, the main difficulty still appears to be in finding enough students to keep the engineering school open on a full-time basis.

Aeros Choose Spring Officers

The first meeting of the spring quarter of the Institute of Aeronautical Sciences was held April 12 in the Union. Since the ban on civilian flying has been lifted, the Minnesota Flying Club is again functioning, and its members were also present. The main topic of business was the election of officers, and Don Simpson emerged as the new chairman. Other officers elected include Robert Korsmo, vice-chairman; Norman Delin, treasurer; Eugene Leadon, secretary, and Lucy Luck, corresponding secretary. After the business meeting movies on building the Martin B-26 and English Lancaster bombers and on a day in battle on an aircraft carrier were shown.

Senior Engineers "Face" Graduation

Records of the University Placement Service show that approximately ten of the seniors graduating from the Institute of Technology in June have been placed in jobs in industry. This group comes from a graduating body numbering somewhere around seventy students. As might be expected, the majority of the remaining seniors will enter the armed services upon completing their college training.

Although a drop in the number of companies taking college graduates into industry does exist, this is chiefly because they feel that they cannot be too sure of keeping young employes. After the war these companies will once again be interested in college students. The fact that the Glenn L. Martin Company of Baltimore, has already called for the applications from servicemen for postwar employment with that company shows that industry is not completely ignoring future labor problems.

Magazine Holds Presidential Poll

Spotlight, a youth magazine of national circulation, is undertaking a poll of youth opinion to determine their general attitudes toward the prospective candidates in the November Presidential election.

"The opinion of students polled in this way, will form a most important contribution to the nation," said Claudia Jones, Editor of *Spotlight*, in discussing the survey. "Students are one of the most articulate sections of American youth. They are acutely aware of the importance of the outcome of this crucial election. Their selections will be a good gauge of the sentiment of the white collar and professional groups of the country, generally, on this question." It is for this reason that we urge everyone on the campus to participate in this survey.

"The poll is a simple one. The only question is—'Who would, in your opinion, do the best job of winning the war, establishing an enduring peace and assuring democracy and economic security to all Americans?'"

The following choices are given: Roosevelt, Dewey, Stassen, Bricker, and "undecided." Also any other choice that you may have in mind.

Any student wishing to participate in this poll should cast his vote in the TECHNOLOG office, 17 Murphy Hall, or else notify us via campus mail as to your choice.

Tech Alumnotes

Sibley Stewart, M.E.'44, and Walter Kiriluk, M.E.'45, have entered the Army Air Forces Training Command School at Yale University for aviation cadet training in armament. Upon successful completion of their courses, they will be commissioned second lieutenants and assigned to active duty.

Second Lt. Alden Allen, who received his B.S. degree in aeronautical engineering from the University of Minnesota, has been sent to the Dodge City Army Airfield. He has been assigned to duty as an engineering officer aboard a B-26 medium bomber.

Inherent in the design of the Timken Tapered Roller Bearing is the answer to practically every bearing requirement.

The term "anti-friction" long has been inadequate as a bearing description—in fact ever since the Timken Bearing was introduced 46 years ago.

In order to fulfill every requirement a bearing must be more than an anti-friction bearing; it must also be able to carry radial loads, thrust loads, and every combination of both, as well as hold shafts in positive and accurate alignment.

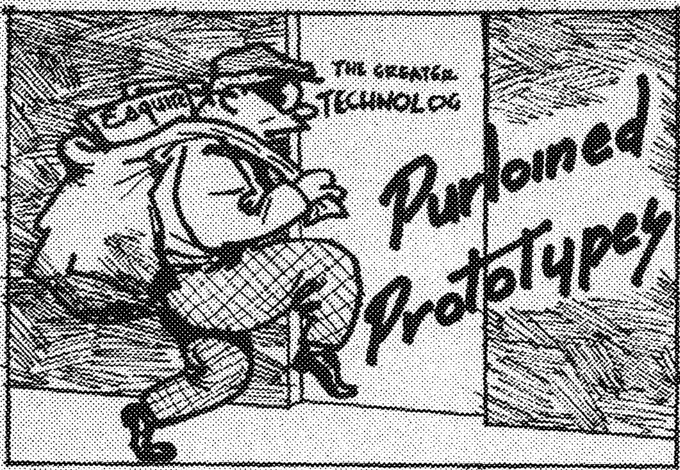
All these requirements are contained within the scientific tapered design and precision construction of the Timken Bearing.

With a thorough knowledge of Timken Bearing design and application as part of your education you will be in position to solve practically any and every bearing problem you may ever encounter. Begin to acquire this knowledge now — you will be a better engineer for it. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



BY IVAN DOSEFF, JR.

A girl's a minor till she's 18. After that she's a gold-digger.

* * *

Two small negro boys were sitting on the curb. One turned to the other and said, "Ah's five. How old is yo?"
"Ah doan know. Ah guess ah's five, too."
"Does yo dream of wimmen?"
"Nope."
"Yo's only foh."

* * *

E. E.: Didn't I get my last haircut in this shop?
Barber: I don't think so since we've only been open for business for two years.

* * *

It doesn't matter how watchful and vigilant a girl is; if a fellow kisses her, it's ten to one he will do it right under her nose.

* * *

"I represent the Mountain Wool Company, madam. Would you be interested in some coarse yarns?"
"Gosh, yes. Tell me a few."

* * *

POULTRY

He married Helen,
Hell ensued:
He left Helen,
Helen sued!

* * *

CHEMICAL ANALYSIS OF WOMEN

SYMBOL—Woe. Thought to be a member of homo sapiens.

ATOMIC WEIGHT—Reputed to be 120. Isotopes are known though from 100 to 180.

CHEMICAL PROPERTIES—Highly explosive and dangerous in inexperienced hands. Extremely active in 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.

PHYSICAL PROPERTIES—All colors, sizes and shapes. Seldom found in the pure state. Boils at nothing, and freezes without reason. Surface is usually covered with a film of paint or oxide in colors and depths. Unpolished specimen turns to green in presence of a highly polished one. Most varieties melt with proper treatment. Very bitter if used incorrectly. Density is not as great as generally supposed.

* * *

And then there's the one about the M.E. who took a girl riding and after reaching a dark lonely road, stopped the car, and said: "Girl, there's something wrong with the engine." So—he gets out, opens his tool kit, repairs the engine, gets back in the car, and drives the girl home.

* * *

Mary had a little lamb
She tied it to a heater
Every time he turned around
He burned his little seater

Mother: "After all, he's only a boy, and boys will sow their wild oats."
Father: "I wouldn't mind if he did not mix in so much rye."

* * *

She was only a moonshiner's daughter, but he loved her still.

* * *

Pete: "Let's give the bride a shower."
Repete: "Count me in—I'll bring the soap!"

* * *

If gents could read
What coeds thought
There'd be more dating
Than there ought

* * *

Delighted Daddy: "What'll we call it?"
Moderate Mama: "Quits!"

* * *

POVOITED PROVERBS

Many a tight nut has been loosened by a small wench.
You can lead an engineer to water, but why disappoint him.

* * *

If you take somebody's life,
It's a sin.
If you love somebody's wife,
It's a sin.
If you drink or smoke or chew,
Or take what's not your due,
With heaven you are through,
For it's a sin.
If you play around with dice,
It's a sin.
If you don't treat others nice,
It's a sin.
If this sort of life seems dry,
Suicide you cannot try,
For it's a sin.

* * *

There is an engineer on this campus who never takes a drink. You gotta hand it to him.

* * *

We always called a spade a spade until we hit our foot with one the other day.

* * *

She was just an optician's daughter—two glasses and she made a spectacle of herself.

* * *

It's all right to tell a girl she has pretty ankles, but don't compliment her too highly.

* * *

"Well, how was the burlesque dance?"
"Abdominal."

* * *

LOGIC

Dames are pushovers for gay caballeros. Caballeros are athletes in Spain. Athletes in Spain throw the bull for diversion. Therefore dames are pushovers for bull throwers.

* * *

She was only a miner's daughter, but oh! what natural resources.

* * *

An optimist is a man who thinks his wife has stopped smoking cigarettes when he finds cigar ashes around the house.

* * *

Physics Prof.: "You can't sleep in my class."
Chem. E.: "If you didn't talk so loud, I could."

* * *

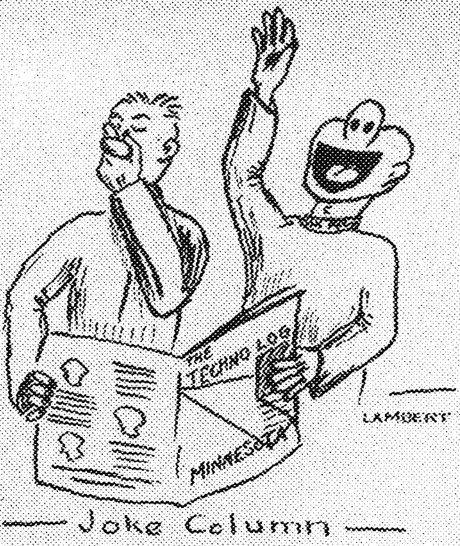
An AE is someone who concentrates more and more on less and less till he knows everything about nothing.

* * *

"Lips that touch wine shall never touch mine," said the co-ed in engineering, and after she graduated she taught school for years and years and years and years.

* * *

"There's only one thing wrong with me, blondie. I'm color-blind."
"Yo' sho' mus' be, mistah."



MORE PURLOINED PROTOTYPES

If it's funny enough to tell, it's been told,
If it hasn't been told, it's too clean; and
If it's dirty enough to interest an Engineer,
The editor gets kicked out of school.

• • •

Have you heard the story about the fellow who took his girl out in the night and mist?

• • •

The Japanese Admiral reported to the "Son of Heaven":
"We blasted Pearl Harbor, mission not so successful. We blasted Wake Island, success not so good. We blasted Midway Island, no good. We blasted Bataan and Attu, no good. We just a bunch of no-good blasters."

• • •

There is a girl on campus who is so used to having her own way, she writes her diary three weeks in advance.

• • •

"Were you ever pinched for going too fast?"
"No, but I've been slapped."

• • •

After Hitler's death we predict the top tune will be "Oh What a Beautiful Mourning."

• • •

Discussing the girl shortage around army-navy camps one GI offered this: "Never have so many pursued so few, with so much, and obtained so little."

• • •

"So I says to her, please honey, don't be difficult, one obstacle course in a week is enough for me."

• • •

Mr. Henpecked had summoned the family doctor who, after carefully examining him said:
"Yes, it is some chronic evil which has deprived you of health and happiness."
"Shhh!" cautioned his patient, "For heavens sake, speak softly—she's sitting in the other room."

• • •

"Lawsy, Susie done had a fizzical 'zamination and dey's plenty wrong wif her. Dey say she is sufferin' from hardenin' of de ar-tillery, an' lan' sakes, she ain't even been near no army camp!"

• • •

Girl Friend (pouring out the drinks): "Say when."
Pipe Engineer: "Any time after the first drink is o.k. by me."

• • •

First Small Boy: "See that little girl over there? Her neck's dirty."
Second Small Boy: "Her does?"

• • •

"Where didja get that black eye?"
"For kissing the bride after the ceremony."
"Isn't that the usual custom?"
"But this was three years after the ceremony."

• • •

Daffynitions: A pink elephant is a beast of bourbon.

"WITH APOLOGIES TO THE NAVY"

An officer in the Navy Nurse Corps was called to task by the OinC and told that she could not have dates with anyone lower than an ensign. She countered that she "didn't know anyone lower than an ensign."

• • •

FASHION NOTE

Black garters will be worn out of reverence to those who have passed beyond.

• • •

Landlady: "How do you like the room as a whole?"
Tenant: "As a hole it's fine; as a room not so good."

• • •

Wife (To late retiring husband): "That you, dear?"
Husband: "It had better be me."

• • •

Woman's philosophy: "If the shoe fits, buy a size smaller."

• • •

And then there's the one about the sculptor who put his model to bed and chiseled on his wife.

• • •

Selectee: "They can't make me fight."
Draft Board: "Maybe not, but they can take you where the fighting is and let you use your own judgment."

• • •

Navy Doctor: "Tell me, Chief, how do you feel when you actually kill a man?"
CPO: "Not so bad, Doc, how about you?"

• • •

A GI went into a hotel lobby with a female and registered.
"I'll have the boy take up your bag for you," said the clerk.
"Never mind," said the GI gruffly, "She can walk."

• • •

Gentlemen may prefer blonds, but the fact that blonds know what gentlemen prefer has a lot to do with it.

• • •

A far western newspaper heads its lists of births, marriages, and deaths briefly and to the point: "Hatched, Matched and Dispatched."

• • •

Boy: "Say, Honey, what have you got on for tonight?"
Girl: "Nothing I couldn't get out of for you, dear."

• • •

Here's to hell, may the stay there be as pleasant as the way there.

• • •

He: "Please."
She: "No."
He: "Just this once."
She: "No!" I said.
He: "Aw, hell, maw! All the rest of the kids are going barefoot."

• • •

Shirley: "Why doesn't Harry ever take you to the movies any more?"
Joan: "One evening it rained and we stayed at home."

And so with this number, volume twenty-four of the TECHNOLOG is closed. This has probably been one of the most varied series of LOGS in our long history, to say the least. We started out last summer with the first summer issue of the LOG ever published. Since then, our staff, member by member, have left for the service. More than that, the students have been leaving too. But the LOG was always in there pitching to bring you all the magazine you love to read.

The LOG was put out this year under the direction of three editors, namely Bob Giantvalley, Eugene Andrews, and yours truly. Bob and Gene are now in the Navy, but I'll be around for another year.


Dynamic Dick

On the other side of the fence, namely the business staff, Dick Engdahl has worked tirelessly and fearlessly as our dynamic business manager. He is the boy that has been in charge of advertising and circulation. He is a mechanical engineer, and will be leaving us for his future job in Cleveland, Ohio. To Dick, we extend our sincerest thanks for doing such a bang-up job here in the past year and our best wishes for success and happiness wherever he may go.


Raring Ray

Taking Dick's place as business manager for the coming year will be that ray of Texas sunshine, Ray Tarleton. Ray is majoring in Chemistry, a very touchy subject with him. He wants it known that he isn't taking engineering—just chemistry. In other words, he is a first cousin to an engineer, but he doesn't let it bother him. We know it doesn't bother us because Ray is really a very likeable fellow, and we have become quite attached to him in the relatively short time that we have known him. He is a rabid baseball enthusiast, and if possible, always tries to be at the St. Paul Saints' baseball games. However, we think an ulterior motive is involved. But come what may, the LOG is very fortunate in having Ray as our next business manager. He is a good boy.


Hairbreadth Harry

• • •

Our sincerest thanks also go to Ralph Stanley and all those at the Bruce Publishing Company. It is quite a job to put up with a bunch of psuedo-journalists and still get the mag out on time every time.

• • •

Well, that is just about that for another year. We'll be with you next October with more TECHNOLOG. Till then, so long and happy vacationing. H.S.B

This American is *not* expected to buy an extra War Bond in the 5TH WAR LOAN

But we are.

For each of us here at home, the job now is to buy extra Bonds—100, 200, even 500 dollars worth if possible.

Many of us can do much more than we ever have before.

When the Victory Volunteer comes to you and asks you to buy extra Bonds, think how much you'd give to have this War over and done.

Then remember that you're not *giving* anything. You're simply *lending* money—putting it in the best investment in the world.

Let's Go . . . for the Knockout Blow!

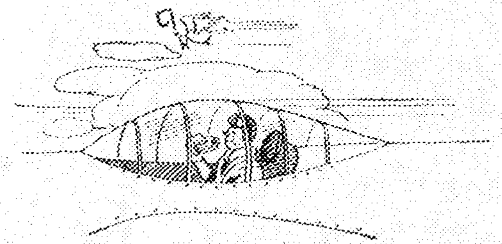
BRUCE PUBLISHING COMPANY

Saint Paul . . . Minneapolis

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

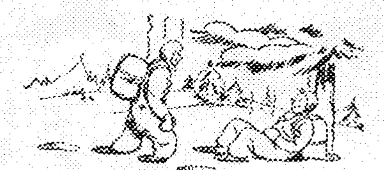


AUTOMATIC PILOT

FLYING blind most of the time, a pilot has a hard job keeping his plane on its course. An automatic pilot, electrically-driven, allows him to relax occasionally . . . to save his physical and mental resources for the job that may, and often does, lie far ahead.

An electric motor spins 12,000 revolutions per minute to keep the gyroscopic mechanism, guiding power of the automatic pilot, rotating at constant speed. The unit is tightly sealed to insure constant speed of rotation even when the air outside contains many dust particles, or its temperature is very low.

The automatic pilot is able to take over the controls and hold the plane on a predetermined course. Any pitch, roll, or yaw—that is, lengthwise or crosswise tilt or turn of the plane—produces an electric signal in the G-E automatic pilot. This signal is amplified and converted into hydraulic power which moves elevators, ailerons, and the rudder to bring the plane back to its correct position.

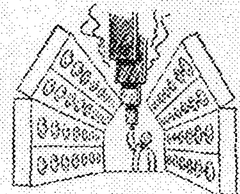


FLYING SUITS

WHEN planes land in unpopulated regions, or when fliers have to bail out in the middle of nowhere, there is comfort to a General Electric flying suit. Even when not plugged in, the suits can take rugged terrain, strenuous action, and cold weather.

A short time ago some G-E engineers spent two days and nights in the suits on Mt. Cranmore and Mt. Washington in New Hampshire. They skied, hiked, blazed trails, and camped out in heavy snowdrifts at temperatures close to zero.

After the ordeal, men and suits were doing nicely. The men had kept warm; the suits had withstood the wear; and the electric circuits built into the clothing operated perfectly when they were plugged in.



SPEED DRYING

DRYING time has been cut from six hours to 27 minutes on airplane instrument cases by using the new General Electric infrared Drying Lamps. These lamps are one of the important "little things" that G.E. is manufacturing to speed things up on the production front.

These lamps are being used in many war industries to dry everything from paint on tanks and jeeps to photographic film and the glue on envelope flaps. In addition, some are designed for roving jobs such as drying out important equipment after it has been drenched by floods. Equipment speedily dried is frequently salvaged with little loss. *General Electric Company, Schenectady, New York.*

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

BUY WAR BONDS

GENERAL ELECTRIC