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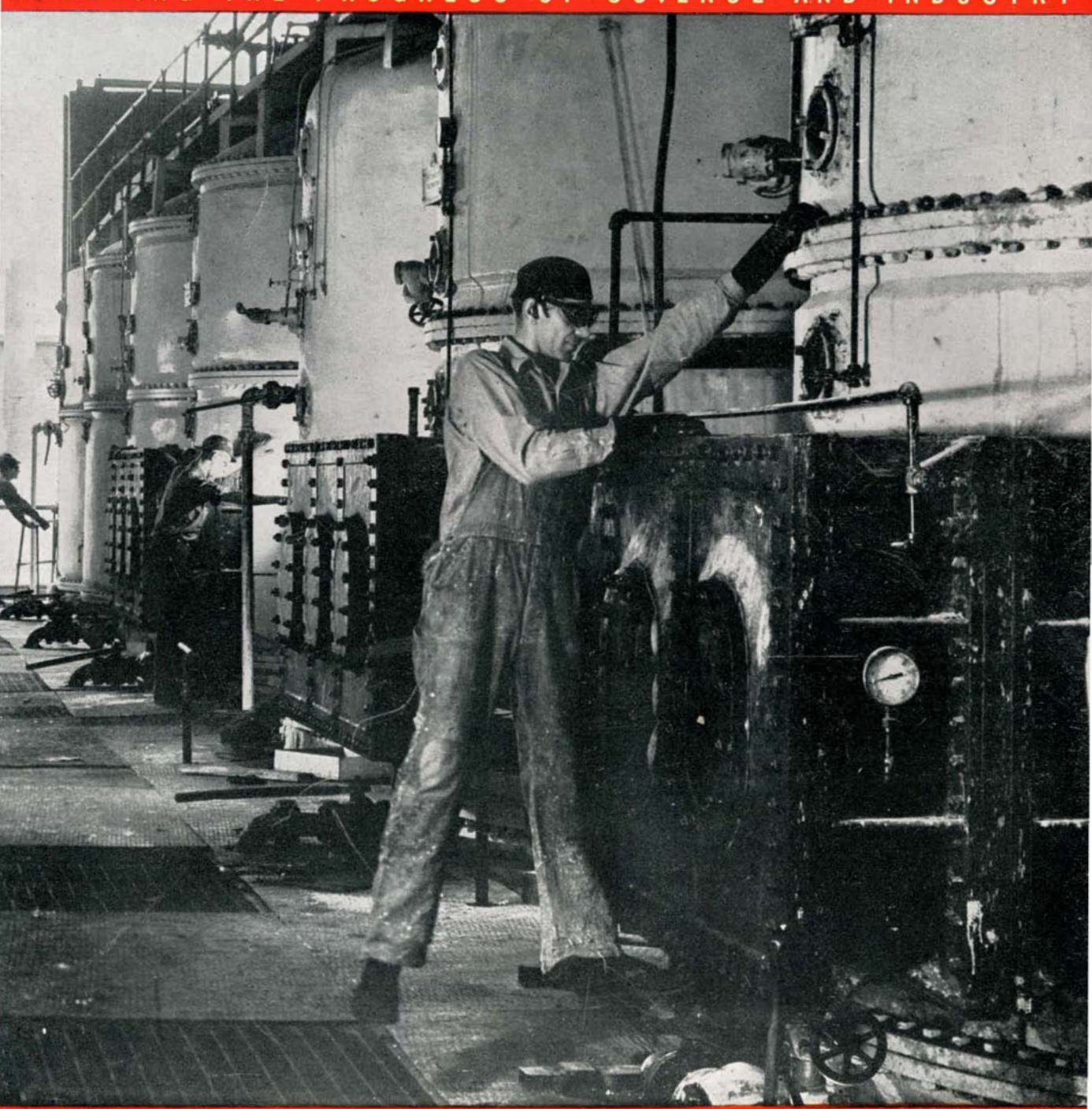
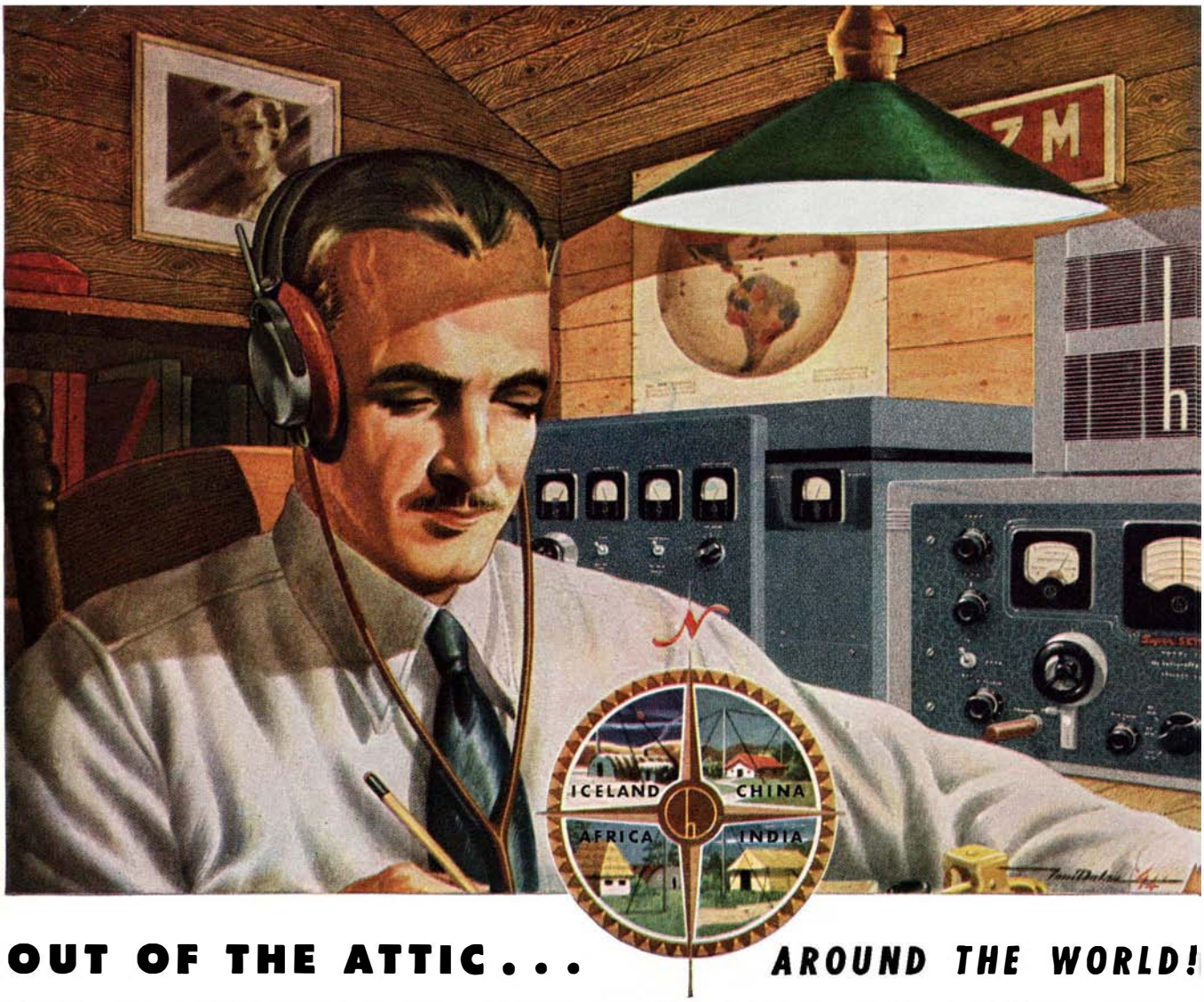


Chlorine Will Affect the Future ... See pages 192 and 202



OUT OF THE ATTIC . . . AROUND THE WORLD!

This is only part of the story of the role played by amateur radio in extending the lines of victory around the world. It is a long, exciting and strictly American story. Before the war the amateur used to love to sit in his attic and talk to fellow enthusiasts on the other side of the globe. But long before war came he got out of the attic and began to use his special skills, his inventive genius to help establish wartime communications. The amateur radio expert found an especially valuable place in the ranks of the AACS—Army Airways Communications System. This group by the end of 1943 had established 600,000 circuit miles in 48 states and 52 foreign countries. It maintained vital communications over 100,000 miles of airways. Hundreds of millions of dollars worth of aircraft and tens of thousands of lives have been guarded by the far-flung safety and navigation facilities of the AACS.

It is officially acknowledged that the technical and operating leadership of this great group has come from amateur circles. Hundreds of their unsung heroes are licensed amateur radio operators. These are the anonymous workers on the radio front who should share some of the praise given to Edison, Bell, Marconi and the other giants of communications. Long before the war Hallicrafters served these exacting technicians with the best possible equipment. Hallicrafters sets were developed in the great testing grounds of amateur radio—and were built to perfection, by and for amateurs. Hallicrafters sets have served an "attic apprenticeship" and have come out of the attic to go around the world with victorious Allied armies.

For radio equipment that won't be satisfied with the limits of the pre-war world, for radio that will go places and do things hitherto undreamed of and uncharted—look to Hallicrafters, builders of the radio man's radio.

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COVER: In the production of chlorine, highly important in the war effort, and equally important in the peace-time production to come, as told in the article starting on page 202, a salt solution is decomposed in electrolytic cells to yield chlorine and caustic soda. In the plant of the Niagara Alkali Company, where this process is carried out on a large scale, the resulting caustic soda is concentrated in a battery of evaporators, part of which is shown on our front cover, and used for other purposes.

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Previews of the Industrial Horizon

By A. P. Peck

NO FEAR OF SYNTHETICS

TIME was when people shied away from anything bearing the tag "synthetic." In many ways they coupled it with "ersatz" and considered synthetics in the light of substitutes that they had to accept for the time being. But the chemical industry has upset all that. People like the shiny, smooth, warm-feeling plastics that they know to be synthetics; women want synthetic nylon hose far more than they ever yearned for silk; lives are being saved by the thousands through the use of synthetic drugs.

The chemical industry has proved that by manipulating molecules and atoms it can produce materials which, in many ways, surpass anything that nature ever made possible. Now it is learning something else. It is becoming more and more conscious that profits are to be found in greater bulk when basic chemicals are turned into new synthetic consumer products or into materials from which these products can be fabricated, than when these same chemicals are sold in carload lots to processors who reap the harvest. This new-type thinking on the part of the large chemical producers—Dow, Monsanto, Du Pont, Union Carbide, and others—is setting a new trend in the largest basic industry of the United States.

HIGH-TEST GAS

WHEN thinking of the millions of gallons of 100-octane gasoline being produced for our armed forces today, don't fall into the error of supposing that this same gasoline, when available for civilian use, will make high-powered superdupers out of old jalopies. Quite the contrary. If you put 100-octane fuel in the tank of a car that has an engine designed for 75-octane gasoline, the results will be disappointing. They may even be poorer than when using the type of fuel for which the engine was designed.

Gasoline rated at 100 octane must be squeezed harder before ignition to get the most out of it than is the case with lower-octane fuel. High-octane gasolines call for high-compression motors. Thus, with the know-how garnered through aircraft engine design, the automobile engine designers will be in a position to dream up engines which will out-perform anything ever mounted on four wheels in the past—*when* the high-octane fuel is widely available. Until that time comes, motor-car engines are going to be no better than the best pre-war.

Here is a case where the egg comes before the hen. The super fuel is here, will be available post-war. But remember that there are millions of cars on the road which cannot make efficient use of it, that it cannot be profitably and widely distributed until there are enough cars on the road that need it, and that it is of no benefit to present-day engines. It all seems like a vicious circle, but it is one that will be straightened out with time—not overnight.

A CHANCE FOR THE LITTLE FELLOW

AFTER years of production for war comes the beginning of civilian production. Conversion has already started in a minor way. But when the war at last is over, then will start a race—a real race in which the devil of failure will surely take the hindmost—to meet the pent-up demands of civilian needs. Here as never before will be the golden opportunity for the little fellow, the independent, the smaller manufacturers who, pre-war, had to be content with crumbs. For an appreciable time after peace, it is probable that consumer needs will be far too great to be filled by even the big boys working at top speed. What will be more natural than for war-starved consumers to turn to less well-known producers rather than to wait their turn for the products of the big manufacturers?

Thus will come a revised version of the better mouse-trap. The small producers who turn out reliable products at reasonable cost will be in an enviable competitive position. They will be able, with wise management and adequate advertising, to ride a wave that, if they take full advantage of their opportunities, may soon put them in the class of the big boys. Failing that, they will not be too badly off in the role of medium-sized producers who, in a relatively short time, will have carved for themselves a reputation and a following that will insure at least moderate success.

FLAME-SPRAYED PLASTIC

INTERESTING and significant is the recent announcement of the development by Du Pont of a flame-spraying method of applying polythene plastic to provide a high degree of protection against brines, chemicals, and other corrosive agents. Films of plastics thus produced are tough, uniform, and highly impermeable. They may be produced on metal, wood, glass, other plastics, and even on paper.

In the process, particles of the finely ground polythene plastic are passed through a flame where they are melted or softened. These particles are then projected forcibly on the surface to be coated, where successive particles impinge on those previously deposited before they solidify. The coating is thus made continuous and free from even microscopic holes.

The physical advantages of flame-spraying, proved in the metallizing field, have now been extended to at least one plastic, with trend possibilities that reach beyond the presently visible horizon.

ABUNDANT CHLORINE

AN IDEA of the changing demand for chlorine (see also page 202) can be had when it is known that pulp treatment, the biggest pre-war user, averages about 200,000 tons annually, while the chlorine industry now estimates that needs of the chlorinated hydrocarbon family will run as high as 250,000 tons a year. One degreasing agent alone used 100,000 tons of chlorine last year.

FOR FUTURE REFERENCE

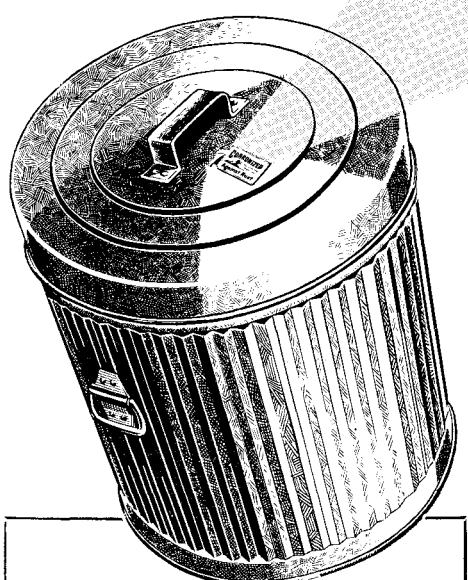
PRACTICAL electrical heating systems for homes may be based on reverse cycle refrigeration, in which the heat of the outside air, even in winter weather, is "condensed" to warm the interior of the house. . . The quick-frozen food industry reports an increase of 15 percent in poundage during 1944 over 1943, with even brighter prospects for the future. . . Similar advances in dehydrated foods may make an interesting battle between the two methods. . . Success of NE (National Emergency) steels has shown that, contrary to former opinion, many low-alloy steels will give satisfactory service and that steels should be selected by physical properties rather than chemical composition. . . It is predicted that the real post-war car (when it arrives) will use 15 to 20 pounds of plastics, as against five pounds pre-war.. . . And this is without considering the "plastics car" of the dreamers. . . Those having an interest in the liquor industry (whether from a thirst or a financial angle) should keep an eye on the Anti-Saloon League, which is reported to have set $5,000,000 as their goal for a prohibition war-chest and to have already accumulated over $3,000,000. . . Infra-red lamps loom as a possible replacement for winter blankets on your bed.

Look for this Label

On the Next Ash Can You Buy

CORRONIZED
For Enduring Protection
Against Rust

...Because CORRONIZING MAKES METALS LAST UP TO 4 TIMES AS LONG!



Q. What Is Corronizing...

A. Corronizing is an inexpensive, tissue-thin armor against rust made an integral part of the metal by a patented combination of electroplating and heat treatment. Corronized metal can be formed, drawn, welded, soldered, sheared, blanked, pierced or embossed with minimum loss of rust-resistance, and offers an ideal bonding surface for paint or other finishes. **Sales and production executives are invited to write for complete information.**

THE MANUFACTURER who offers you products bearing the "Corronized" label is giving you far greater value than you could ever buy in the past. Why accept less for your money when you buy metal products? Look for this label—ask for it—whenever you buy.

Corronizing is an amazing new armor against rust that makes metals last up to 4 times as long. The Corronizing process has been developed thru years of research by Standard Steel Spring Company—and has been proved on vital war equipment on every fighting front.

On your next ash or garbage can, the "Corronized" label will assure 4 times as long service as you've had from such cans in the past. On scores of other products—from furnaces to fencing—automobile mufflers to metal boats—farm equipment to building supplies—this label will be your guarantee of up to 4 times as long service for your money.

The Corronizing process is already available to all makers of metal products. Soon, on more and more metal products, you'll find the "Corronized" label identifying 4-times-greater values. Look for it—ask for it. It's your assurance of products that will defy the ravage of rust up to 4 times as long.

CORRONIZING

Division of

Standard Steel Spring Company

DEPT. B-4

CORAOPOLIS, PENNSYLVANIA

Other peacetime products of Standard Steel Spring Company are automobile bumpers and springs, precision mechanical coil springs, universal joints, floor gratings and stair treads.

Victory Is Still Many Dollars Away. Buy War Bonds.

ARMY E NAVY

50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of November, 1894)

CANAL — "The company which has just been formed for taking over the works at the Isthmus of Panama has issued a report, giving what it professes to be an accurate idea of the present state of the canal. . . So far, no plan for completing the canal has been definitely adopted, and this matter will be left to the technical commission which will be appointed as soon as the company is in working order."

BALLOONING — "An interesting experiment in aeronautics was tried in the latter part of September to determine the conditions under which a series of ascensions might be made for a certain number of days, executed successively with the same gas and the same balloon. . . The trip continued for a week. The ascensions were determined by the action of the sun's rays, which expanded the gas and dried the material of which the balloon was made. The descent invariably took place by reason of condensation at twilight. During the entire trip it was not necessary to open the escape pipe."

RUSSIAN RAILROAD — "A length of 2200 miles of the Russian Pacific Railway is now open and Omsk is now reached by rail. The cost has been about $44,000 per mile. The natural conditions were on the whole unfavorable. . . On the sections between Ufr and the Sima River there was, between Urakowo and Bulaschawa, a bog of about 60 miles extent, which had been formed through the rain water accumulating in the course of thousands of years in this natural pit of granite."

GREAT AND SMALL — "Modern science has . . . revealed the beautiful processes of nature, but it has also revealed her destroying agencies. The more closely man has studied, the more complicated has he found conditions and the more dangers has he recognized. Where all is outwardly lovely, he has found inward harm. The microscope has disclosed minute horrors, none the less horrible because minute. The telescope, as it sweeps the heavens with its farseeing eye, has foretold stupendous catastrophes. Much that was thought beneficial has been proved dangerous, and much that was thought harmless has been proved fatal."

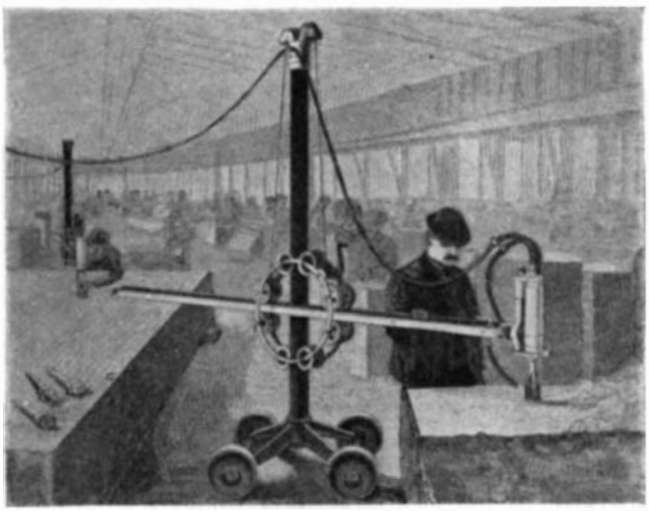
HOBBIES — "The man who undertakes to cultivate some fad like the growing of plants, the raising of fish, photography, entomology, boating, bicycle riding, athletic sports, microscopy, painting, drawing, music, fishing, hunting, and a thousand and one other things which may come under the head of personal recreation has always something within his reach which makes him independent of the outside world. . . All harmless amusements, but more valuable than gold, because they take a man away from himself."

JAPS FOLLOW — "An officer of the Japanese navy has written a letter to a friend in this country, in which he speaks highly of the efficiency of several American electric search lights used in the fleet to which he is attached. These lights stood the test of actual service better than the English and German apparatus, which will be doubtless condemned by a board of survey. He also states that the best maps of the Yellow Sea and Corea are from the United States Hydrographic Office in Washington."

COLD STORAGE — "Money can be borrowed on butter, eggs, cheese, chickens and farm produce of all kinds that will keep, as easily as on diamonds and watches. . . Cold storage and the development of the storage warehouse business in New York have made this possible. . . The banks will accept storage certificates for collateral as readily as they would United States bonds, when the application for a loan comes to them through men whom they know."

WORK AND WORRY — "It is a well understood fact that it is not work that kills, says the Massachusetts Medical Journal, but worry, and from this text some most sensible and profitable hygienic discourses have been preached during recent years."

STONE DRESSING — "We illustrate one of the improvements introduced by the American Pneumatic Tool Company . . . the new portable stone dressing machine. This machine is designed for use on the hardest granite for working it to a surface. . . The stone to be operated on is placed in about the position required to work it by hand; the stone dressing



machine is moved to any convenient place near the stone (or the stone to the machine), the play of the counterpoise is adjusted for the height of the surface to be operated on, and the tool started. The hard granite at once succumbs, and in a very short space of time the surface begins to take shape. . . The exhaust of the tool is caused to maintain a blast against the point of the tool to blow away the chips and dust. In the foreground of the picture the machine is shown operating a cross chisel, while fine brushing is shown in progress in the background, the operator holding the tool in his hands so as to regulate its work."

NOISE — "The great increase in mechanical appliances and the growth of populaton in cities has brought about a disagreeable effect, the increase of noise. From the private office, where the rattle of the typewriter has proved the successor to the classic squeaking of the quill pen, to the street, where the traffic of carriages and carts is overtopped by the roar of the elevated railroad, our life is spent in the midst of noise. It would seem that not one field but a hundred or more fields are open to the inventor who will attack the noise problem in its minor as well as major phases. When a machine, in addition to doing its work, produces noise, the latter is pretty certain to be the indication of a useless expenditure of energy if not directly the cause of such waste."

LUMINESCENT LAMP — "The luminous substance of Ebert's 'luminescent' lamp is said to be a small disk of compressed luminous paint. This is enclosed in an exhausted glass receiver upon the external surface of which are glued two strips of tinfoil, to which the terminals of the circuit are attached. When the electric oscillations act upon these coatings, active cathode rays are formed on the inner surface. These, though almost invisible themselves, produce a strong luminescent light upon the surface of the luminous paint."

HOT AND COLD — "On one occasion, when M. Pictet was suffering from a severe burn due to a drop of liquid air, he accidentally scorched the same hand very seriously. The scorched portion was healed in ten or twelve days, but the wound produced by the cold burn was open for upward of six months."

A WELCOME HAND TO BELL SYSTEM WAR VETERANS

Some day we shall have the pleasure of welcoming back to the Bell System the men and women who are now in the armed forces. They number more than 55,000. Some 3500 released from service are already back with us. We shall have a warm welcome for the rest as they join us again. Not only shall we be glad to see them personally but we shall be glad of their skill and energy for the big tasks which face the Bell System in the future.

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Engineers with talent in tooling, machine design, precision assembly methods . . .

The United States Time Corporation—the world's largest watchmakers —are making precision instruments for war.

For this big job, we need engineers. Engineers with talent in tooling, machine design, precision assembly methods. Engineers who appreciate teamwork and will share our zeal for accomplishment. Engineers who want *permanent* jobs.

We suggest you fill out and mail us the attached coupon.

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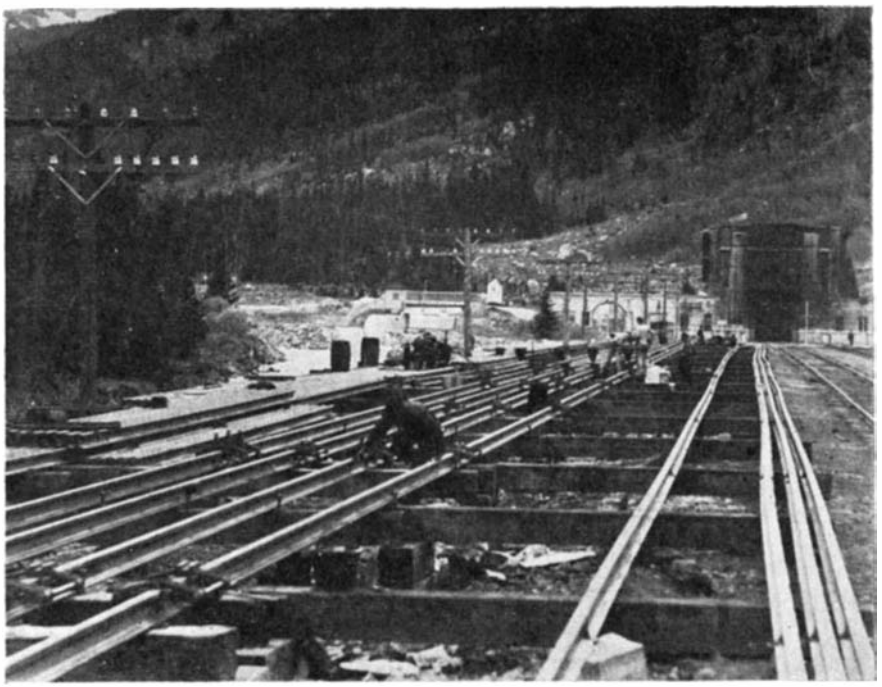
METALS IN INDUSTRY

Conducted by FRED P. PETERS



Thermit welding of railroad rails outside the Moffat Tunnel, Colorado

Thermit Branches Out

Intense Heat (Above 4500 degrees, Fahrenheit) is Generated by Reaction of Granular Metals When Correctly Ignited. The Heat Alone Can be Applied to Many Uses, or the Resulting Metallic Mass Can be Used for Construction or Repair Purposes. Major Trends are Now in View

By KENNETH ROSE

Engineering Editor, *Metals and Alloys*

An ore bridge has been prepared for demolition by The Interlaken Iron Corporation; whistles warn the workmen to move to places of safety. Wires run to packs around four of the eight steel columns supporting the towering structure. The engineer in charge assures himself that everyone is out of danger, then nods to the assistant at his side. A plunger is pushed—but there is no answering roar of explosives. Has something gone wrong? Not at all, for within a few seconds the steel tower starts to totter, then tilts, slowly at first, and crashes to the ground in the predetermined spot.

The agent that has so silently toppled this structure is thermit. A stable, granular material, non-explosive and perfectly safe to handle, it is capable of producing a molten metallic mass at a temperature above 4500 degrees, Fahrenheit, when properly ignited. Heat from this molten metal fused the steel columns in the ore bridge at the areas where it was placed, causing the bridge to collapse.

Thermit, just at present, brings up thoughts of incendiary bombs, and it was widely used in at least one type of aerial missile. The extremely high temperature generated by thermit makes it suitable for such use, although other preparations have now been found that are more suitable from a military standpoint. The thermit mixture is so stable that a temperature of 2400 degrees, Fahrenheit, must be produced by an ignition powder to start the reaction. This ignition powder is composed of a mixture of materials which can readily be ignited by a simple means and which will then quickly reach the temperature necessary to start the thermit reaction. Some ignition powders can be started by the heat of a match; an electric spark is frequently used.

Chemically the thermit reaction is quite simple. Aluminum and a metallic oxide react to form aluminum oxide and the original metal, intense heat being generated during the reaction. While most familiar in connection with the oxide of iron, the same reaction will liberate chromium, nickel, manganese, titanium, vanadium, molybdenum, silicon, tungsten, columbium, boron, and other elements from their oxides. Its discoverer, Dr. Hans Goldschmidt, of Essen, Germany, obtained his first patent in connection with the use of the process for the reduction of chromium and manganese. It is still used commercially for the preparation of these two metals, and of ferro-titanium also.

A few years after its discovery the process was applied to welding by the Goldschmidt Thermit Company. The steel, produced at the very high temperature of the reaction, theoretically about 5000 degrees, Fahrenheit, was poured into a mold surrounding the parts to be welded, and the whole was fused into a single unit. It was as a welding process that the thermit reaction came into widespread recognition and use. The original company eventually was acquired by Metal and Thermit Corporation.

Because of its simplicity in method

and required equipment, the process was used is the early nineteen-hundreds for welding street railway rails. The welding could be done while the rail was in position. Welded railway rails were more generally used in Europe than in this country, but many of the larger American cities used the method for repairs, or at places where service conditions made it advisable to eliminate joints between rails.

Railroads began the use of thermit-welded rails more than ten years ago. Maintenance of track inside tunnels is difficult, so that welding of rails into continuous lengths was especially advantageous in such locations. It is the usual practice to weld the rails outside the tunnel, and to drag the continuous length into place. Considerable interest was shown in the installation of welded rails in the Moffat Tunnel, near Denver, Colorado, more than a year ago. In this six-and-a-quarter-mile bore the rails were joined into 1000-foot sections outside the tunnel, dragged into place, and closure welds were made inside the tunnel to join the sections into continuous lengths.

Rail welded into continuous lengths in the open is exposed to greater variations of temperature, since the actual temperature of the metal exposed to the sun's rays may rise substantially above that of the atmosphere. This poses the problem of expansion and contraction. The normal expansion of rail under a 100-degree rise in temperature is about 41 inches per mile. Temperature conditions have been reported under which expansion might exceed 60 inches.

However, experience has shown that no difficulty will result if the rail is placed while the air temperature is about 60 degrees, Fahrenheit, halving the maximum range of temperature and the resulting stress, and if the rail is properly restrained. Any tendency on the part of the rail to move is prevented by anti-creepers, spring clip fastenings, and similar holders.

HEAVY EQUIPMENT REPAIRED—Repair of heavy equipment has formed the bulk of thermit welding applications for many years. Recently a broken shaft on a large Mississippi River paddlewheel steamer was welded without removing the part from the boat. Frames of heavy machinery have been repaired by this process. Both cast iron and steel can be welded, although the former metal requires caution, due to the difference in thermal expansion between it and the weld metal.

In steel mills, worn equipment has been built up by fusing thermit steel to the abraded surfaces. Repairs have been made to rolls, crankshafts, pinions, and other parts by this method of casting hot steel around worn or broken parts.

More recently heavy parts have been fabricated by joining several castings or forgings with thermit welds. Heavy crankshafts are made from two forged shaftings, a pin, and two forged blocks. The method of fabricating this heavy piece of equipment is typical of that in general use. The parts are lined up and the proper size gaps are cut with an oxyacetylene torch. Then wax is filled into the gap in the space to be occupied by weld metal, a sheet metal mold box is placed about the area to be welded, and a special refractory mixture is rammed up around the wax pattern and the parts to be joined. After the wax is melted out and the parts preheated, thermit powder in a special crucible is ignited, then tapped into the mold a few seconds later, and, after cooling, the weld is completed. Gates and risers may be trimmed off with a cutting torch.

Lower Left: The ends of a crankshaft to be fabricated by thermit welding are flame-cut. Above: Molten thermit steel is tapped into a flask surrounding the parts to be joined. Lower Right: The finished crankshaft, plainly showing the welded areas

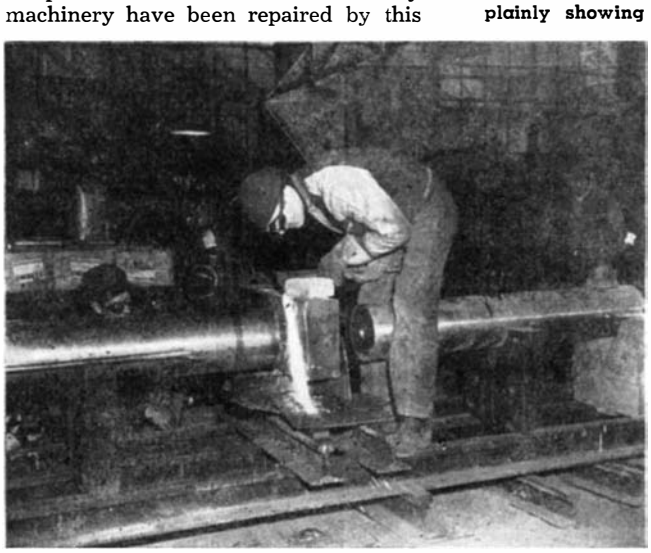
Stern frames for the huge shipbuilding program were taxing steel foundry capacity for castings of this size. These frames were roughly 20 to 26 feet in outside dimensions, and of irregular outline. It was decided to cast the frames in sections, and to join these smaller castings by thermit welds. Liberty ship stern frames were cast in two sections, requiring one weld, while the larger Victory ship stern frames were made in four sections, requiring four welds. So satisfactory did this method prove that it has been adopted in almost all of the shipyards in the country.

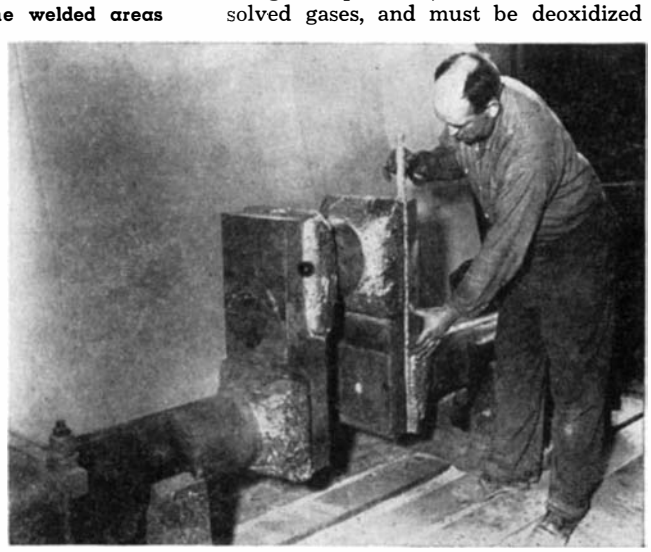
Thermit powder, as ordinarily employed, is composed of 23.25 percent fine granular aluminum and 76.75 percent processed mill scale. The processing is a roasting operation to increase the percentage of oxygen in the mill scale, and hence increase the yield of molten metal from the reaction. By this roasting, the equivalent FeO of the mill scale is lowered from 56 percent to about 18 percent. The subsequent reaction will produce about half as much steel as the original weight of thermit powder.

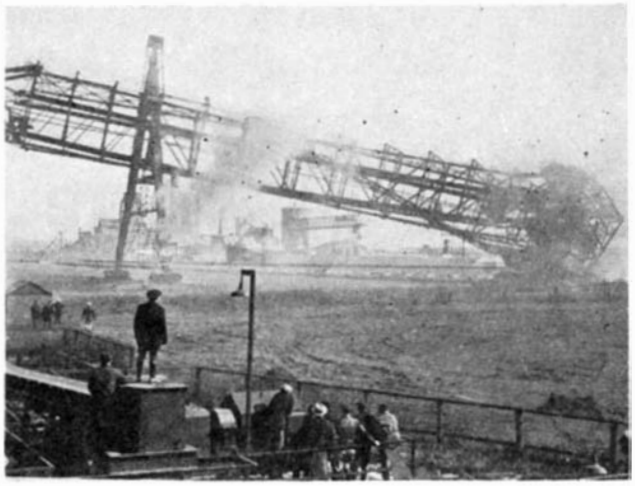
STEEL IS ADDED—In order to increase further the quantity of steel obtained from the reaction, about 15 percent of steel punchings is usually added to the mixture. The great heat generated by the thermit is sufficient to melt this additional steel—indeed, the added metal may be increased as high as 50 percent without lowering the temperature below about 3300 to 3400 degrees, Fahrenheit. However, in order to assure a complete fusion with the work, it is usually desirable to add only enough metal to maintain a temperature of about 4000 degrees, Fahrenheit.

A wide range of composition of thermit weld metal is available. The reaction, as already stated, can be used with a number of metallic oxides. By using a mixture of oxides in the thermit powder, or by adding pieces of another metal or alloy, carbon content and content of alloying elements can be controlled.

Steel, when cast in the foundry from a high temperature, tends to hold dissolved gases, and must be deoxidized







Demolition of an ore bridge was recently accomplished by the aid of thermit, which was employed to melt the supporting columns, as described in text

by some means. In the case of thermit, an excess of aluminum, one of the deoxidizing agents used in steel manufacture, insures against "wildness" in the poured metal. Thermit steel is quite dense, since it solidifies from the inside out because of the presence of the parts to be welded. These metal parts, being at a temperature much below that of the weld metal, take heat from it, and cause the weld metal to chill first approximately along the axis of the work.

An interesting use of the thermit process is to prepare metal for small castings, usually for emergency repairs, when no melting equipment is available. This sometimes happens in isolated mining districts, as in Australia and South Africa. The correct thermit powder must be obtained, or the necessary composition made up by adding pieces of the desired constituents. The reaction is started in the usual thermit crucible, and the metal is run into sand or other molds, as in ordinary foundry practice.

The thermit process, originally used in heavy engineering chiefly for repair and maintenance work, has added in recent years a respectable list of "new construction" applications, of which the joining of forgings or castings (like the ship stern frames mentioned earlier) is typical. This trend is expected to continue into the post-war period, with thermit welding emerging as a major method of engineering construction.

ALUMINUM-BRONZE EXTRUSIONS

Have Desirable Properties for Many Uses

A very recent and significant development in the field of metal-forms has been the availability of extrusions made of the mechanically desirable but hard-to-work aluminum-bronze alloys. Long known for their hardness, tensile strength, and corrosion resistance, these alloys have generally been available chiefly in cast rather than wrought iron.

Extrusion equipment developed for and employed at the Wrought Products Division of Ampco Metal, Inc., is built around a hydraulic horizontal type Schloemann press having a capacity of 2275 tons total pressure on the main ram and equipped for tube extrusion with piercer attachment of 275 tons.

The extrusion process has so increased the physical properties of the already strong aluminum bronzes (especially those containing 2.5 to 5 percent iron and 8.5 to 15 percent aluminum) that they are finding increased use for aircraft engine parts, landing gear parts, propeller parts, bearings, and so on.

SKIN RECOVERY

Corrects Deficiency in Heat-Treated Steel Surfaces

Decarburization of steel—the lowering of the carbon content at the surface and hence the formation of a soft skin—has probably brought more headaches to heat treaters, metallurgists, and steel manufacturers than any other problem associated with heat treating.

A new method of surface treatment developed by Surface Combustion Division of General Properties, Inc., comprises restoring carbon to the depleted surface by heating the steel in a gas atmosphere under conditions so controlled that carbon enters the steel surface in exactly the right amount to correct the deficiency.

In typical cases carbon recovery is complete and within 0.03 percent of the original carbon in the steel. For example, forgings receiving the treatment have shown no signs of failure due to surface conditions, in sharp contrast to the high mortality rate observed before the use of the skin-recovery process.

OUTSTANDING DEVELOPMENTS

Listed in the Metal-Engineering Fields

Based primarily on a survey by Edwin F. Cone of the opinions of leading engineers and metallurgists in the metal-working industries, *Metals and Alloys* has just issued a list of the ten outstanding non-secret wartime developments involving new materials or metal-processing methods that have made major contributions to Victory and which have considerable significance from the standpoint of post-war materials and processes.

The ten leading developments all fall within the framework of three broad achievements for which American metal-working plants, the War Production Board, and Army Ordnance share top honors. These general programs were:

a. Expansion in metal-production, especially of steel (about 10 million-ton increase) and of light metals.
b. The conservation program—including substitution, process-conversion, and salvage—that stretched our available metal supplies phenomenally.
c. The co-operative pooling of know-how on materials and methods by all industry.

Specifically, the 10 chief materials and methods developments (listed here not necessarily in the order of their importance) were found to be:

1. The development and use of the National Emergency (NE) alloy steels.
2. The development of special heat-resistant steels and alloys and of precision manufacturing methods for turbo-supercharger and gas-turbine components.
3. The development of new high-strength aluminum alloys and of clad aluminum alloy combinations far superior to the best available before the war.
4. The production of magnesium from seawater at plants on the Texas Gulf Coast.
5. The expansion in the use of welding for fabrication, especially of ships.
6. The application of tungsten carbide tools (especially for high-speed milling) to increase the output of machining operations.
7. The development and performance of heat-treated cast steel armor plate.
8. The rapid development and wide use of new methods of "packaging" steel products to protect them against corrosion, particularly during overseas shipment.
9. New resin-bonding adhesives for joining metals to metals and to non-metals, sometimes with the strength of welds.
10. The production of forged aluminum cylinder heads for airplane engines, permitting considerable increases in power per unit of engine weight.

BRIGHT ELECTROPLATE

Has Nearly the Reflectivity of Silver

A new bright alloy electroplate has recently been placed on the market by Hanson-Van Winkle-Munning Company, that has a combination of properties not heretofore available in electro-deposited coatings.

The deposit, an alloy of copper, tin, and zinc, is bright as-plated, is non-magnetic, and has a reflectivity nearly that of silver. It is tarnish-resistant and efficiently protects the underlying metal (usually copper or brass) from corrosion.

The coating is abrasion-resistant and can be bent and formed without peeling if thinner than 0.0002 inch.

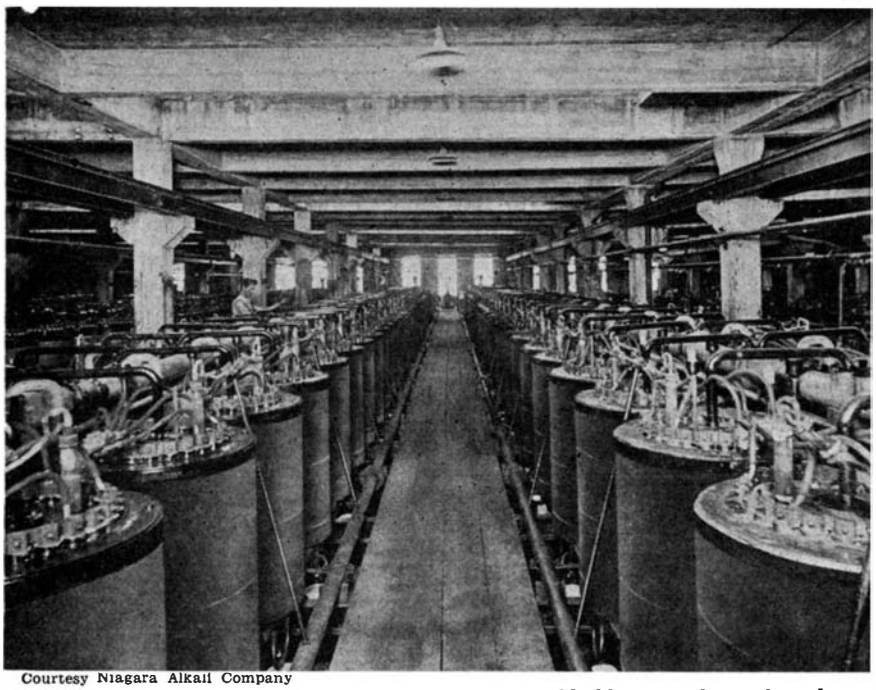
Abundant Chlorine

Production Capacity for this Common but Important Chemical is Now Double that of Pre-War Times. This New Abundance Will Make Chlorine Available for the Development of New Derivatives and Applications and for the Expansion of Old Uses that Have Already been Proved in Practice

AFTER Victory, many things will be different. Novelties and wonders will grow out of this war's developments to make the post-war world a far better place to live. But the novelties we hear most about will be far less significant than homelier developments of familiar things expanded to greater usefulness. Plastics, light metals, and 100-plus octane gasoline fill principal roles of miracle workers in imaginative accounts of tomorrow, for, we are soberly told, they will give us pre-fabricated houses, jitney airplanes, and automobiles that will run countless miles on each gallon of motor fuel. Perhaps that is so. These and other strange novelties will undoubtedly be interesting, but the really vital aspects of tomorrow are bound up with more familiar things made newly abundant through production facilities swollen huge for war. Chemically, this is particularly true, for chemistry and the chemical industry work with the intrinsic natures of materials and little, if at all, with those superficial aspects which most inflame the imaginations.

Chlorine illustrates this new abundance and its consequent effects on usefulness. Certainly it is familiar and many of its applications and derivatives are well and long known. Some derivatives of chlorine will receive such attention as to make them appear quite new; but by and large the developments that are really vital to tomorrow have already been under way for a long time.

The new phase is one of quantity and hence price. In 1939, our capacity to produce chlorine in commercial plants was 1700 tons a day. That compares with 617 tons a day in 1925 and with nearly 4000 tons a day in 1944. This excludes capacity owned and operated solely by the government, which may or may not be available for commercial production at war's end. Clearly such an increase in production, when no longer needed for war, will affect our future. Great pressure to sell over-production may be expected to encourage new and to enlarge old outlets for this product at the end of unnatural demand.



Courtesy Niagara Alkali Company

Electrolytic cells in which brine is decomposed to yield chlorine and caustic soda

The implications of enlarged markets for any staple commodity extend in all directions and into many fields. Obviously, changes of price and quantity affect both direct producers and consumers at once.

Sometimes these effects are spectacular; more often they attract little attention. Yet their importance can scarcely be over-stated. Without the goad of war, with its demand that could not be denied, reductions in the costs of many products take years instead of months. Liquid chlorine, for example, sold for 27 cents a pound in the early days of its production in this country (1907) and it required three decades for it to come down to 1.75 cents a pound.

REFLECTED COST DROPS—Costs of chlorine derivatives seldom drop in proportion to that of the gas itself. Indeed, since numerous other raw materials enter these derivatives and one or more processing steps are required for their production, it would be surprising if any exact correspondence did exist. Yet the fact of cheaper and more plentiful chlorine is sure to be reflected in ultimate lowered costs of its products and in their greater abundance; and these factors quite naturally will encourage tomorrow's development of new and enlargement of old markets.

Looking forward to peace, we can safely anticipate a potential output of chlorine substantially more than double the corresponding pre-war figure, even assuming that government-owned plants will not enter the general market. Without going beyond 1939's uses of chlorine and those brought to special prominence in the war period, its early post-war future can be readily approximated. Obviously, invention must be barred from the discussion lest we be carried away by our own dreams and lose ourselves and any possible value of this discussion by the same fault that nullifies the value of most forecasting of the post-war future.

Outstanding consumer of chlorine is its producer: the chemical industry itself. From the yellow-green gas come a host of valuable products formed through its chemical reactions with many different raw materials. Chlorine,

PRINCIPAL COMMERCIAL USES OF CHLORINE—PRE-WAR

Chemical Industry

Aluminum Chloride
Amyl Alcohol
Amyl Chlorides
Anilin Oil
Beryllium
Bromine Recovery
Carbon Tetrachloride
Chloramine T
Chlorinated Diphenyl
Chlorinated Naphthalene
Chlorinated Rubber
Chloroform
Chloropicrin
Cyanogen Chloride
Dichlorodifluoromethane
Dyestuffs Manufacture
Ethyl Chloride
Ethylene Chloride
Ethylene Glycol
Ferric Chloride
Hydrochloric Acid
Hypochlorites
Insecticides, Fumigants
Lead Oxide
Magnesium Metal
Metal Chlorides
Methylene Chloride
Monochlorobenzene
Orthodichlorbenzene
Paradichlorbenzene
Pentachlorethane
Petroleum Refining
Phenol, Synthetic
Phosgene
Steel, Pickling
Sulfur Chlorides
Tetraethyl Lead
Tin Crystals
Trichloroethylene
Tungsten, Metallurgy of
Vinyl Chlorides

Bleaching

Bleaching Shellac
Pulp Bleaching
Textile Bleaching

Sterilizing

Sanitation of Industrial Wastes, Sewage, and Water
Slimes, Condenser and Pulp Mill, Prevention of

Miscellaneous

Chlorination of Wool
Flour Maturing
Glucose
Respiratory Diseases, Treatment of

by this very chemical activity, is also an invaluable tool to enter and alter molecules and convert them to others having particular values. Some of these products contain chlorine in their final state, but many are simply transformed when chlorine is introduced into its molecule and later removed. More than half our chlorine production is normally consumed in chemical operations.

Chlorine possesses extraordinary ability to bleach and whiten paper, wood pulp, and textiles, and this bleaching action is its second great use. Bleaching powder, made by combining chlorine with lime, was at one time the exclusive chemical bleaching agent but the greater economy and effectiveness of chlorine itself, as well as its freedom from some of the drawbacks of bleaching powder, have permitted it to replace the older agent practically completely.

The third great service of chlorine in point of quantity, and by all odds its most important one on every other basis, depends upon its strong germicidal properties. Tiny dosages of chlorine added to water supplies effectively destroy the bacteria of certain diseases formerly spread by drinking water. Most notable of these is typhoid fever, once a universal plague but now, thanks to chlorine, a rarity in the United States even with density of population always growing. Similar treatment of sewage overcomes or minimizes the contamination of streams from this source. Chlorination of industrial water for certain uses prevents troubles arising from the growth of certain slime-forming organisms in plant equipment.

One might well add to the list of applications of chlorine a fourth miscellaneous class having considerable utility but falling outside the foregoing important groups. Into this class fall the treatment of respiratory diseases by atmospheres containing safe but germicidal concentrations of the gas, maturing of flour, pickling of steel, and a few others of smaller significance.

Chlorine's value in post-war developments and the trend apparent from the expanded production of the war period may be deduced from consideration of a few of its outstanding applications. Clearly, reduced costs resulting from cheaper chlorine will be reflected in widened markets and these in turn will raise standards of living in a number of ways. The same thing is likely to happen in other parts of our economy quite aside from any effects which may be produced by entirely new inventions or new adaptations of older ones. It therefore behooves us to take special account of recent important factors in our lives and to look into the probable effects on tomorrow of their considerable expansion.

USES OF COMPOUNDS—Four uses of chlorine compounds will suggest the probabilities in chemical industry's operations: Vinyl chlorides for resins; solvents for dry cleaning; refrigerants; and insecticides.

A number of different vinyl and vinylidene chlorides possess the ability to form synthetic resins. Two classes of resins containing chlorine possess important values. Vinyl chlorine resins can be made with a rubberlike character once familiar in belts, suspenders, tobacco pouches, and other such items. Curious as these novelties are, their importance is trivial beside the application of the same resins to the problem of protecting ships from magnetic mines. Here the vinyl resin forms the insulation of the de-gaussing cable, major protective device. Advantages are high insulating value and resistance to moisture, sun, ozone, and weather, combined with a satisfactory degree of flexibility. This use suggests important post-war applications in various electrical fields where weather destroys rubber or nullifies its value rather too quickly. New efficiency and longer life of insulation on electric lines may be realized through this use of chlorine.

The vinylidene chloride resins lack rubber's elasticity but are highly resistant to chemical attack. The ease of their fabrication has led to the development of highly resistant pipe and pipe fittings which can be readily and cheaply installed, and which possess great value in chemical plants and other locations subject to highly corrosive conditions. Another type of the same basic resin makes "wire" insect screen of high weather resistance and a rattan-like product having long life, resistance to washing and cleaning, and other advantages when used in caning chairs, seat backs in railroad cars, and like services.

DRY-CLEANING CHANGES—Fire-resistant, non-flammable solvents had before the war put dry cleaning into shops on the main streets of towns instead of remote locations previously required by fire laws. Retail establishments could quickly and efficiently clean garments practically while you waited. They could, that is, so long as chlorinated solvents were to be had. Just now dry cleaning has returned to its flammable solvents, its isolated locations, and its wholesale plants where proper precautions can be taken against fire. But this seems likely to be a temporary move and one to be reversed when war demands for chlorine abate and free it for making the kind of solvents required for retail shops to practice this art.

The Freon refrigerants, typified by dichlorodifluoromethane, now carry with them to war great quantities of chlorine consumed in their production. The air conditioning and refrigerating systems of ships, for example, are safe and efficient because their working fluids are these non-toxic, non-flammable refrigerants. The same products also serve the important purpose of motivating the mosquito bombs which effectively spray insecticide into the air of an enclosed space to rid it of mosquitoes and other annoying and dangerous insects. These highly effective instruments play a leading role in the comfort and protection of our armed forces in insect infested places.

Chlorine also enters the composition of many important insecticides and performs an essential service in the synthesis of others. Typical of the first group are paradichlorobenzene, familiar in household moth-controlling preparations, also a later development which has come into extraordinary prominence for its remarkable ability to destroy body lice and thus protect our soldiers from typhus fever. The second group can be represented by ethylhexanediol, a valuable repellant for insects.

Courtesy Niagara Alkali Company

Evaporators for concentrating the caustic solution produced from brine during the manufacture of chlorine

The foregoing paragraphs merely suggest, and by no means exhaust, the chemical products into which chlorine enters. Each of them may be affected to some greater or lesser extent by the abundance of chlorine after the war. Just how great this effect may be on any one of them cannot now be determined. However, should each of them be made a little cheaper and a little more plentiful, the combined effect on comfort and the standard of living of many is sure to be immense.

One is no little comforted that practically all municipal water supplies in the United States and Canada—so nearly all of both publicly and privately owned supplies that the number missing is negligible—have the benefit of chlorine treatment to destroy any noxious germs they might otherwise carry. The few exceptions draw naturally germ-free water from deep wells. A further fact is that public water supplies are made safe to drink at a cost of somewhat less than one cent per person per annum! Certainly that is cheap enough for a service so vital.

Large quantities of chlorine are now consumed similarly by our armed forces in sterilizing and purifying the water they must use. The technique of supplying this important service wherever it may be required represents a significant development. Heretofore export of liquid chlorine has been hampered by the necessity for handling cylinders as deckload on ships to avoid hazard in case of leakage, and by the necessity of returning the heavy, expensive cylinders for refilling. Compounds containing active chlorine in a form suitable for water purification have usually been uneconomical as means to get supplies to remote points. However, development of methods of supplying our forces throughout the world and at the same time proof to native populations everywhere of the efficacy of the chlorine treatment of water, leave no doubt that this will be an important factor in chlorine's future.

That becomes spectacular in the light of the cold facts of typhoid fever, outstanding example of water-borne disease. Before 1910, when water treatment was new, the death-rate in the United States from typhoid fever had been gradually reduced to some 25 persons annually per 100,000 of population. The present death-rate from this disease is approximately one twentieth of this number.

Obviously, reduction of cost of chlorine will have at most a trivial effect on water treatment in this country. However, cheapness combined with other vital factors is likely to encourage the adoption of effective sanitary measures in other countries which still suffer large numbers of deaths annually from this dread disease.

Without laboring the point, it seems clear that essential changes and improvements in our post-war world can and will come from the efforts producers must make to sell their swollen outputs after war's demand stops. The point could be as well illustrated by choosing another material than chlorine, or even a different list of its derivatives. Nevertheless, the conclusion is inescapable that we must and can with safety look to the cheapening of customary products and their consequent widening use both at home and abroad for the greater part of our post-war prosperity. It is all very well to hope that fantastic dreams will come true, but that hope is scarcely reliable.

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CARCASS STOCKS

Improved by Use of Litharge Activator

RESEARCH recently conducted at the laboratories of the National Lead Company definitely establishes the fact that litharge-activated GR-S compounds can be achieved with far superior aging properties, with desired curing rate, stable over an extremely wide curing range, and with improved heat build-up. This has been accomplished by using litharge as an activator for thiazole or thiuram accelerators with low sulfur content.

Many investigators did considerable research into accelerators for use in the compounding of GR-S stocks soon after the development of GR-S as a replacement for natural rubber. Chemists of the National Lead Company succeeded in producing activation by litharge, which has resulted in a satisfactory carcass stock for vehicle tires.

LAMINATED PLASTIC

Gives Added Protection To Military Airmen

A NEW three-ply laminated plastics sheeting has been designed to give added protection to American airmen flying in pressurized high-altitude planes. The new sheeting reduces the possibilities of disintegration of clear plastic canopies when pierced by bullets or flak while flying at high speeds under pressurized conditions.

Called laminated Lucite-Butacite, it consists of a single layer of Butacite polyvinyl butyral resin sandwiched between two layers of Lucite methyl methacrylate resin. Perfection of the sheeting was recently announced by E. I. du Pont de Nemours and Company.

Tests conducted by both the Army and the Navy show that, under certain conditions, the new laminate has a self-sealing tendency in that holes created by bullet penetration close up almost completely because of the rubber-like nature of the Butacite interlayer sheeting.

At ordinary temperatures, even under pressure, the hole left by the bullet is small and the amount of shattering is not excessive. In most cases, the hole may be promptly sealed with a patch, permitting maintenance of essential air pressure within the cabin. Solid clear plastics usually shatter beyond repair when struck by a bullet in low temperature and under high pressure.

TEXTILE CHANGES

Wrought by Application Of Chemical Research

RADICAL developments in the chemical treatment of fibers, which will have a profound effect on the post-war textile industry, are announced by Monsanto Chemical Company.

As a result of research dealing with chemical treatment of natural fibers, the company claims that its accomplishments to date include:

Treatment of wool so that it won't shrink.

Treatment of both cotton and wool so that the wearing qualities of these fabrics will be doubled.

Treatment of serges to eliminate the shine from the cloth.

Treatment of wool so that it creases durably under steam and heat. Thus trousers or suits that are pressed will retain the crease even in a rain and will not wrinkle when packed into a suitcase.

Treatment of fibers so they will not slip. This means that stockings will not run nor will seams pull out.

All of these developments, it was announced, are based on new techniques of treating either the surface or the heart of fibers to produce the desired effect without in any way changing the feel or texture of the material. In some cases the treatment involves the deposit of a submicroscopic film of plastics. In the case of the elimination of runs in stockings, the treatment involves the deposit of silica or submicroscopic grains of sand. This prevents the fibers from slipping out of the positions into which they were knitted, yet does not alter the feel or texture of the fabric.

Part of a long-range research program into the chemical treatment of textiles, the results up to now include greatly increased water-repellent qualities for cottons and rayons and increased fastness to washing or dry cleaning through impregnation with chemicals which are highly resistant to heat, water, and acid.

Precast Solves Many Problems

When Concrete is Precast Rather than Cast in Place, it is Possible to Accurately Control Many Desirable Qualities. In Addition, Standardized Forms Are Available Which Can be Quickly and Easily Put to Use. Concrete Products Can be Made on a Production-Line Basis

AN ELECTRICAL products manufacturer had to fit a deep tank into an odd corner of a process room. To have the necessary capacity the tank had to fill all the space available, and that space was pear shaped. Worse still, production could not be halted while a special tank was built in place and the tank had to have fair thermal insulating abilities.

Precast concrete solved the problem. A template was made of the exact space that could be used. Careful measurements were made of all floor joists and other obstructions; the tank would rest on some but had to fit around others. Forms were made in the carpenter shop. The tank was poured with lifting lugs cast in its walls. Then the necessary flooring was cut out of the way, the tank picked up by the shop crane and lowered into place. There was no interruption of production.

A machinery manufacturer was retooling for a new product. One of the old machines could be used, but for fastest output the shop needed special stock racks, a pedestal for its driving motor, pockets for tools, a larger bin for holding and draining chips until the scrap disposal truck came along, and other features.

Precast concrete solved this one too. The planned base first was mocked-up with scrap lumber to make sure that everything would be as desired. Then the forms were made. Dowels on which the special stock racks could be fitted were cast in place, arrangements being made for lift trucks to take away empty stock racks and replace them with filled ones, with the dowels serving as positioning guides as well as anchors. The anchor bolts for the motor frame also were cast directly in place as inserts.

Stairs that will never creak

When the time came for the change-over, the usable machine was lifted clear of the floor with a crane, the new precast base was skidded into place and lowered, the machine was lowered onto its base and positioned there, the machine base was through bolted and concreted-in, the motor was installed, and the new set-up was ready for tooling.

Specially designed precast concrete shapes like these have been used in industrial plants for many years. Other examples are battery boxes, forming dies, pedestals to stiffen the supports of outboard bearings, silo staves for chemicals tanks, counter weights, ballast blocks, and ducts.

READY-MADE PRODUCTS—Back of these is a line of products which can be bought ready-made from concrete products manufacturers. Blocks are part of that line, and pipe, floor slabs, wall panels, joists, lintels, cornices, manhole covers, columns, catch basins, and shingles. The products manufacturer stands ready to make the special stuff, too, and to advise about how it should be made. Thus an industrial plant has two choices. It can design and make its own precast shapes, or it can have them made almost anywhere.

The reasons for using precast are those of convenience and versatility. Not only can the manufacturer produce unusual shapes and move them into place only when he knows they are perfectly right, but also he can obtain controlled properties and qualities which are desired, perhaps, in only a few parts of his plant.

Light weight is one property obtainable in precast shapes; noise absorption, oil resistance, nailability, thermal insulation, stiffness, tensile strength, and chemical resistance are others. These same properties, of course, can be had in concrete poured in place. But when special qualities are wanted, or when there is anything at all difficult about the work, then doing the pouring in a place especially prepared for concrete production can have plenty of advantages over working where the concrete is to remain.

For standard shapes such as blocks and joists, the special precast-facilities have another advantage. They permit concrete products to be made on a production-line basis. Forms and other repetitive tools can be designed for rapid action, special materials-handling equipment designed, every advantage taken of high early strength concrete techniques to get more work from the same equipment and floor space. With repeated small savings added to big ones, the price of the finished product often is less than the cost of pouring that product in place.

Courtesy Lone Star Cement Corporation

Precast manholes and covers are carried in stock, ready for quick use

Designing of precast products to secure unusual qualities offers almost infinite possibilities. Cements can be varied, as can aggregates, admixtures, surfacings, reinforcements, and mixing and placing methods. In fact, there are so many practical combinations of materials and methods in the precast concrete field that the inexperienced engineer always should seek the advice if not also the use of the production facilities of experts.

Some cements, for example, are almost pure white in color. Mixed with white aggregates, they can be cast into wall panels, floor slabs, machine bases, and so on, which give unusual reflectivity of light combined with minimum glare. Other cements are specially resistant to the sulfates—those old enemies of concrete.

High early strength concretes have the advantages of quick production. Table tops, piers for reinforcing buildings or for strengthening floors on

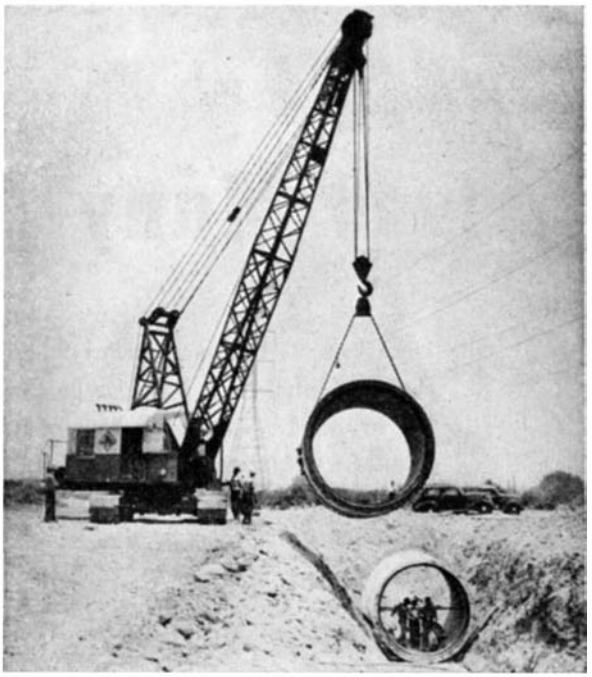
which unusually heavy loads are to be placed, and other products can be cast on Saturday and be ready for use on Monday. Thus the time interval between finding out what is needed and getting it ready for use may be reduced by weeks.

Aggregates can be varied. And this is perhaps the most important opportunity which precasting provides. For concretes are very largely what their aggregates make them. The cement itself is only a means of fastening the aggregates together. Nearly all of the special qualities come from the special selection of aggregates.

Weight is an example. By using ordinarily obtainable aggregates, concrete can be made to weigh anything from 30 to 150 pounds per cubic foot. In fact, some specializing engineers divide all concretes by two classes of weights: (1) the 80 to 105 pounds per cubic foot class, and, (2) the 140 to 150 pound class. Class 1 can be produced with such aggregates as expanded mica, expanded slag, or with clay, shale, or slate which has been expanded, or with cellular aggregates such as cinders. Class 2 can be made with stone, gravel, trap rock, limestone, dense slag, and the like.

One way to cut down on weight, and on cross-section too, is to prestress the reinforcement. Ordinary concrete has great compressive strength, but a tensile strength of only about 500 pounds per square inch. Prestress the reinforcement, and the tensile strength can be brought up to 2000 or more pounds per square inch. This means that concrete sections can have longer spans between supports and can be thinner and lighter, too. In one recent test a beam with prestressed reinforcement stood four times as much as a similar one with ordinary reinforcement before breaking.

Prestressing of reinforcement lends itself peculiarly to precasting techniques. It can be done, of course, with concrete which is to be cast in place. But the prestressing means that the reinforcement is stretched—put under tensile stress—and held in its stretched position until the concrete has hardened and been firmly bonded to the steel. The stretching can be done with ordinary fence pullers for some kinds of work. But, when real results are desired, then carefully controlled methods, usually involving the use of nuts and bolts which take up exactly predetermined amounts, are used. One patented method requires that the reinforcement be coated with a mastic before being placed in the forms, then be electrically heated to 250 degrees, Fahrenheit, above the temperature of the surrounding material, then tightened up predetermined amounts by the use of nuts. As the reinforcement cools, the nuts keep it from shrinking and thus provide the prestress. The mastic causes the concrete to bond firmly and uniformly.



Precast pipe can be big or small, as needed

Controlled prestressing like this is not too hard to do when everything is set up for mechanical handling of forms, and so on, and there is plenty of elbow room in which to work—conditions easy to create where precasting is being done, but not always obtainable when concrete is to be poured in place.

Admixtures can help when special results are wanted. There are, of course, plenty of construction engineers who do not believe that any admixture ever added a thing that could not have been had by proper selection of aggregates plus proper mixes and placing methods. But the admixture men point out that their products can add colors, water resistance, chemical resistance, compressive strength, oil resistance, early strength, and other qualities. And the most hardened "cement and aggregate only" man in the business will admit that the admixture sales engineers hand out qualities and quantities of technical advice and engineering suggestions which are worth far more than their products cost.

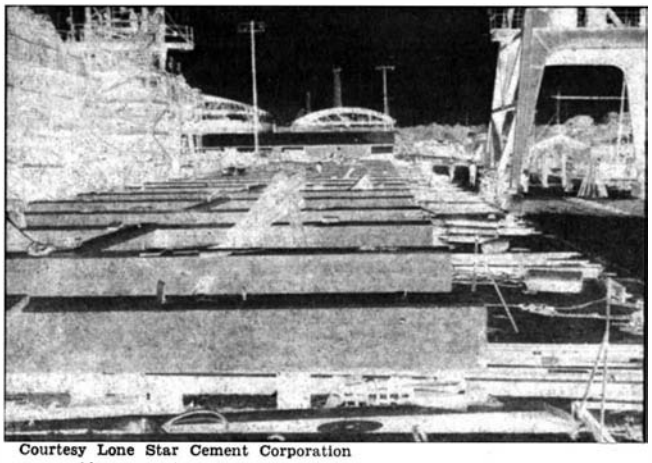
Calcium chloride is used for its effect upon high early strength. One professional precaster mixes 100 pounds of calcium chloride in a 50 gallon barrel of water, uses one bucket of the mixture to each 25 cubic foot of batch, and estimates the gain in high early strength to increase his output per form by an average of over 16 percent.

Special surfacings, which can be applied while precasting products, include everything from special mixes of concrete itself to glass, steel, wood, and the like. Much of the surfacing is applied with the help of special mastics developed during the war. The mastics compensate for the differences in thermal expansion between, for example, concrete and glass or steel. And they make the surfacings stay in place.

Like so many other special concrete materials, surfacings are easiest to handle when applied in small amounts to precast products which are made by carefully controlled mechanical methods.

Mixing and placing methods are helped by production conditions which can be set up for precasting. For best results, concrete batches must be mixed with as much care as chemical formulas; the old fashioned combination of a "bohunk with a trough, a shovel, a hose, and a strong back" will not do. Water, for example, is measured out so carefully that the amounts contained in the sand and the aggregates are counted in.

Vibration is important to placing. With proper vibration, far less water need be used in the mix, the early



Courtesy Lone Star Cement Corporation

Shipway beams precast, with eyebolts as inserts

Courtesy *Engineering News-Record*

These precast columns and beams were delivered from stock

Chemical tanks can be quickly assembled from precast concrete staves

strength is higher, and the results are more uniform.

The frequency of the vibration is far more important than the amplitude. In fact, too hard shocks can result in elements of the mix being separated out, bad surfaces where the mix has frictional contact with the forms, inadequate cementing to the reinforcement, and other troubles.

But high frequency with low amplitude is easy to provide when production conditions are controlled as they are in precasting. A simple table top can be mounted on rubber supports, on springs, or on anything that will flex. Vibratory motion can be applied with compressed air, by attaching a high-speed imbalanced rotor, or by electrical means. No plant maintenance department has much trouble in making such a rig once it knows what is required.

With so many possible variations in production techniques, industry can have almost anything it wants in its precast concrete products.

Noise absorption is obtained by using light weight, cellular aggregates. Blast-furnace slag is one of these. Vermiculite, an expanded mica, can produce concretes weighing only 30 pounds per square foot and having high noise-control qualities.

Nailability can be had by using aggregates into which nails can be driven. Another method is to cast nailable strips into the faces of harder and stronger concretes.

Temperature control can be had by using expanded aggregates. With expanded mica, for example, K values (thermal conduction coefficients) approximating those of asbestos have been obtained, although at a sacrifice of compressive strength.

With selected aggregates and reinforcement, concrete can be increased in heat conducting ability. Thus precast products can insulate to preserve heat or protect against it, or can conduct heat, as desired.

CONCRETE IN PREFABRICATION—Prefabricate-ability can be had by the control of aggregates and mixes. Precast products can be intended to be drilled, sawed, or otherwise reshaped at will after being installed.

The dividing line between the practices of pouring in place and of prefabricating seems to be in the size and the nature of the structure to be built. An ordinary flat machine base might well be the poured-in-place concrete floor on which the machine is to stand. But when there are to be recesses for vibration-absorbing pads, special noise absorption, extra stiffness, through holes for pipes and belts, steel faced gibbs for adjustments, and the like, the precast techniques have the versatility which means so much in the long run.

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FASTER FILING

Provided by New File Metals and Styles

THE ART of hand filing is staging a come-back. This art was supposed to be disappearing with the advent of high-speed grinders which could be held in the hand, filing machines, more versatile tool-room machines of all kinds. But the answer of the file makers has been files which would do things which old-time files would not do.

One of the latest entries in this field is the cemented carbide file, made by Kennametal Inc., which can cut cast iron at 900 surface feet per minute and cut steel up a hardness of 62 Rockwell C.

Curved tooth files by Nicholson have their teeth so arranged that the file tends to keep itself on line. At the same time, the tooth form gives a double shear cutting effect, gets the work done at higher speeds. Files of this type are much better for comparatively untrained mechanics to use, since much of the skill in old-time hand filing was in preventing the file from running off line. Well trained mechanics find these files faster and more satisfactory for much of their work; they tend to provide more speed with less effort.

Hand filing is not likely to get back all the work it has lost to machine methods, but with these and other new files, this art is creating brand new fields for itself by making operations economical which previously were too costly.

SAFER REPAIRING

Can be Assnred with Simple Precantions

MORE tanks, drums, pipe systems, and ducts which contain flammable materials are in use than ever before. And under the pressure of war production schedules, the maintenance problems are increasing.

Maintenance often involves the use of blow torches, welders, and other devices which may start fires. Even worse are cold chisels, wrenches, and pliers which can cause sparks that will ignite flammable gases.

First step to prevent fires and explosions is to clean the tank. Water, steam, or a mixture of six ounces of trisodium phosphate or sodium silicate to a gallon of water, are used for cleaning. Care must be taken that the cleaning is done in the open air, or in a well ventilated place. Window or roof ventilation is not enough; flammable fumes usually are heavier than air and will flow along the floor as they are forced out of the vessel, getting into ducts, drains, and other places where they are hazardous. All open flames must be removed from the vicinity.

Another protective measure is to fill the vessel with an inert gas, or a mixture of inert gas and air. The gas must be in a concentration of at least 50 percent by volume of the contents of the vessel. Higher concentration may be necessary if the vessel walls hold scale, sludge, and so on,which are likely to exude dangerous gases when heated.

Nitrogen is an excellent inert gas if obtainable. More commonly, carbon dioxide is used. The CO_2 should be used at the rate of one pound of dry ice or liquid CO_2 for every 17.4 cubic feet of the volume of the vessel. For example, the contents of a 15 pound CO_2 fire extinguisher is enough for a tank 10 feet long and 4 feet in diameter, holding 130 gallons of oil when filled.

MASS RADIOGRAPHY

Detects Incipient Tnbercnlosis in Factory Workers

INDUSTRIAL workers in factories controlled by the government are now being given the advantage of chest X-rays similar to those used in examination of men for the armed forces. Results to date indicate that about one person out of every 1000 working in factories has unsuspected tuberculosis —a threat to his own health and that of all his fellow workers. Government X-ray programs so far have found more than 200,000 previously unknown cases.

The procedure is simple. Employees stand in line, walk to the portable machine, and are X-rayed at the rate of 150 per hour. Time away from work seldom is more than ten minutes per man. The cost is between 75 cents and $1 per man. Most cases found are in early stages when healing is easy. The average cost of curing a case not detected in its early stages is $10,000, most of which must be paid by charitable institutions or added to tax bills, since patients seldom have that much money themselves.

When an early or "minimal" case is found, the patient is given work which will not require too much exertion; he also is given shortened hours, rest periods, special diet. His skill and usefulness as an employee are preserved. Advanced cases, of course, must have sanatorium care.

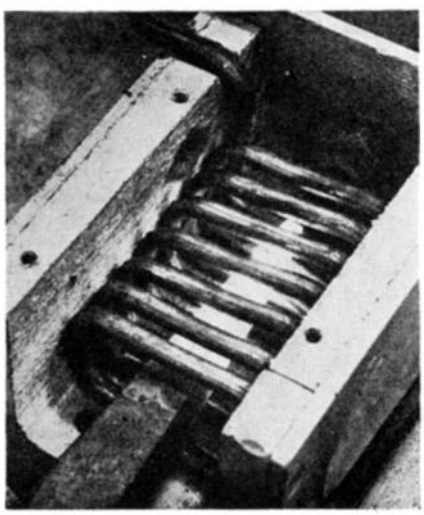
The highest percentage of cases is found among the older workers whose long-developed skills are hardest to replace. Preventing the breakdown of these men is important. But most important is the morale effect upon other employees who learn that they themselves are not infected and are not being subjected to infection.

Electronics In Tomorrow's Industry

Its General Trend Will Take Three Directions—Improving Old Processes; Applications of New Principles Not Yet Released from the Secrecy Seal of the War; and Commercialization of Techniques Now Being Developed, Such as Electronic Cooking, Sterilization, Personal Radio-Telephones

Of all the industrial contributions to the war effort, the biggest expansion from pre-war status has unquestionably occurred in the field of electronics. In communications, in detecting enemy facilities and automatically aiming guns, in bombing through clouds, in spotting submarines deep under water, and in robot-like automatic controls for big aircraft, electronic tubes are today accomplishing military feats that foretell a promising post-war boom in civilian electronic applications.

Up to about ten years ago electronics had not been accepted in large plants such as steel mills, foundries, machine shops, and mines, to any extent at all: As a matter of fact, it was difficult for an engineer even to get into a steel mill if he was thinking about putting vacuum tubes to work. The head of the mill might point out the rough-and-ready workmen hoisting things about the plant and ask with a laugh: "What chance would a glass tube have in such an environment?" Today, however, this attitude has completely changed, and now electronic tubes are mounted right on huge punch presses and rolling mills, doing jobs so satisfactorily that shutting down the electronic controls would create a minor catastrophe among the men.



Heating a chisel point for hardening, using a 15-kilowatt General Electric radio-frequency generator that sends current through the water-cooled copper coil surrounding the chisel

Probably the outstanding attribute of electronics in heavy industry is that it can be made to function with precise action and speed, exactly the two characteristics needed to control processes, inspect parts, control power, and perform other operations that give us better products at lower cost.

The general trend of industrial electronics extends in three directions:

(1) Improvement of old processes and products by war-inspired application of electronic equipment, such as in electronic sterilization, dehydration, welding, and control methods.

(2) Utilization of radically new electronic principles still under restrictions of military secrecy; such as radar locators, underwater locators and communicators, electronic map drawing devices for mobile equipment, and electronic gun-fire directors.

(3) Commercialization of electronic techniques now in the idea or blueprint stage, such as electronic cooking of food, personal radio-telephones, electronically glued plywood furniture, and electronic diagnosis and treatment of ailments.

ELECTRONIC WELDING GENERATORS—Welding has made tremendous advances in war-time years. Most spectacular are the new techniques utilizing high frequencies produced by electronic generators. For metals, high-frequency welding produces a joint so fast that fingers held close to the joint can scarcely detect a rise in temperature, yet the resulting joint constitutes a perfect fusion even for metals hitherto difficult or impossible to weld. A butt weld of two dissimilar rods gives a smooth joint with practically no discoloring or weakening of the metals due to heat, since the high-frequency current concentrates its heat in surface layers only a few molecules thick.

For glass, on the other hand, high-frequency welding permits fusing together thick pieces for forming complicated piping systems such as might be used in milk pasteurization plants, or fusing a ground-glass disk across the end of glass tubing. The high-frequency current is here passed right through the glass, because molten glass becomes conductive.

The pieces to be welded are placed between two facing gas jets whose metal bodies are connected to the terminals of the electronic generator. The current flows from one jet through the flame to the molten glass, through the glass to the other flame, and through that flame to the other generator terminal. The current heats the inside of the glass pieces after they have been butted together, keeping the glass molten there long enough to achieve perfect fusion.

Conventional welding has been advanced by electronics to the stage where it is now acceptable for use in such critical applications as aircraft structural assemblies. Electronic tubes known as ignitrons and thyratrons generate the surges of current that are shot through the metal in modern spot and seam welding techniques, while small tubes and even ordinary radio tubes control the magnitude and time duration of the current and voltage. The welded spots can actually be made so fast that they overlap to make a seam even better than that produced on cloth fabrics by sewing machines. Now at last it is possible to weld together thin sheets of aluminum and other metals without burning or weakening, or even weld a thin sheet to a heavy structural member—something unheard of before the war.

This RCA electronic detonator of explosive rivets is being used in aircraft plants to speed up assembly work. High-frequency currents generate sufficient heat to detonate small charges of explosives in the rivets, spreading them at the end

The extensive war-time applications of electronic welding in the aviation,

ELECTRONICS

What It Is:

Electronics is the industry based upon the utilization of glass or metal tubes in which electric current flows through a vacuum or gas. Most of these tubes closely resemble those used in ordinary radio receivers and broadcast stations; others, many of which are new and secret, bear such names as Klystron, magnetron, thyratron, ignitron, megatron, and iconoscope.

How It Works:

First—a device converts a physical change into an electrical impulse. Examples of these devices are phototubes (affected by light), thermocouples (affected by heat), vibration pickups (affected by movement).

Second—a vacuum-tube amplifier builds up the strength of the initial electrical impulses and selects the correct impulses needed for control.

Third—another device performs the desired final action in response to the amplified electrical impulses. Examples of these final actuating devices are electromagnets that reject sub-standard objects on a conveyor, and relays that turn on alarms, lights, motors, and other electrical equipment.

What It Does in Industry:

Analysis
Color Measuring
Cooking
Counting
Curing of Tobacco
Dehydration of Food
Detection of Foreign Particles
Dielectric Heating of Non-Metals
Flame Failure Detection
Gas Detection
Geophysical Prospecting
Germination of Seeds
Grading
Illumination Control
Induction Heating of Metals
Inspection
Irradiation
Killing Bacteria
Liquid Flow Control
Machinery Control
Measurement
Motor Control
Power Conversion
Preheating of Plastics
Process Protection
Smoke Detection and Control
Smoke Precipitation
Sorting
Sterilization of Packaged Food
Temperature Control
Vulcanizing of Tires
Welding
Worker Protection
X-ray Examination

automotive, and shipbuilding industries will certainly be even more extensively used in these fields and many others after the war, replacing riveting, clamping, bolting, and other fastening methods.

Whereas the foregoing welding techniques all produce the required heat as a result of actual current flow through the objects being joined, the new process of joining thermoplastic materials by welding utilizes high-frequency waves like those used in radio and communication fields. These set up molecular friction within the material, producing thereby the heat required for perfect fusion of sheets of Pliofilm and other transparent or colored sheet materials such as are used for tobacco pouches, light-weight rain capes, umbrellas, and similar products. The material is fed between two metal rollers connected to the terminals of the electronic generator, and the equipment has become popularly known as the electronic sewing machine.

To the industrialist, the important role of electronics in war production suggests new manufacturing techniques for his regular products. Such operations as electronic brazing, annealing, hardening, soldering, paint-drying, gluing, and heating will boost post-war production just as much as they are today boosting the daily output of military equipment.

HEATING COSTS—Heat generated by high-frequency power is admittedly more expensive per pound of material heated, but in hundreds of jobs the increased power cost is more than justified because it means doing a hitherto impossible job or turning out a better product faster than by older electric, gas, or steam heating methods. The high cost of electronic heat is due to the fact that the electric power taken from the power lines must be changed to higher frequencies by an intermediate power conversion unit or generator. The power tubes and associated parts of this generator are relatively costly at the present time since mass production has not yet been achieved. When post-war demands of industry create volume sales that lower cost, electronic heating units will quickly expand in scope of application.

The generation of heat in food and drugs promises to play a major role in these two industries. Three food-processing methods—dehydration, sterilization, and cooking—are even today done faster and better electronically than by conventional techniques in a great many instances. The non-metallic material to be heated is simply placed for a few seconds between two metal plates connected to the output terminals of the electronic generator, which is nothing more than an old-fashioned radio transmitter having a self-excited oscillator rather than crystal control.

By making possible wholesome food for our troops in the South Pacific and the other tropical fighting fronts, electronic dehydration is making a major contribution to our military successes. Conventional methods of dehydrating vegetables, milk, and other foods cannot remove sufficient moisture for refrigerated storage in humid tropic locations, without causing case-hardening, burning, and loss of flavor. So electronics takes over where they leave off and removes that extra 3 or 4 percent of moisture. Now even dried whole milk can be shipped anywhere without danger of its butter fat content becoming rancid, because its moisture content is reduced electronically from 2 percent to 1 percent. When the powdered milk is reconditioned by the addition of water, the liquid becomes as palatable and nutritious as fresh milk.

Considerable research has been carried out this year in electronic cooking of food. A large ham was in one instance cooked uniformly throughout in 20 minutes instead of the usual four hours, indicating great promise for this new technique in food-processing industries as well as in restaurants. In other tests, individual cold portions of chicken pie, already pre-cooked, were brought up to serving temperature in 15 to 30 seconds. In the future, this can mean elimination of efficient but flavor-spoiling steam tables for long-time warming purposes, because compact electronic warming ovens will be able to provide almost instantaneous warming, cooking, or even baking. In restaurants, table-model electronic bun-warmers will permit serving buns without the hard crusts resulting from ordinary oven storage.

Although electronic cooking has a commercial future, economic problems make immediate post-war use at home unlikely. A two-quart pot requires about the same two kilowatts of electric power for heating whether on an electric stove or between the plates of an electronic generator, but the high cost of converting ordinary power to high-frequency power is what may prevent electronic cooking from becoming a domestic science for some time.

Since electronic baking of bread gives no crust, many bakers are skeptical of electronic cooking. Chefs, too, offer objections, and suggest that uniform cooking provided by the electronic method might alter familiar flavors by eliminating juice-sealing crusts, but public acceptance of electronic flavors has not yet been tested. Bakers, however, praise controlled electronic heat for melting chocolate to simplify handling and speed mixing of cake and cookie batter. Conventional methods of melting chocolate require close watching to prevent over-heating and consequent spoilage.

Roasting of peanuts, coffee beans, and cocoa beans are other economic successes of electronic equipment. A moving

belt carries cocoa beans between the energized metal plates, and the beans often heat so rapidly that they shell themselves by an explosive action.

FOOD STERILIZATION—At the present time, sterilization of food products has developed into an important job for electronic heating. When equipment is available, it will be possible to take any given quantity of grain or processed food, no matter how badly infested with insects, and completely sterilize it in one treatment. The sterilized material can then be stored along with uninfested material or shipped with assurance that there will be no further infestation. Since the loss due to insects in grain products amounts to hundreds of millions of dollars a year, according to the United States Department of Agriculture, electronic sterilization should receive widespread acceptance in the food industry. In addition to direct savings, the process will prevent loss of goodwill of purchasers of packaged food.

The sterilizing technique for grain being prepared for storage involves running the grain on a conveyor belt between the plates of an electronic heating unit at an appropriate speed to bring the grain to sterilizing temperature. In most installations, a time of 20 to 30 seconds between the plates is enough.

The instant the grain moves beyond the plates the particles receive no further heat. By use of this conveyor belt technique, packaged products such as breakfast foods, baby foods, baking mixes, flour, dog food, and so on can be sterilized on the way to the warehouse or at any time before shipment. Cost of the process is about a hundredth of a cent a package for electric power. Amortizing, maintenance, and power costs for a typical three-kilowatt unit over a 10-year operating period amount to about 17 cents an hour of operation.

Besides applications in the food industry there is another tremendous field for electronic sterilization in the drug and pharmaceutical industries, for such items as bandages, sulfa powders, sutures, and so on. Notwithstanding rumors to the contrary, the equipment can be operated by anyone without risk of personal sterilization.

These applications serve only as outstanding illustrations of the versatility of electronics in tomorrow's industrial world. Electronics will inspect and grade materials, sort them according to color, measure and analyze vibration, control the speed of motors, regulate voltage and current, and do other things too numerous to mention. It is not a cure-all and it is not magic or mysterious—but, properly applied, it is a useful science, here to stay and do its bit to make the world a better place in which to live.

Sterilizing packaged flour

flour can be sterilized as a complete unit on its way to the warehouse. A heat-treat time of 10 to 30 seconds is usually adequate to develop a temperature of 130 degrees, Fahrenheit. Experiments have shown that complete destruction of all insect life is accomplished in this short time.

The cost of the heat treatment and also the power required are both low. Under average conditions, about 480 one-pound packages can be sterilized each hour for 5 cents worth of power. [For further details on these processes, see feature article which ends on this page.—*Ed.*]

ELECTRONIC FLASH

Stops High-Speed Motion Photographically

RAPID movement can be stopped photographically with a flash of about one thirty-thousandth of a second duration, produced by the Lee Strobo-Speed lamp made by Guardian Electric. A rectifier tube is employed to build up a high charge on a bank of capacitors. These capacitors are discharged in series through the flash lamp by a relay that does all the required switching automatically. One flash of this electronic lamp equals in light intensity the illumination by 20,000 ordinary hundred-watt tungsten lamps, yet the whole unit plugs into a 115-volt, 60-cycle wall outlet and fits into a carrying case scarcely heavier than a travelling bag.

LEVEL INDICATOR

Electronically Shows Amount of Material in Bin

USING an electronic amplifier, a new device for indicating the level of solids in a bin has been designed by Mosher Electronic Control System. It operates entirely on electronic principles, has no moving parts, and can be used in the measurement of all types of coarse or fine material.

The device includes two parts: a detector box which is attached to a probe extending into the bin, and a second box containing the signal control lights to show the condition of the bin level. The signal lights may be supplemented by valve control devices, sound signals, or remote control devices. The electronic amplifier measures differences in electrical capacitance between a bin that is empty and one that is full.

TIRE VULCANIZER

Uses Electronics, Has Broad Possibilities

DEVELOPMENT of a tire-vulcanizing device employing electronic principles, which would enable major tire repairs to be made in 10 minutes in combat zones and which promises to become a factor in extending the service life of

Lt. Col. Vogt, right, and Eino Lakso, second from left, with tire vulcanizing equipment they developed

post-war tires to 10,000 miles, was announced at a recent meeting of the Society of Automotive Engineers.

The 500-pound mobile military unit, designed to effect repairs on any tire and to replace Army tire-repair equipment weighing tons and taking hours to operate, was described by Lt. Col. C. W. Vogt, Chief, Technical Staff for Supply, Transportation Corps, War Department, Washington, D. C. It was developed by Lt. Col. Vogt and Eino Lakso in the Forest Products Laboratory at Madison, Wisconsin, after reports from overseas had revealed that existing equipment was slow and unsatisfactory.

The device, consisting of a press ram equipped with an electrode coupled to a high-frequency generator, and a press frame, applies "internal heat" to make spot and sectional cures within minutes. The ram and frame, fitted with filler bags, which adjust themselves under pressure to tire contours, obviate the use of molds, effect repairs on any size tire, and eliminate current vulcanizing hazards such as destructive over-heating of adjacent sections.

Tests were said to indicate the possibility of utilizing the principles of the device after the war, both for recapping and for new tire production operations.

FOOD HEATING

For Purposes Other than Cooking Now Accomplished Electronically

HEATING of food products for purposes other than cooking or dehydration is receiving widespread attention today in the food industry. As one example, cakes of chocolate are being heated to the melting point to make handling easier. Another example is the heating or roasting of cocoa beans.

Sterilization of food products has developed into perhaps the most important food job for electronic heat at the present time. Whether it will continue to hold this position remains to be seen, but there is now a very imposing list of applications. The product can be treated after packaging. For example, a carton containing 24 boxes of pancake

Has The Glider A Future?

Brilliant Military Successes of Gliders in Transportation and Pilot Training Have Apparently Paved the Way to Commercial Glider Trains for Peace-Time Operation. But Closer Examination of All the Factors Involved Reveals a Number of Limitations that Must be Taken Into Consideration

IT IS A sign of the times that the Soaring Society of America has grown from a friendly group of enthusiasts to a serious organization of technicians, and that its recent Conference held at the Polytechnic Institute of Brooklyn should have brought forth a number of such scholarly, deeply technical papers, dealing with every aspect of glider art and science. The Conference comes at a time when the towed glider has proved itself invaluable in the invasion of France, when the earlier tactical uses of the glider by the Germans have been developed and surpassed by the Troop Carrier Command of our own forces, when the American armies announce the formation of an entirely new form of army—an army composed solely of airborne troops.

LARGE-SCALE GLIDER USE—Perhaps the most interesting paper presented at the Conference, at least from the public's point of view, was that of Major Eliot F. Noyes, AAF, on "The Tactical Uses of the Glider." The first large-scale military glider operation in history was the invasion of Crete by the Germans in May 1941. The most recent were the attacks on the Western Front since June 1944. A comparison of the operations is the best measure of the advances achieved in the military use of the glider. It is true that the German airborne troops succeeded where their seaborne troops perished under the blows of the British Navy, and their capture of the Maleme airdrome was the first serious blow. But the scale of operations was very small, the landings were made by day only and not more than 40 or 50 gliders were sent against any one objective. A total of 70 gliders were used, carrying about 10 men each.

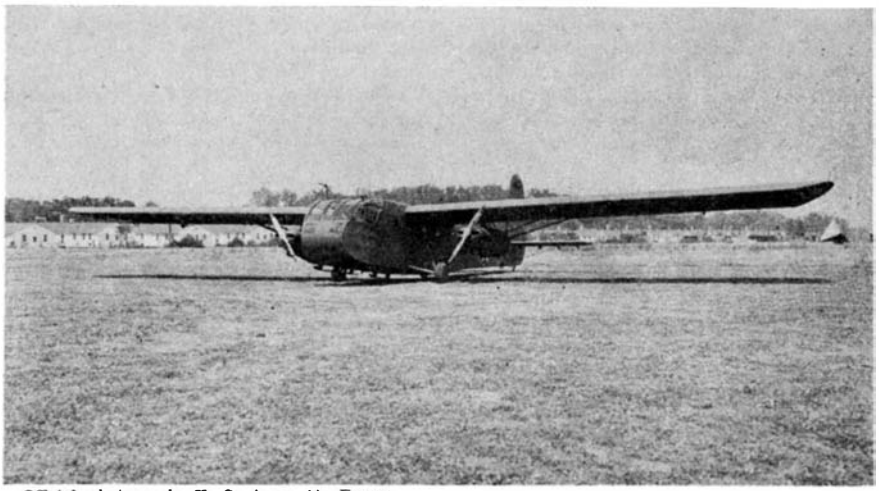
In Europe our Armies used CG-4A's carrying 15 men each, and British built Horsas carrying 25 men or heavy artillery and transport vehicles. Still bigger craft, the Hamilcars, carried airborne tanks. And, instead of 700 or so men, several whole airborne divisions were involved. These gliders landed far behind the German lines. What is more, they landed at night in rough and unprepared terrain where transports could not possibly have landed without danger of crack-up. Moreover, unlike the parachute troops, the glider-borne troops brought with them real equipment and artillery. Consequently, they were a coherent unit, capable of immediately putting up a fight. By pick-up methods the craft could be retrieved if desired.

In Burma, Colonel Cochran's Air Commandos did more; they established an airhead behind the enemy lines, and the airborne force comprised the entire assault. In other Burma operations the gliders first brought in engineers and troops who were able to lay down strips for landing and to rapidly construct the equivalent of airports. Then the air transports were able to follow. The Germans in North Africa landed barrels of oil for advanced tank units which could not have been refuelled in any other manner.

With the aid of pick-up devices the military utility of the glider can be greatly enhanced.

There is a subsidiary yet important application of the glider in the preliminary training of power-plane pilots. The approach to power-plane flying, by first learning how to fly in a glider, has been tested on a very large scale in Germany, Russia, and Poland. While soon after World War I the Germans turned to the glider because they were restricted in the use of power aircraft, it certainly was not on the grounds of restriction or expense that the Nazis turned to preliminary glider training in 1936—it was because German psychologists had demonstrated that the Wright brothers were perfectly right in seeking the approach to power flight by the way of glider experiments.

Dr. W. R. Miles, Professor of Psychology at Yale University, stated that Germans had a lower accident index in the training of their military pilots than we had in the United States, and made a strong plea for pre-flight glider training as a method of teaching fundamental fiying habits, and as a means of lowering the accident rate. Glider training, as pointed out by other speakers at the Conference, also teaches the novice the essential elements of meteorology and makes him sensitive to every gust of air, every change in the weather. It further serves to give him a confidence which power-plane flying may instill only after hundreds of hours in the air.



Official photograph, U. S. Army Air Forces

A possible forerunner of new light-plane design—a motorized glider

Still another expert, Loren V. Petry, of Transcontinental Western Airlines, argued for the value of the glider as a background to airline fiying. The glider trains in precision flying and precision landing. The soaring pilot seeks thermal currents as a means of maintaining height, and in general, soaring practice makes the airline pilot a practical meteorologist.

GLIDERS AND JET REACTION—The Bazooka, the rocket bomb, the Bell jet-propelled plane, and finally the robot bomb, which has caused such infernal

damage in the south of England, have aroused the world to the potentialities of the jet as a means of propulsion. Strange as it may seem, the jet has great possibilities for that type of aircraft which normally is without power. At the Conference, Mr. Zbigniew Krzywoblock spoke of "The Problem of Applying Reaction-Propulsion to Gliders."

Jet propulsion can be divided into two types: rocket propulsion in which the fuel carries its own supply of oxygen or air—as, for example, in the form of black powder—and true jet propulsion in which the fuel needs an external supply of oxygen or air. While powder rockets have dangers and drawbacks, they do not need an actual motor compressors, and so on as are required by the jet engine. Hence the simple rocket is well adapted to the glider.

Both the Germans and the Italians have experimented with powder rocket gliders, with a fair measure of success. But why should means be sought to adapt any type of rocket to the glider, since this is a vehicle of flight without power? The answer is that there are very definite advantages to be gained by the use of the rocket. Equipped with a rocket the soarer can take off from a level hilltop where no gain in altitude is required, or it may take off from flat ground, the rocket making possible the necessary gain in altitude. Or rocket power may serve to prolong a soaring flight when all upward currents fail and a few minutes of rocket propulsion spell the difference between immediate descent and continued soaring. Moreover, the application of the rocket by the glider enthusiasts will give them a splendid opportunity for research in such problems as jet efficiency, the shape of the nozzle, the best explosives or fuels to use, and the like. Just as glider training leads to better pilots, the use of the rocket as an adjunct to soaring may extend our knowledge of jet propulsion tremendously.

One of the old-time glider enthusiasts, Dr. Wolfgang B. Klemperer, added to the interest of the meeting by his paper on "Contributions of Gliding and Soaring to Aviation." Because gliders have to be of the highest aerodynamic efficiency, their designers adopted aspect ratios of wings far greater than those used in the airplane. Because soaring is dependent so much on aerodynamic efficiency, soaring gliders have been provided with perfectly streamlined fuselages, with wings passing uninterruptedly over the fuselage, with a complete lack of protruding control horns and landing gears, and with thin but immensely strong plywood wings. In fact, it can be said that the glider is the aerodynamic school for the airplane.

These various refinements will carry over into the design of the private airplane and influence it greatly. One of the illustrations indicates what is likely to happen. Here is shown the XPG-1, which is the CG-4 glider motorized with two outboard engines.

The AAF tried out the motorized glider because that meant that a towed glider, once unloaded of the main bulk of its useful load, could fly back lightly loaded under its own power. Thus the military glider, instead of being expendable, became retrievable. But it is not at all unlikely that the motorized glider will lead to the design of a lightly loaded, lightly powered private airplane—particularly of the twin engine variety—which will be most important in the post-war era.

A great many papers have been written in support of the idea that glider trains—two, three, or even more towed by a single powered airplane or tug—would eventually out-do even the success of the towed glider in military use by the development of such trains for commercial operation.

Exponents of the glider have many arguments to offer. The Waco CG-4, a troop and cargo carrying glider, is a wonderful machine. With a wing spread of 83 feet, and an overall length of 48 feet, it weighs more than 7000 pounds fully loaded, can fly just as well at 20,000 as at 200 feet, and is completely outfitted with blind flying instruments, oxygen equipment, and so on. Towed at 150 miles an hour or so, two of these gliders can be pulled by a single twin-engined cargo airplane, and thus multiply the total cargo capacity enormously. Towed to a height of 25,000 feet, they can glide 25 miles from the point of release. The airplane provides the locomotive; the gliders are the freight cars.

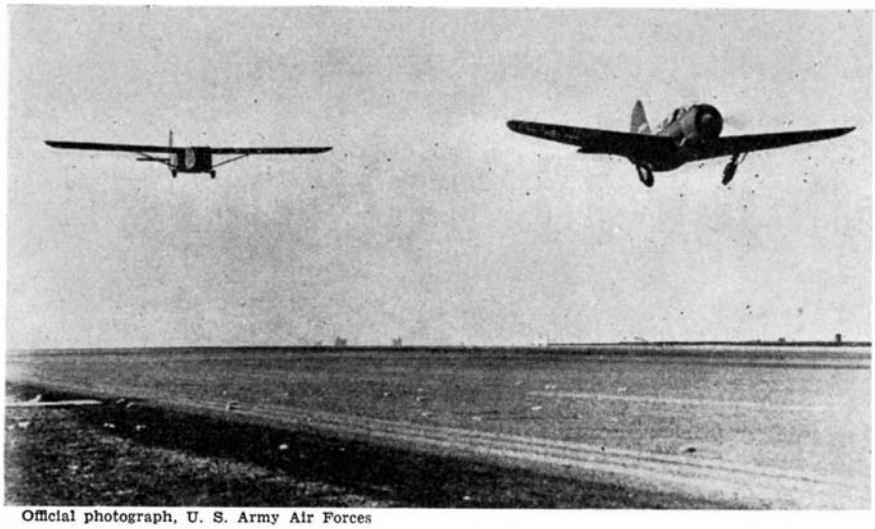
PRACTICAL GLIDER PICK-UP—Gliders can be picked up from small fields, as the late Richard C. Du Pont has demonstrated on a practical scale. Gliders can be released at small fields. Thus the operator of the glider train can operate with all the flexibility of the railroad man. Because the cargo carrying capacity of the tow plane is so greatly increased, the costs per ton mile should go down. In fact—so say the exponents of the cargo plane—the glider will provide service for the smallest town or even village in the United States and bring air cargo costs down unbelievably. Look at what the towed gliders have done in carrying military cargoes all over the world!

ON THE WRONG TRACK—While this writer accepts a good many of these arguments and approves of the sincere enthusiasm of the glider exponents, yet he believes that they are completely on the wrong track and that only in a few isolated instances will commercial glider trains be at all practicable.

It is true that the towed glider will increase payload capacity, but it will also decrease the cruising speed to a marked degree. And, unfortunately, decrease in speed means a large increase

Official photograph, U. S. Army Air Forces

Glider troops splay out about the nose of their silent winged carrier



Official photograph, U. S. Army Air Forces

Exponents of future air trains base hopes on military glider-towing operations

in carrying costs per ton mile. When the speed goes down the pilot has to receive more pay for a given distance, the insurance costs per mile go up, the block-to-block speed goes down so much that the speed differential of the airplane is cut in half. All costs or almost all airplane costs vary inversely as the speed, a point which glider people seem to overlook. Then again, blind flying is quite difficult in the glider and it must be equipped with an expensive automatic pilot.

Each glider must carry its own pilot or pilots so that crew expenses for a train go up very greatly. There is no inherent cargo-carrying virtue in the glider. If we choose to build a transport with huge cargo-carrying capacity, large aspect ratio wings, and so on, we could secure in the transport all the virtues of the glider without its drawbacks. The most serious studies made by the airlines and others indicate that the sky train is not likely to be realized. Besides, there are other difficulties. Will passengers ever consent to being cut loose in a glide to earth or being picked up and launched by a species of catapults. Can it be believed that the small towns of the United States will indefinitely remain without the airport or landing field facilities which will render the glider train and pickup of far less possible value?

It is this writer's belief that the value of the glider in military and naval aviation is thoroughly well established. That as a training method for pilots, nothing can be better than prior experience in gliding and soaring. That gliders will foster refined aviation instruments and much valuable meteorological knowledge. That gliders form a splendid sport which could be followed profitably in many colleges and even high schools. That the ultra-refined design of the glider will have a beneficial influence on the development of the low-powered private airplane.

The glider in its technical, educational, and military aspects deserves every support and encouragement by the Congress and by the people of the United States. But, regretfully, the conclusion must be recorded that the sky train is better adapted to the production of thrilling magazine articles than to the solution of our air transport and cargo problems.

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AVIATION'S FUTURE

Previewed by a British Aviation Expert

RARELY are reports made which are as comprehensive and farsighted as that contained in a paper on the "Future of Civil Aviation," read by Sir A. H. Roy Fedden before the Royal Society of Arts in London. Sir Roy is one of the best informed and most distinguished aviation men in England.

When the terms for Germany and Japan are being discussed, the following sentence strikes home: "It is believed that our first requirement is a steadfast determination that whatever rules are drawn up for the future are rigidly maintained, and if necessary we must be prepared to fight again to enforce them. It is suggested firstly that for at least 25 years, neither Germany nor Japan be allowed to design or to make any aircraft whatsoever either in their own countries or abroad."

In Sir Roy's discussion of International Freedom of Passage is another striking sentence: "Public opinion in this country and in the United States, it appears, is in favour of this being put on a proper basis, so that the civil transport aircraft of any country will have the right to cross any other (except perhaps over certain small restricted areas) and to land for refueling, or emergency purposes, but not for loading or discharging traffic except as may be authorized under reciprocal agreements." The more freedom there is for traffic at sea and in the air, the fewer passport regulations and custom barriers, the fewer jobs for officials, and the greater the chance for international knowledge and amity.

Those parts of the paper which deal with British civil air control concern us less, but there are many technical views and analyses of value. Frequent mention has been made of the thought that there is a limit beyond which the airplane is too large and loses efficiency. But the curve of efficiency against size is very flat, and the author thinks that we can go on building bigger and bigger airplanes without fear for a space of at least 15 years. However, it is probable that a land airplane over 250,000 pounds in weight should not be attempted just yet.

For transatlantic work, Sir Roy favors large flying boats of at least 300,000 pounds weight. Special docks would be built for handling such flying boats with minimum time for loading passengers or cargo. To keep pace with long-range operations, fuel consumption of our engines must go down to only .38 pounds per horsepower-hour. Reciprocating engines for aircraft may well go up to 5000 horsepower. Regarding the gas turbine: "There is no doubt that the advent of the gas turbine will give an altogether fresh impetus to high-speed, high-altitude flying in large civil aircraft, and it will be most interesting to watch this whole development come to fruition within the next ten to fifteen years." Another argument advanced in favor of the gas turbine is that, owing to its more flexible design, it can be tailor-made to fit the needs of a particular airplane.

All in all, the paper is most encouraging. In the opinion of one of our greatest experts, post-war civil aviation holds magnificent prospects for the public and fascinating research and development problems for the engineer, designer, and inventor.

AIRPLANE CATEGORIES

Would Facilitate Growth of Private Flying

BESIDES facilitating insurance and time purchases of private aircraft, there are many other attempts to facilitate the growth of private flying, such as the building of many airports and landing fields. Now Fred M. Lanter, Director of Safety Regulations of the C.A.A., outlines a system of placing airplanes in categories. Why should all airplanes be strong enough to withstand acrobatic maneuvers? Why should a stable, well-designed transport be designed to withstand the violent maneuvers which have to be met only by machines of the training plane type?

The suggestion is that it should no longer be necessary to build all types of aircraft to the same strength requirements. There would be introduced the following categories: acrobatic, training, general purpose, transport, and special purpose. Top strength would go to the acrobatic class, while training planes would come next. Only the transport airplanes would be required to have certain features essential for scheduled operations. With such classification—which is *not* relaxation of the safety rules—private planes would be able to carry added fuel or baggage or passengers as the case might be.

Glowing Color In The Dark

The War Effort Has Stimulated the Development of an Extensive Line of Luminescent Pigments. These are Now Used in Paints and Coatings, Paper, Plastics, Printing Inks, and Pastes, Foreshadowing a Number of Interesting Peacetime Possibilities for Luminescent Products

By M. A. HEIKKILA
New Jersey Zinc Company

THE PHENOMENON of photo-luminescence has been known for years, but until a comparatively recent time it was principally of scientific interest, and found only limited commercial application, one of the most important of which is the so-called fluorescent lamp, introduced just before the war. Under the impact of the present war effort, however, scientific study and development in the field of photo-luminescence was accelerated, resulting in a large number and variety of practical applications.

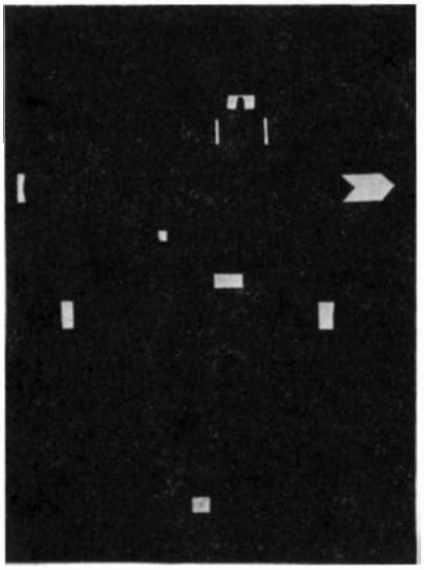
Photo-luminescence is the term generally applied to the absorption of some form of radiant energy, usually ultra-violet light, the transmutation of such energy to another wavelength, and the re-emission of such energy as light, usually visible light. This is often referred to simply as "luminescence."

The theory of the phenomenon of luminescence is that it results from the absorption of energy within the molecular structure of the material exposed to the excitation of a suitable source of radiant energy, each quantum of energy raising an electron to an upper level, from which it returns, either immediately or after a period of time, to its equilibrium state, simultaneously releasing the energy in the form of visible light.

There are two types of luminescence: (1) *fluorescence*, or the luminescence which continues only during the time of exposure to an exciting light source, and (2) *phosphorescence*, or the luminescence which continues for some period, from a few seconds to several hours, after the exciting light is extinguished. Fluorescent materials, therefore, have no afterglow, and are distinguished from phosphorescent materials which, in addition to fluorescing, have a useful afterglow. Radioactive materials, which are self-activated, are not included in this discussion.

EXCITING LIGHT SOURCES—It is obvious that the correct use of luminescent materials requires the employment of a suitable light source. In general, fluorescent materials require a light source which emits very little or no visible energy if their fluorescent light is to show to best advantage. An ultra-violet or so-called "black" light source, which contains a large amount of energy in the spectral range from 3200 to 4000 Angstrom units, is suitable. Ultra-violet light sources include argon glow lamps, regular fluorescent lamps, special "360BL" fluorescent lamps, high pressure mercury vapor (arc) lamps, and ordinary tungsten filament lamps (operated at high filament temperatures). Suitable ultra-violet filters should be used to eliminate nearly all traces of visible energy.

When phosphorescent materials are used only for their afterglow properties, light sources containing appreciable amounts of visible energy may be used for excitation to phosphorescence. Sunlight is therefore a most efficient and satisfactory exciting light with the afterglow effective in the dark. This is true also of the illuminating systems—fluorescent and incandescent— in regular use today.



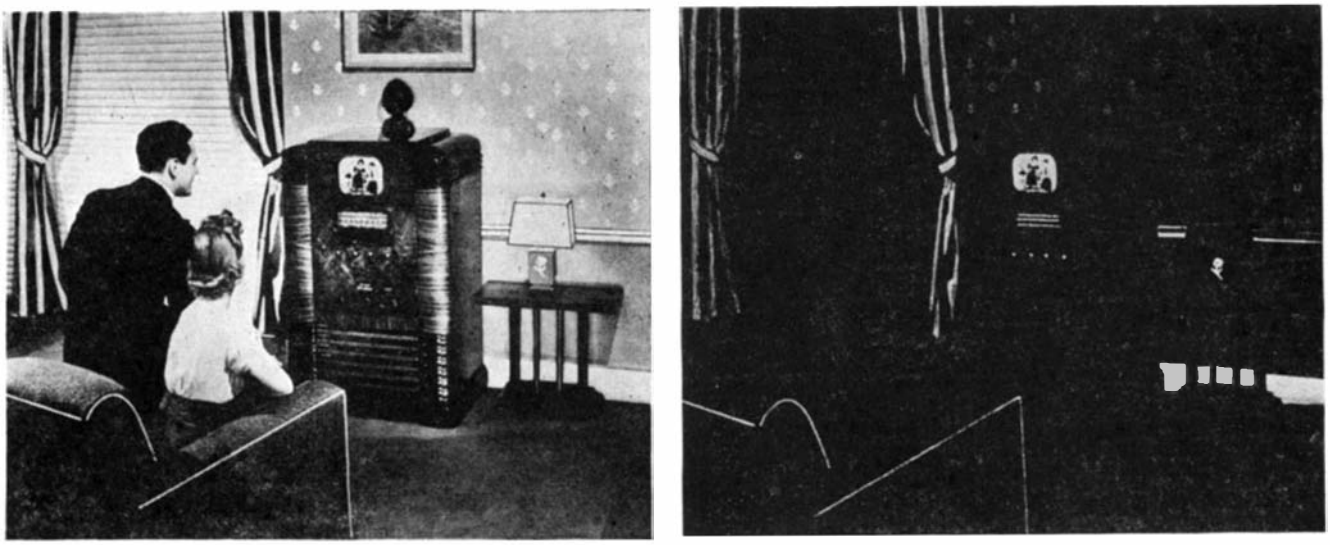
Phosphorescent marking tape identifies a fire-fighting station

FLUORESCENT PIGMENTS — Fluorescent materials generally are divided into two groups, based on their chemical composition: (1) organic, which includes synthetic dyes, dye intermediates, and metallic salts of dye intermediates; and (2) inorganics, which are generally the sulfides of zinc, or combinations of zinc and cadmium sulfides.

The dyes include such coloring materials as rhodamine, eosine, and flavine, and are obtainable in colors covering the range of the entire visible spectrum. They have the desirable property of a color similarity in the fluorescent and daylight colors, but these colors are not fast to sunlight or daylight.

Somewhat more stable fluorescent materials may be prepared by precipitating the dyes on a suitable inorganic base, such as aluminum hydrate, to form lakes. Very little research on these types of fluorescent materials has been done, and their full characteristics are as yet unknown.

Considerably more stability on exposure to sunlight is obtained with metallic salts of dye intermediates, of which the zinc salt of a 8-hydroxy-



Luminescent draperies, wall coverings, furniture trim, molding, and baseboard as guides in a darkened television room

quinolin is an outstanding example. Available in powder form, this material is white in daylight color, and exhibits brilliant green fluorescence.

The most useful and stable fluorescent materials are the manufactured inorganic pigments which are produced under conditions insuring the greatest possible purity. Very small and controlled amounts of activating heavy metals, such as copper, manganese, or silver, are included in the pigment. (These activating metals act as energy centers in the molecule.) The pigments are prepared by calcination at relatively high temperatures, and as a result their particle size is somewhat coarse as compared with ordinary pigments. (The average particle size of these fluorescent pigments is about one micron, approximately 1/25,000 inch.) The daylight color of these pigments varies from white to yellow, while the fluorescent color ranges from blue to red. In general, the orange and red are highest in cadmium sulfide content, and lowest in fluorescent brightness.

PHOSPHORESCENT PIGMENTS — Phosphorescent pigments are essentially inorganic pigments. They may be divided into two groups: (1) those having a short afterglow (up to two hours) and (2) those having a long afterglow (6 to 10 or 12 hours and more).

The short afterglow phosphorescent pigments are zinc sulfides and combinations of zinc and cadmium sulfides. They are prepared in much the same way as the fluorescent inorganic pigments, except that they are calcined at higher temperatures, with a resultant coarse particle size. These pigments are quite stable and are obtainable in light green, yellow, and yellow-white daylight colors with brilliant green and orange-yellow phosphorescence.

The long afterglow phosphorescent pigments are calcium and strontium sulfides, prepared by calcination at high temperatures. They are very coarse in particle size, and in addition are sensitive to moisture, requiring care in processing if exposure to moisture in use may be expected. These pigments come in daylight colors of gray-white and light green, and exhibit violet, blue, and greenish-blue phosphorescence.

APPLICATIONS—The development and application of luminescent pigments for war purposes were motivated principally to provide: (1) low intensity illumination for night operations, (2) signal devices, and (3) emergency light sources in the event of power failure or black-out.

In night operations, the luminescent pigments serve two purposes. They permit a "working" amount of visibility without the use of normal light sources, and they protect the dark adaptation of the eyes of operators of equipment. For these purposes, luminescent pigments are employed in paper, printing inks, paints, and plastics for the manufacture of military maps and charts, instrument dials, navigational computers and calculators, instruction plates, correction sheets, and so on, for use by airplane pilots, navigators, and bombardiers, P-T boat pilots, field officers, and by other personnel of the armed forces.

Fluorescent zinc sulfides and zinc and cadmium sulfides are the pigments that have found most use in these applications. They can be ground on roller mills to make reasonably satisfactory paints and printing inks, can be dispersed in paper or plastic coatings by mixing or colloid milling, and can be dispersed in paper finishes in the beater and in plastic granules in the batch mixer.

Phosphorescent pigments—both the short and the long afterglow pigments—are the ones principally used as emergency light sources, although they are also employed as instruction plates, signs, and in similar applications. Phosphorescent coated adhesive tapes are used extensively aboard ships and in the field to provide sufficient light to permit movement and easy identification of equipment and supplies in the dark without the use of normal lighting. Long afterglow phosphorescent pigments are used. These pigmented tapes are kept excited by exposure to daylight or to the normal lighting system in use, and will continue to glow and be visible to dark-adapted eyes throughout the dark hours of the night. Signs and instruction plates, of course, are used under similar conditions.

POST-WAR USES — The restrictions caused by the war have prevented any great amount of pre-peace experimentation and development of post-war applications of luminescent pigments, making it difficult to arrive at any definite conclusions of coming civilian uses for these glowing pigments. There are, however, a number of indicated applications for luminescent pigments that appear logical, including:

PHOSPHORESCENT
(Excited by daylight exposure)
- Apparel accessories
- Architectural trim
- Automotive accessories
- Cord pulls (lights and window shades)
- Decorative floor, furniture, and wall coverings
- Displays and fixtures
- Door knobs and kick plates
- Electric switch plates, fixtures, and equipment
- Escutcheons and medallions
- Fish lures
- Games
- Jewelry
- "Juke" boxes
- Light diffusers
- Marking tapes
- Product packages and labels
- Slipper tips
- Tools

FLUORESCENT
(Excited by "black" light exposure)
- Automotive and aviation dials and accessories
- Charts and maps
- Decorative coverings
- Displays and advertising
- Drapery
- Light diffusers and color transmuters
- Murals and decorative designs
- Paper specialties
- Theatrical effects

Undoubtedly, as usually happens, the public will find uses which the manufacturers have not envisioned—some of them perhaps more important than those which have been discussed here.

Rays That Sterilize

Wherever Industrial Operations Require a Bactericidal Effect for Sterilizing Air, Packaged Goods, Utensils, Containers, and so on, There Will be Found A Field for Application of Ultra-Violet Radiation. The Use and Measurement of these Rays is Becoming Rapidly an Exact Science

By DR. HARVEY C. RENTSCHLER
Director of Research, Westinghouse Lamp Division, Bloomfield, New Jersey

OF ALL the marvels of divine handiwork, the sun shines forth as the brightest; laboratory workers who daily are trying to simulate its remarkable qualities are the best witnesses of that fact.

Sunlight sustains life, makes possible the normal development of plants and animals and at the same time has an amazing purifying effect, killing bacteria and other micro-organisms. It is the bactericidal effect of sunlight that has been duplicated in the ultra-violet tube called the Sterilamp. The radiations of this lamp speedily kill surface and air-borne bacteria, viruses, and mold spores. Hundreds of thousands of these lamps now are on guard in a wide variety of fields where destruction of these things are vital or desirable.

The Sterilamp's bacteria-killing radiations are invisible and it may be helpful to outline here the various bands of visible and invisible light.

Visible light, ranging from about 8000 to 4000 Angstrom units—an Angstrom unit is equal to 1/10,000,000 millimeter, or about a 1/250,000 inch—is separated into bands of different wavelengths which produce the characteristic spectrum or colors of the rainbow.

The ultra-violet spectrum, which ranges from 4000 to below 1850 Angstrom units, is similarly subdivided into bands which have varied effects, both physiological and chemical. There are four recognized bands of ultra-violet wavelengths, characterized by the effects which they produce. The four bands are:

1. The near to visible ultra-violet band, 4000 to 3300 Angstrom units, produces fluorescent and other photochemical effects, and is useful in photography. This band is transmitted by most ordinary glass.

2. The erythemal range, 3350 to 2800 Angstrom units, produces sunburn and tan and develops vitamin D. Sun lamps deliver most of their ultra-violet radiation in this range, as it is the range used largely for therapeutic treatments. The shortest wavelength reaching the earth from the sun is approximately 2950 Angstrom units and only a very small part of these wavelengths is transmitted through ordinary glass.

3. The bactericidal band, 3000 to 2000 Angstrom units, is most effective in killing micro-organisms such as bacteria, molds, yeasts, and so on, whether in the vegetative or spore stage. Special glass or quartz is required to transmit these wavelengths and the maximum bactericidal effect is obtained at about midway in this range. Practically, this maximum is at about 2650 Angstroms and close to the 2537 Angstrom resonance radiation for electrical discharge through mercury vapor at low pressures.

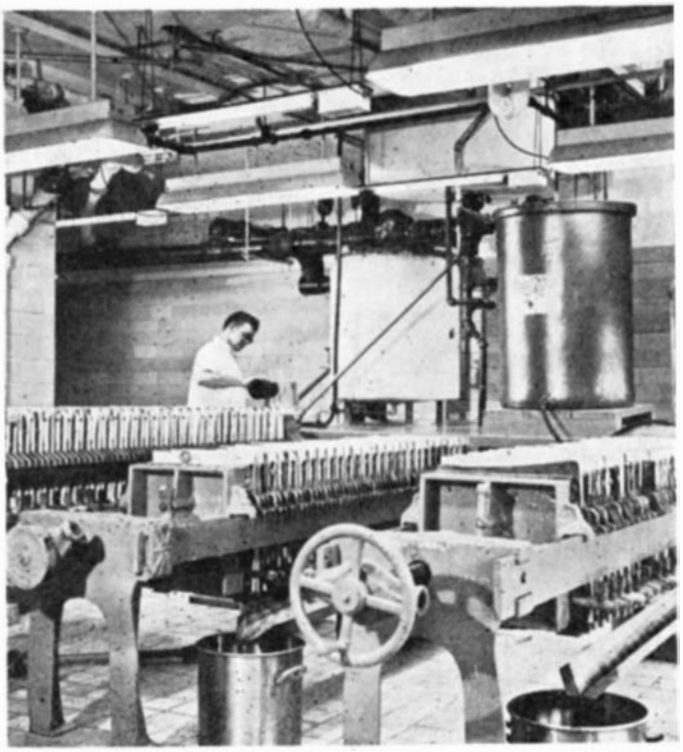
4. The ozone-producing range, below 2000 Angstroms, has the ability to convert a portion of the oxygen of the air into ozone (O_3) which is an active oxidizing agent.

In order to determine the killing efficiency of ultra-violet in the bactericidal band, a suitable measuring device had to be developed. Segregating characteristic parts of the ultra-violet region always had been difficult.

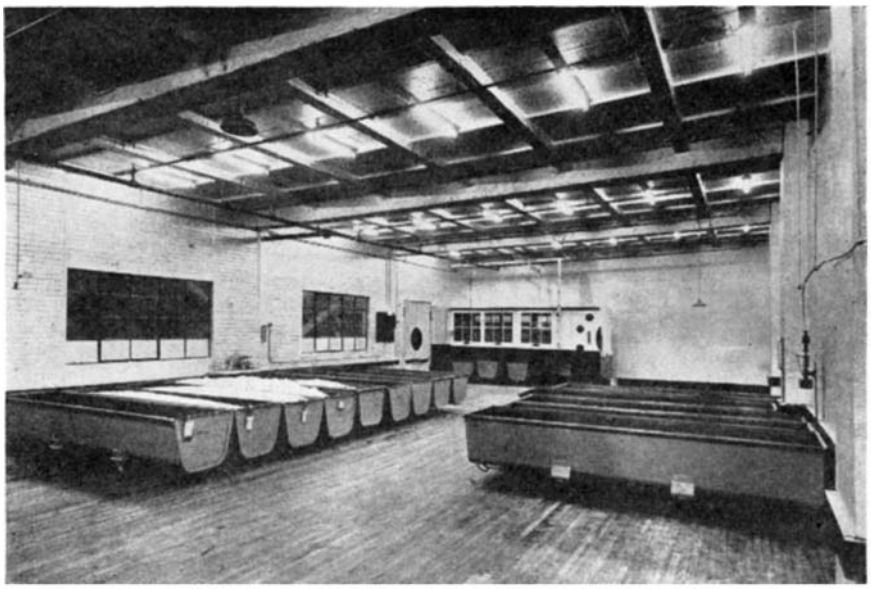
It was observed that various metals reacted differently to the photoelectric effects of ultra-violet waves. After many experiments, certain metals were selected which responded to useful groups of the invisible ultra-violet waves.

SPECIALIZED PHOTOCELLS—A phototube with the cathode surface of thorium was found to have a photoelectric response ranging from 3675 Angstrom to 2000 Angstroms, covering the general ultra-violet spectrum. Zirconium responds photoelectrically to wavelengths shorter than 3150. Such a cell, in proper transmitting glass, has a response very similar to the erythemal sensitivity and is useful in measuring erythemal and vitamin D radiation of sources having a high percentage of visible and near ultra-violet without having to mask the shorter wavelengths by filters.

As a photocell cathode, tantalum is sensitive to radiations below 3000 Angstroms, with a maximum at about 2600 Angstroms when cell is made with proper glass, thus confining its measurement activity to wavelengths having bactericidal action. Platinum responds only to radiations below 2000 Angstroms and thus becomes a useful cathode in a phototube for determining the amount of ozone supplied by any ultra-violet generator.



Ultra-violet bactericidal lamps in ceiling fixtures purify the air in this room where blood plasma goes through filter presses



Air-borne contamination is reduced in a bakery dough room by ultra-violet radiation

Used in connection with a special "click" meter, these phototubes make possible the quantitative measurement of various bands of ultra-violet. Radiations falling upon the sensitive cathode of the phototube permit electric current to flow through the tube and charge a small condenser. When this charge reaches a predetermined value, it is discharged through a relay tube which, in turn, operates a counter. The condenser automatically begins to store another charge and the rate at which this charge is accumulated is determined by the intensity of ultra-violet radiation striking the phototube's cathode. Each unit registered by the counting mechanism, indicated by an audible click, represents 220 microwatts per square centimeter on the standard meter.

Although nearly all the bactericidal wavelengths in sunlight are filtered out by the upper layers of air, the germ-killing effect of sunshine has been recognized for ages. This explains the potency of electrically generated ultra-violet radiation adjacent to the point where the purifying effect is desired. Bactericidal radiation can pass through many feet of air yet effectively kill floating disease germs and other organisms.

As a result of experiments with the click meter, the intensity of radiations multiplied by the time of exposure in seconds required to kill many types of organisms was determined. These tabulated values provide the basis for reliable estimation of the number and location of Sterilamps required for various applications.

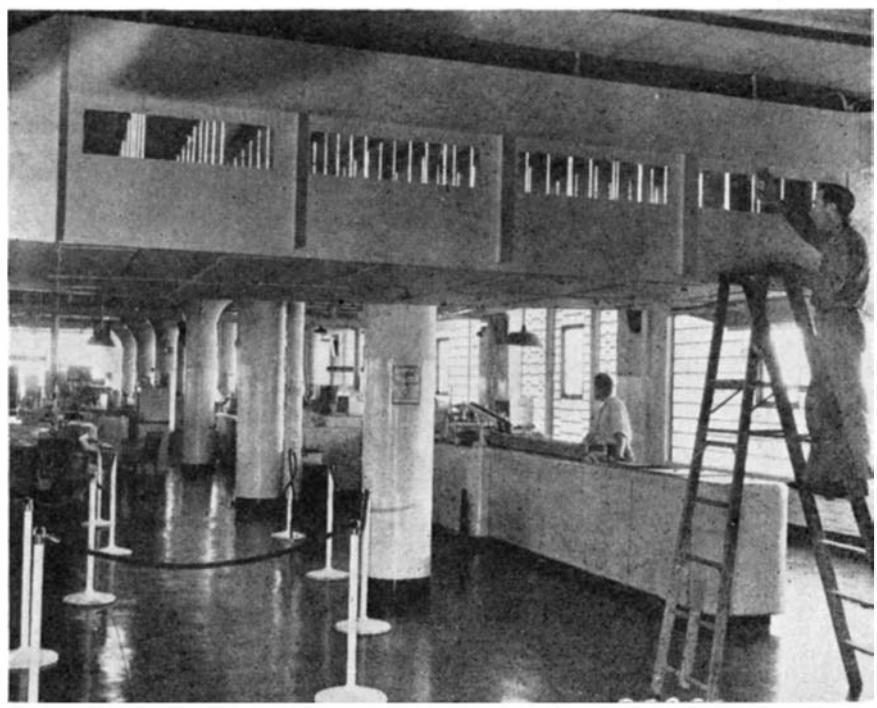
The ability to generate and control ultra-violet radiation inexpensively has greatly increased the number of applications in general sanitation. Heretofore, there has been no practical way of purifying the air which circulates in a building, school, office, or home. Now it is possible to install ultra-violet lamps which materially reduce the bacteria count in the air.

LOCATION OF LAMPS—The lamps are located above eye level. This has a double purpose—shielding the eyes from the rays which can cause conjunctivitis in eyes unprotected by goggles and placing the lamps in the upper area of rooms, where convection currents carry the organisms. Tests have shown that the number of living organisms in an irradiated room is readily reduced by about 75 percent and that there is a greater reduction in the number of cross infections in a room where the upper area has been irradiated compared to similar rooms which have not been irradiated.

The ultra-violet rays which are effective in killing air-borne and surface bacteria and mold also are capable of penetrating water to a limited degree. The transparency of water differs in different localities because of the varying amounts of chemicals and suspended matter contained. For this reason, it is recommended that water be filtered to remove solids before being irradiated. One treatment consists of placing Sterilamps over a flat trough carrying water at a depth of not more than six inches and allowing a flow of not more than ten gallons per minute per lamp. For general use a reduction of 99 percent or more of bacteria count is satisfactory unless the original contamination is high. In the water tanks of railroad coaches and dining cars, ultra-violet radiation can help to purify the water supply.

Any product which must be manufactured or packed under sanitary conditions requires protection from air-borne organisms. Such protection is being supplied by ultra-violet radiation. For example, baked goods come from the oven essentially sterile on the surface and may be kept in this condition by being cooled in a room in which the air is irradiated before coming in contact with the product. The wrapping operation also should be kept under ultra-violet radiation to insure that the package leaves the bakery free of partly developed colonies of mold.

The commercial value of protection by ultra-violet radiation has been demonstrated further by the success of the "Tenderay" process which speeds the tenderization of beef. Tenderizing beef is a slow, natural process whereby the connective tissues or collagens break down into gelatin. It has been known that this process could be accelerated by increasing the temperature and humidity of the storage room but such acceleration was impractical because of the greatly increased rate at which slime and mold developed on the surface of the beef. The difficulty was that losses due to necessary trimming of the spoiled surface made the speedier aging too expensive. Sterilamps installed in meat storage rooms guard against mold and slime, prevent spoilage, and eliminate discoloration of the beef during the two or three day period required to tenderize at increased temperatures.



Germicidal lamps installed in an air conditioning duct

All photos courtesy Westinghouse

Under the protection of ultra-violet radiation, lines of Pepsi-Cola bottles are maintained in a sterile condition until they are filled and capped

Any effective and inexpensive method of purifying air has applications reaching into nearly every conceivable commercial field. Results accumulated in recent months prove the economic advantages of irradiating the air in incubators for chicks and poults. The reduction of air-borne organisms gives the chicks a better start. Continued irradiation after their early hours of life produces better weight development, better pigmentation and feathers, and reduces cannibalism. This provides evidence that a small percentage of radiations near an invisible ultra-violet region stimulates vitamin D absorption with assimilation of calcium resulting. Laying hens are stimulated to greater egg production in irradiated hen houses.

The health of other farm animals also is benefitted when they are protected by ultra-violet radiation. Pharmaceutical manufacturers who maintain animal laboratories for production of serums and vaccines have installed bactericidal radiation in their animal rooms as an additional sanitizing agent.

Past experience with ultra-violet radiation largely has been directed toward determining where limitations exist in its application. Throughout most of this century Boards of Health have studied ways and means of purifying urban supplies of water and milk. Public attention has been called to the need and desirability of supplying clean drinking glasses at soda fountains and bars as well as supplying sterile tableware and dishes in restaurants. The recontamination of such utensils by air-borne organisms while they are stored after rinsing has had scant consideration and no means has been available for such protection. Now the sterile storage of restaurant and bar equipment may be accomplished easily and cheaply by providing ultra-violet radiation in the storage cabinets.

Air circulating from heating and cooling systems is a constant source of distribution of both harmless and pathogenic organisms which are given off by human beings. Filtering does not remove all of these living organisms and the best means of supplying pure air to the various rooms and apartments is by passing the circulated air through a radiation chamber containing high-intensity bactericidal rays.

GERM-FREE AIR—By this method, the air entering any area may be made practically germ-free and the air supply certainly becomes a source of pure air rivaling the results which would be obtained if there were no recirculated air in the system and the entire supply were from some remote mountain top.

Recirculation of air without bactericidal treatment doubtless will soon be considered as unsafe as the use of unwashed glasses at a soda fountain. Offices without air conditioning or air circulating systems will be equipped with upper zone radiation which kills organisms floating upward on convection currents into the radiated area. Such protection, resulting in a reduction of the bacteria population, has been found to reduce materially the number of absentees and the total number of days' lost time in industrial plants. Schools are equipped with ultra-violet radiation to reduce epidemics of measles, mumps, chicken pox, and so on.

Radiation in private rooms, wards, and operating rooms of hospitals will become as widespread and essential as the cleaning of the walls and floors. The benefits of radiation in hospitals thus far reported justifies the prediction that means for more and more bactericidal radiation will be provided in the plans for future hospitals.

All in all, the sanitation of air by bactericidal radiation is destined to become one of the prime elements in the development of a stronger and better race.

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RESISTANCE WELDING

Is of Greatest Value When "Engineered"

A RECENT statement by Floyd E. Taylor, President of the Resistance Welder Manufacturers' Association, contains timely advice for manufacturers now thinking in terms of improvements and economies for their post-war products.

"As the tremendous advances in resistance welding techniques on all types of metal war equipment manufacture begin to be known, makers of a wide variety of products from instruments to heavy machinery are naturally beginning to figure where and how welding may be applied to their problems," states Mr. Taylor. "Actually, there are few types of metal products wherein resistance welding processes will not play increasingly important roles. When the full story of war developments can be told, even men who thought they knew 'all about welding' are going to be amazed.

"The big point to remember, however, is the fact that resistance welding is not something to be thought of at the last minute, when products are just about ready to be put into production. Actually, resistance welding scores its biggest economies and manufacturing improvements when the product itself is designed for welding. Welding can, of course, be adapted successfully to many present designs—and often has been. On the other hand, design engineers who think in terms of resistance welding while designing their products may be pleasantly surprised at the far greater degree of efficiency that may be achieved."

Among the types of products cited by Mr. Taylor wherein resistance welding processes are progressing rapidly are: radios and other electrical appliances; such small items as optical frames; watches; vacuum tubes; alloyed wire fabrications; cutlery; tools; hardware—as well as larger products such as truck axles; refrigerators; washing machines; and many others in addition to the more conventional applications.

GLASS FIBER INSULATION

Lightweight Incombustible Material For Sound-Proofing

GLASS fibers with a diameter measured in ten-thousandths of an inch, and weighing only four one-hundredths of a pound per square foot when bound with a thermosetting resin and formed into half-inch-thick sheets, are being used in the cabins and flight decks of certain types of United States war planes to provide insulation against the extreme cold of the stratosphere and to deaden fatigue-causing sound.

Particularly on long flights, it has been found that a high sound level within the plane is one of the major factors contributing to the fatigue of the crew. With planes operating at altitudes where temperatures of 60 degress below zero are commonly encountered, insulation is necessary to reduce the burden on heating equipment and permit lighter equipment to be used.

The fibrous glass sheets are incombustible and are the lightest inorganic material commercially available for sound-proofing and insulation. Another important factor is that the sheets gain less than 1 percent of their own weight from moisture in the air, when subjected to temperatures of 125 degrees, Fahrenheit, and 90 percent relative humidity. Organic material frequently used for heat and sound insulation in planes may gain as much as 40 percent of its own weight from moisture pick-up under service conditions.

The fibrous glass sheets, known as Fiberglas Type XM-PF, are manufactured by Owens-Corning Fiberglas Corporation.

SKID-PROOF COATING

Made of Sprayable Mixture of Synthetic Rubber and Cork

A non-skid airplane walkway coating that is less than one fifth the weight of rubber matting, adheres to metal, plywood, and painted surfaces, remains flexible at temperatures ranging from minus 20 to plus 160 degrees, Fahrenheit, and is resistant to fire, gasoline, aromatic fuels, salt water, oils, hydrau-

Skid-proofing a catwalk section

lic fluids, and oxidation has been developed by the Minnesota Mining and Manufacturing Company for use in Allied war planes. Made of Thiokol synthetic rubber and ground cork, this new non-skid surfacing material is applied at room temperature with an open nozzle paint spray gun, making for speedy application as well as rapid repairs in the field. It can also be applied with a knife or brush, and patches so placed blend well with the original coating.

In exhaustive laboratory tests as well as field trials during bombing raids over Europe and patrol work under extreme high temperatures in the South Pacific, this new Thiokol-cork composition has stood up extremely well. Abrasion resistance has been tested both by Calibrase wheel and by a special floor panel which showed virtually no sign of wear after passage of 100,000 people over it. The tendency of this Thiokol coating to gain weight through moisture absorption is also slight. In laboratory tests, the absorption was 2.9 percent after four hours constant immersion and rose to only 28.6 percent after nine days.

One of the most important properties of the new coating material is its high coefficient of both static and sliding friction even when covered with water or a film of engine oil.

Only one spray application is necessary to build up a Thiokol-cork coating of sufficient thickness. The material dries so rapidly that the panels are ready for actual use within 12 to 14 hours.

With its light weight and speed of application this material promises to be not only a valuable war material for airplane use, but also to have many useful post-war applications in the aviation, automotive, and home fields.

HEATING BACKWARD

Can Solve a Variety of Problems

THE boiler in the heating system of the Naval and Marine Reserve Armory in Los Angeles is hooked up backward! The return water is brought into the top of the boiler and the supply at the bottom. This unconventional method of heating came about as the best solution to a variety of problems.

In the first place, a hot-water system was chosen by the heating engineers since it seemed the most practical way to heat the training areas and the mess rooms in the basement where head room was too low for duct-work. Supply and return pipes, which could be concealed in the ceiling with a hot-water system, solved this problem easily.

Second, if an ordinary hot-water system with a conventional boiler hook-up had been installed, the combination of static pressure and that from the pumps would have been just enough load on the boiler to require the services of a janitor—since state laws say there must be a janitor for any system with a boiler using over 15 pounds pressure and having more than 10 horsepower.

In the "backward boiler" system which the heating engineers finally evolved, the water which enters the top passes through a header similar to a steam header. The circulating pump is located on the supply side, thereby creating a suction and thus lowering the pressure on the boiler.

Connected to this unusual central heating system are 22 Trane blast coils located in two fan rooms—one in the basement and one on the top floor mezzanine. They provide comfortable conditions for each type of activity carried on in the huge armory, which provides training accommodations for some 400 men.

QUICK ACTING BRAKE

Uses Magnetism for Release

CAPABLE of stopping a one-eighth horsepower motor traveling at 16,000 revolutions a minute in less than six turns, a new magnetic brake has been developed by Chester I. Hall, General Electric engineer.

"Another way of expressing the force with which this new brake works can be gained by comparison with an automobile," Mr. Hall explains. "The outside edge of this rotor, moving at 16,000 revolutions per minute, is traveling a 62 miles per hour. Stopping it within six turns would be the same as bringing a mile-a-minute auto to a dead stop in 2.73 feet.

"It is called a magnetic brake but magnetism plays no part in its stopping operation. A cork shoe and friction does the trick," according to Mr. Hall. "Magnetism releases it, once the need for braking is removed. The motor is braked at all times, except when current is applied."

Another feature of this brake, from a manufacturing viewpoint, is that there are 15 parts, compared to 51 parts in the model previously used for this purpose.

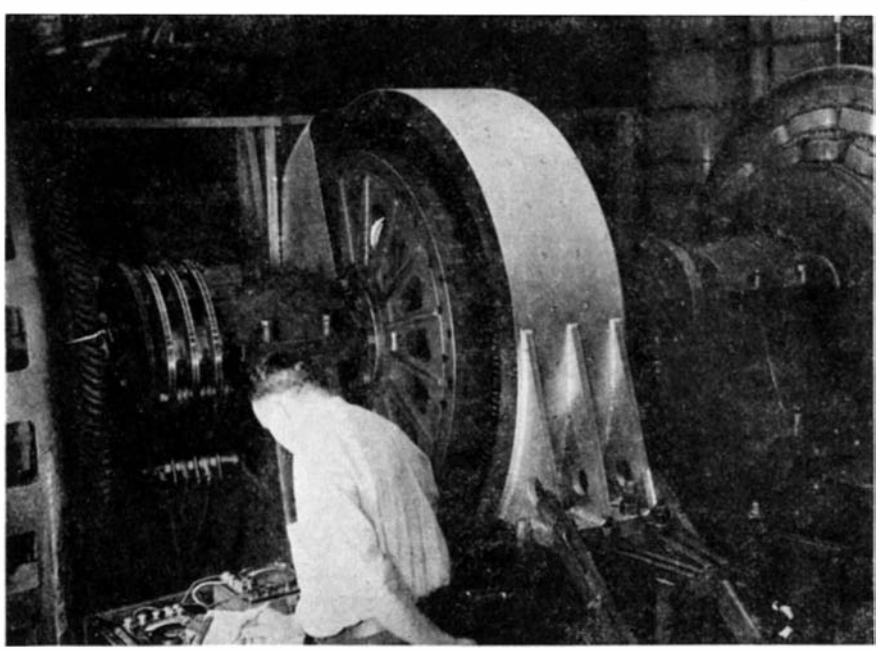
SPEED REDUCTION

Accomplished for Ship Drives By New Electrical Device

REDUCTION of speed between modern high-speed prime movers and drive shafts for mechanical applications where gears and coupling combined are ordinarily necessary, is accomplished by a new electrical device recently announced by the Ridgway Division of Elliott Company, manufacturers of power and process equipment. This is an electric drive which maintains a substantially constant speed ratio between driving and driven members of ship propulsion equipment. The new unit also provides some power for auxiliary service loads through slip ring take-off circuits and can be used as a source of electrical power for operation of cargo handling and similar functions when disengaged from its primary job of speed reduction and torque multiplication.

Three main elements, concentrically mounted, comprise the drive. These are (1) an engine element which is bolted to the prime mover shaft, (2) a shaft element which is coupled to the driven shaft, and (3) a stationary element.

The engine element, which is essentially a synchronous generator rotor with poles selected for the desired



Part of the shaft member of a Bowes ship drive is visible here. See text above

Spectrograms made by the light radiated from a bar of ultra-pure iron as it glows under the heat of an electric arc (above), are compared (right) with wavelength "portraits" of other metals for checking quality

speed ratio, is permanently attached to the shaft of the prime mover and revolves at the normal engine speed.

The shaft element consists of a rotating spider on which two armatures are concentrically mounted in relation to the engine element.

The inner armature, together with the engine element, form a generator. Its winding not only generates electrical energy but also transmits torque to the driven shaft of the unit.

The outer armature makes use of the field of the third or stationary element to operate as a motor, converting electrical energy into mechanical energy for turning the driven shaft.

If the shaft element is held stationary the inner parts of the Bowes Drive, as the device is known, behave like an ordinary synchronous generator and electrical energy can be taken continuously from the drive. This is particularly advantageous on a ship propulsion system where large amounts of power are frequently required while the vessel is in port. In normal operation, of course, the shaft element rotates at the speed desired for the driven shaft. The relative speed between the engine field element and the shaft element adjacent to it results in the generation of electrical power. The reaction torque which, in a normal generator, would be absorbed by the frame supports, is available to turn the shaft element.

The immediate application of the Bowes Drive is expected to be for ship propulsion where it will be used to reduce (by wholly electrical means) the speed of modern prime movers to the lower speeds required for the most efficient operation of propellers.

PUREST IRON

Serves as Yardstick For War Metals

IN THE Pittsburgh area, where steel output is measured in millions of tons annually, scientists are now engaged in "mass production" of ultra-pure iron—at the rate of only 1000 pounds a year.

Made in "radio wave" furnaces at the East Pittsburgh Works of the Westinghouse Electric and Manufacturing Company, the special iron enables United Nations war plants to keep close check on the metals going into guns, planes, tanks, and ships.

The iron contains only about one ounce of impurities in the 1000 pounds produced each year and provides a yardstick against which the composition of steel, aluminum, magnesium, and other metals vital to the war effort may be quickly and accurately measured.

A process developed by Dr. T. D. Yensen, manager of the Magnetic De-

partment of the Westinghouse Research Laboratories, made possible "mass production" of this chemically untainted iron. Formed into rods about the size of a lead pencil, the 99.999 percent pure iron is used in steel mills, war plants, and laboratories in all parts of the anti-Axis world. The rods are put in a metal-analyzing spectrograph, which heats the iron with an electric arc. This causes the iron to radiate light rays which print a wavelength picture, a series of vertical lines, on photographic film.

These wavelength pictures of the pure iron are then compared with similar pictures of the metal being tested, enabling investigators to determine the composition of the latter swiftly and accurately. Iron is used as a standard because its spectrographic picture contains a large number of lines, which make it easy to identify the test metal's components.

Until Dr. Yensen perfected his process in the laboratory, the best standard obtainable was iron 99.9 percent pure—one part in every thousand was some foreign material which added confusing lines to the wavelength picture. Now only one part in every ten thousand is not iron.

SOFTER ICE

Produced With Aid Of Carbon Dioxide

CARBON dioxide has solved one problem of ice manufacture, eliminating brittleness in ice blocks and making it possible to increase production as much as 35 percent, according to a report to the American Chemical Society.

Use of low temperatures to freeze water naturally increases the capacity of an ice plant, but ice frozen so quickly tends to shatter, says Dr. Philip W. West of the Coates Chemical Laboratories, Louisiana State University. But carbonation of the water, he reports, makes "softer" ice, and prevents cracking or shattering, even in cases where other softening and anti-crack compounds failed.

The process is economical, and in some cases carbonation has enabled as high as a 35 percent increase in production without addition to existing plant facilities.

Ice blocks may shatter from both mechanical and chemical causes. The mechanical faults usually can be readily eliminated. One main chemical cause is strains of impurities such as calcium carbonate caught in the quick-freezing ice. Softeners are used to counteract this, but use of carbon dioxide appears even more effective.

An even greater problem in ice manufacture is opaqueness, resulting from high concentrations of total dissolved solids in the water, particularly the bicarbonates of calcium, magnesium, and iron, Dr. West points out. Among recent advances in water treatment are demineralized filters which can be used to remove minerals from waters which could not be treated by older methods.

"Filters of this type now make available to the ice industry hundreds of waters which previously could not be used," Dr. West says.

The ice industry in this country consists of almost 4000 individual plants, annually producing over 34,000,000 tons of ice, 91 percent of it from fresh water.

PLANT CLEANING

Speeded by "Blowing Down" With Compressed Air

PREACHING cleanliness might be expected from a laundry. The way in which one such concern practices it in

An air hose used for plant cleaning

keeping its own plant clean suggests a method other industries might adopt in their plant cleaning programs.

A problem peculiar to laundries is clinging lint and ravelings which float away from cotton articles to the tops of overhead pipes, underneath machinery, close to electric motors from which a spark might find ready tinder, and in hard-to-get-at corners. In different

GONE IS THE OLD BLACK BUTTON AND CORD

Hard-of-Hearing Acclaim Zenith's New "Look of Youth"!

NEW NEUTRAL-COLOR EARPHONE AND CORD

Less Noticeable than Eyeglasses!

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ONCE more, the public response to another great Zenith hearing aid advancement has far exceeded even our most glowing forecasts!

By their nationwide acclaim, America's hard-of-hearing have told us this new Zenith Neutral-Color ensemble is what they have been hoping and waiting for.

And no wonder! Note how it makes the earphone and cord even less noticeable than eyeglasses . . . brings a new smartness and "look of youth" which now enables the most sensitive-minded person to wear a hearing aid with poise and confidence.

The new plastic earphone complements any complexion. It is extra-light in weight, comfortable, long-wearing. The slender, translucent plastic cord, too, looks well with any apparel. It is perspiration-proof . . . kink-proof . . . will not fray . . . and gives less clothing or friction noise than any fabric-covered cord.

Today—see for yourself how this new Zenith ensemble does for the hearing aid what modern smart styling did for eyeglasses! Find out about Zenith's *personal adjustment* principle . . . how the exclusive external Tone Control enables you to fit the Zenith yourself—to begin at once a lifetime of better hearing.

Visit your Zenith-franchised dispenser for a *Free* demonstration. No obligation. Or mail coupon below for Free, complete, detailed description and name of the Zenith dispenser near you.

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MODEL A-2-A

$40 COMPLETE

Why Its Fine Quality Costs You So Little

Like your watch, this hearing aid is a product of precision mass production. If only a few were produced, they would cost many times as much, be far less accurate. But Zenith precision mass production brings you at $40 an *even finer* hearing aid than its original $50,000 hand-made model . . . just as Zenith lowered the price of a $200 radio to $29 and made it an *even finer* instrument. Remember—Zenith leads the world in precision mass production of Radionic products exclusively.

BY THE MAKERS OF

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types of plants it could be dust or soot or some other accumulation than lint.

The Davis Laundry and Cleaning Company, one of Cleveland's oldest and largest family laundries, rids its plant of lint by "blowing down" its building with compressed air every week-end, when workers are off. The master mechanic claims air dislodges the dirt better and quicker than any other known method.

A maintenance man goes through the plant from stem to stern, including ceilings, walls, and floors, blowing the fluff before him. Overhead pipes and ceiling areas are easily reached simply by attaching the air hose to a pole with clamps. Drying tumblers, where the lint is especially heavy, are cleaned by blowing out the lint. Compressed air reaches all other critical spots in the laundry, too.

Conveniently located air outlets facilitate the "blowing down" operation. The compressed air is supplied by the same compressor that delivers the power that operates the laundry's automatic ironing machines and other equipment. A pressure of approximately 75 pounds is maintained. The once-a-week "blow down" not only helps to keep the plant clean and prevent dusty lint from coming down on clean clothes but, equally important, it reduces a fire hazard.

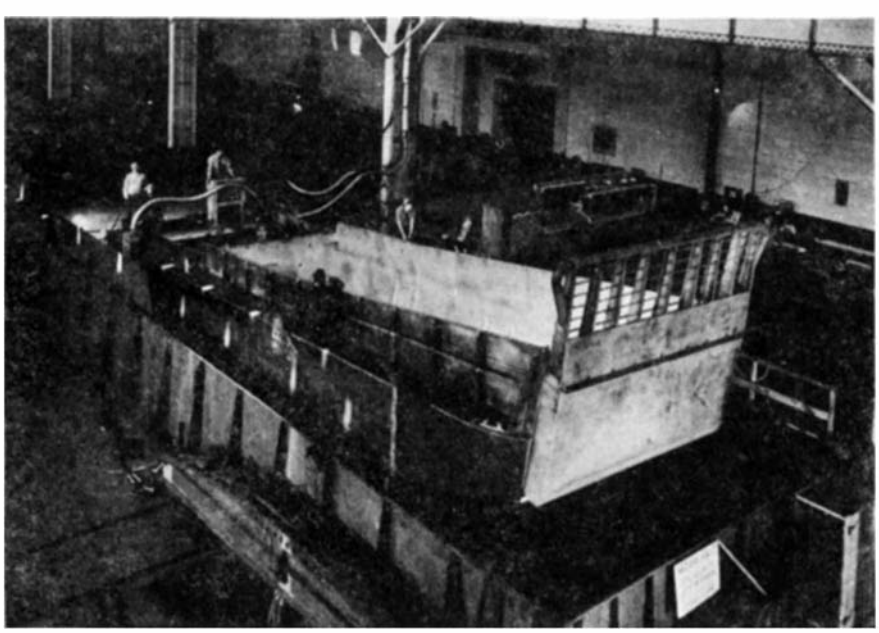
34,000 GALLON TUB

Used for Tests of Landing Craft

INVASION landing craft, produced in the Ohio corn belt at a dry-land shipyard miles from the sea, are "launched" in the only man-made "inland ocean" of its kind—a 34,000-gallon steel tub.

The all-welded, 50-foot barges designed for landing medium tanks, bulldozers, guns, trucks, and personnel are built upside down on an assembly line of the Warren City Manufacturing Company and then inverted for final fabrication and installation of Diesel engines.

From the final fabricating jig each barge is lifted into the "ocean" test tank a few yards from the end of the assembly line. Steel cables are attached to keep the craft from leaping out of the tub, and a worker standing at the control panel and wheel on the pilot deck gradually speeds up the Diesels until the water whips into white, boiling foam. The barge strains at its cables, riding up and down on the waves it creates itself. Each test lasts two hours.



Testing a barge in a 34,000 gallon steel tub

INDUSTRIAL DOLL-HOUSES

Permit Design Engineers to Plan Efficient Plants

TOMORROW'S industrial plants—geared to peace, not to war—will first rise as "industrial doll-houses" in the workshops of plant planning and layout engineers.

Complete construction in miniature to give engineers a three-dimensional preview of a plant's efficiency already is standard procedure for planning engineers of the Westinghouse Electric and Manufacturing Company. Now tiny figures of men and machines, carefully carved from wood, are moved around in "doll-house" factories. After the war, metal figures, molded for permanency, will form a "bank" from which the engineers may draw to construct their little industrial domains.

On "deposit" in these banks will be a score or more of each type of machine used in the electrical manufacturing industry. As new machines are developed, new molds will be made and new miniatures cast to keep the bank up to date.

When companies seek new manufacturing facilities, the engineers will move with speed and accuracy and the time and cost of planning factories will be reduced.

From two-dimensional drawings, skilled woodworkers will construct a "doll-house" factory along the general lines needed. In it they will put traveling cranes, roller tracks—every piece of equipment that is part of a modern

Even routes for roller conveyors are determined in miniature by engineers using "industrial doll-houses"

plant. Then, from the "bank," they will select the number and type of machines needed for the required amount of production. These will be placed in the miniature plant, moved about like men on a chessboard. Because the figures are accurately scaled, engineers can tell in advance how much floor space each machine will take in the completed factory, how much aisle room there will be, and so on.

Given this preview of the factory's workings, engineers may change the design of the miniature plant better to meet its specific needs. When they are through, nothing will have been left to guesswork. Construction men will expand the "doll-house" a thousandfold and a new industrial process will have been efficiently served.

Previously, two-dimensional drawings provided engineers with their preconstruction view of a plant, but even the keen minds of engineers and factory planners couldn't translate mechanical drawings into completely efficient factory units every time. Now and again the completed factory had gremlins—not numerous, but formidable and sometimes costly.

Pre-construction in miniature is not the only field where the "doll-houses" have proved invaluable. Rearrangement of plants already in use now is accomplished more efficiently by mapping out with the tiny models. Space and facilities are better utilized.

WIRE INSULATION

Developed by Special Formulation of Buna S

NUBUN, a synthetic rubber latex insulation for power, lighting, and communication cable has been developed by United States Rubber Company. The new insulation is a result of wartime developments in rubber technology and will permit the design of new types of wire and cable with improved electrical and physical characteristics.

Made by the latex continuous dip method, Nubun will have great advantages over ordinary wire insulations where replacement and space are important factors. Fire alarm, wire and cable police communication systems, as well as other highly essential telephonic systems, will be more easily

SENSATIONAL WAR BARGAINS in LENSES & PRISMS

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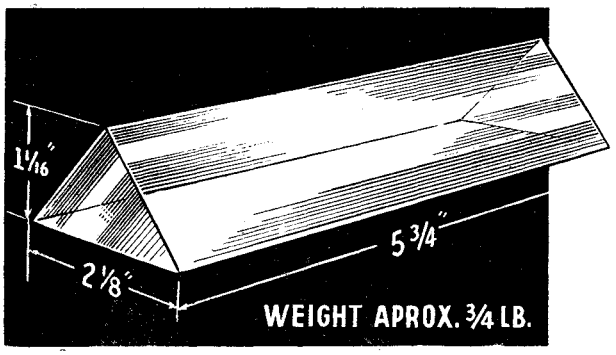
OUR POLICY on WAR SURPLUS

1. We are cooperating to move surpluses while the war is on.
2. Our customers receive full benefits of all savings effected through our purchases of war supplies. We do not hold merchandise for high future prices.
3. We are making an effort to bring our items to the attention of all Schools, Colleges, Amateurs.



TANK PRISMS

In order that the tank driver shall not get shot in the face, two of these Silvered Prisms are used to make a periscope (without magnification). We have secured a number of these that are very slightly chipped, making possible their sale at a very low price. They are 90-45-45 degree prisms of huge size — 5¾" long, 2⅛" wide, finely ground and polished.

Other uses for these Prisms: Experimental Optics, Optical Instruments and Gadgets, as unique gift item, unusual paper weight, desk name plate, etc. Normally these Prisms would retail from about $24 to $30 each.

Stock #3004-S . . . SILVERED TANK PRISM — Price $2.00 each Postpaid. Free Booklet on Prisms incl.

Stock #3005-S . . . PLAIN TANK PRISM — Price $2.00 each Postpaid. This one is excellent for projecting all the colors of the spectrum — a beautiful sight. Free Booklet on Prisms incl.
FOUR PRISMS — Special — $7.00 Postpaid . . . This is the most sensational bargain we have ever been able to offer.

100 Gold Gummed Letters . . . 5¢ Will make a Silvered Tank Prism into an expensive looking desk name plate in a few minutes of easy work. A swell gift item.

ROOF (Amici) PRISMS #5BS ..... $1.50 Postpaid
A few chipped but most were rejected because roof angle was off trifle, more than 2 seconds. Excellent for most uses except for instruments of over 3 power. A. T. M.-ADVANCED gives directions on how to correct the roof for use in higher power telescopes.

PORRO ABBE PRISMS #3006-S ..... 25¢ each Postpaid
Size 9 mm. by 17 mm. . . . another war bargain. Normal prices would be 10 to 20 times above quotation.

RIFLESCOPE LENSES Set #2000-S .... $11.00 Postpaid
5 achromats matched by manufacturer. Cemented, ready for construction of fine 3½ power 'scope which would retail up to $50.00. A rare opportunity! Full instructions included.

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6017-S	*12	80 mm.	Cemented	50¢
6018-S	*15	41 mm.	Uncemented	40¢
6019-S	*15	41 mm.	Cemented	60¢
6020-S	*18	49 mm.	Uncemented	50¢
6021-S	*18	49 mm.	Cemented	60¢
6022-S	*25	95 mm.	Uncemented	50¢
6024-S	*25	11 inches	Uncemented	60¢
6025-S	*25	11 inches	Cemented	75¢
6028-S	*30	64 mm.	Uncemented	70¢
6029-S	*35	60 mm.	Uncemented	70¢
6030-S	*36	171 mm.	Uncemented	70¢
6032-S	*36	178 mm.	Uncemented	70¢
6033-S	*37	51 mm.	Uncemented	70¢
6034-S	38	178 mm.	Uncemented	70¢
6037-S	41	57 mm.	Uncemented	70¢
6038-S	43	57 mm.	Uncemented	70¢
6044-S	11.5	24.5 mm.	Cemented	$1.50
6045-S	13.5	48 mm.	Cemented	$1.50
6047-S	28.5	76 mm.	Uncemented	75¢
6054-S	32	165 mm.	Uncemented	75¢

Free Cement and Directions included with all uncemented sets.
*—Definitely available with magnesium fluoride low reflection coating. Coated lenses will be priced at 10¢ more than the prices shown above. If you want coated lenses, mark "coated" after stock number and include 10¢ extra.

16 MM. MOVIE PROJECTING LENS SET — No. 4002-S. $4.00 Postpaid. Consists of 2 cemented achromats 18.5 mm. in diameter with effective focal length of 2". Originally manufactured for U. S. Government.

35 MM. SLIDE PROJECTING LENS SET — No. 4004-S. $1.50 Postpaid (Reg. $6.00 value). Consists of 2 uncemented achromats 1¼" in diameter for projecting 35 mm. Kodachromes, etc. Mounting directions and cement supplied free.

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replaced and serviced and will have greater resistance to destructive forces which cause circuit troubles with the use of this type of wire.

Qualities claimed for Nubun insulation include flexibility, impermeability to water, laminated construction, and perfect centering of the conductor to produce an insulated wire of maximum conductivity and minimum diameter. The synthetic insulation is said to be exceptionally homogeneous following vulcanization and has high electrical characteristics such as di-electric strength and insulation resistance. The special synthetic rubber compound is low in specific conductive capacity, has good aging qualities because of the presence of special anti-oxidants, and will resist severe wear because, by the nature of the latex process, the rubber particles are not distorted or broken down by milling.

Nubun insulation is made from a special modification of buna S synthetic rubber.

ENGINE OPERATION

Improved if Four Steps are Followed

FOUR STEPS to avoid dangers resulting from formation of hot engine sludge in motor vehicle engines were recently recommended to an SAE National Transportation and Maintenance Meeting by H. C. Mougey, of Research Laboratories Division, General Motors Corporation.

They were: application of oil filters, adequate temperature control, frequent crankcase draining, and use of high quality or heavy duty oils.

Filters help to remove the sludge as rapidly as it forms, Mr. Mougey reported. Temperature control prevents excessive heat from causing oil oxidation and sludge formation, without permitting engine temperatures to get so low as to form low-heat sludge. Crankcases should be drained with sufficient frequency to prevent sludge accumulations from becoming too large, Mr. Mougey explained, adding that draining periods must be determined by use rather than by time or mileage.

Heavy duty oils were described as having a good resistance to oxidation and as discouraging formation of acid and sludge. Mr. Mougey added that when these oils are drained, they carry away much of the sludge and leave a comparatively clean engine.

FOAM PLASTICS

Have Possibilities in the Insulation Field

A NEW type of plastics foam, which is lighter than rockwool, glass, or cork and lower in heat conductivity than any of the three, was announced recently by General Electric. Its present uses are secret but after the war it promises to have many peace-time applications, especially where insulation is required.

An outstanding characteristic of this new development in the company's plastics laboratory is that the material is self-raising and self-curing. In other words, the mixture, which resembles molasses, will begin to foam or expand within two to five minutes after the mixing stops and cures without the application of heat or any other element.

"It just grows all by itself," Dr. J. J. Pyle, director of the laboratory, explained. "It will foam into 30 times its own size; that is, a quart can of the mixture will expand sufficiently to fill a seven- to eight-gallon receptacle in about 10 minutes. What little heat is needed is self-generated by the mixture itself.

Known as foam plastics, a new composition grows at an inch a second

"This type of foamed plastic weighs less than two pounds per cubic foot and is particularly good for insulation. Another type, of greater mechanical strength but weighing seven to eight pounds per cubic foot, has also been developed. This will also have many peace-time uses, we believe," Dr. Pyle said.

ORE THAWING

Solves a Winter Problem of the Steel Industry

FORESHADOWING a process likely to be widely adopted by steel makers, an ore car thawing plant constructed by Rust Furnace Company, for Carnegie Illinois Steel Corporation, has successfully completed its tests. Purpose of the plant is to overcome the winter-time condition in which ore from the Lakes becomes soaked with moisture and freezes in the cars so that it will not run out when dumped.

This condition has been met by crude and inefficient methods in the past, which have included holding gas jets against the cars, building wood fires under them, and placing them in sheds under steam for hours—all wasteful of time and labor, and incidentally not contributing to the life of the cars.

Accordingly, an automatically operated plant for the specific purpose of surface thawing ore cars, so as to permit the ore to fall free of the car when unloaded by a dumper, was planned. This plant consists of a building with a capacity of two 90-ton ore cars on a track which runs through it. An additional track is provided for an

electrically operated pusher locomotive. Housed on a second floor are combustion units for producing hot gas for recirculation and application against the cars.

The arrangement includes a thaw chamber, where the cars stand; two double chamber furnaces with rated capacity of 10,000,000 Btu per hour each; two fuel-oil-fired burners, combustion air fan, fuel supply line, steam supply line for fuel atomizing, and motor-driven air recirculating fan, together with the necessary ducts, passages, and controls.

The thawing operation consists of circulating air and gases from the combustion chamber through a closed air circuit, comprising the thaw chamber, furnace, fan, and interconnecting ducts, the air being alternately heated and cooled in its passage.

In operation, two loaded cars are positioned in the thaw chamber and the doors are closed; whereupon the furnaces and air recirculating fans are put into operation. An adjustable cycle timer regulates the thawing cycle in two periods of approximately ten minutes flash heating in excess of 500 degrees, Fahrenheit, and a cutback to between 200 and 250 degrees for five to 10 minutes of base heating or soaking.

SILVER PLATING ALUMINUMS
Has Advantages in Electrical and Heat-Transfer Field

SILVER may now be deposited electrolytically onto aluminum or aluminum alloys by means of a simple method, known as the Preplate Process, a development of the Technical Processes Division of Colonial Alloys Company.

Silver deposits of considerable thickness can go directly onto the aluminum surfaces, or can follow a copper, nickel, zinc, or cadmium deposition.

The aluminum is thoroughly cleaned as prescribed, passivated, immersed in "preplate solution" for a few seconds, and then electroplated in the usual manner, using the regular equipment found in all plating shops.

Because of its high rate of electrical conductivity, silver plating onto light weight aluminums opens vast possibilities in the electrical equipment, appliance, transportation, and communications fields. Rated high on the scale in conductivity and transfer, silver on aluminums may be considered favorably in many heat-transfer applications.

As a protective and decorative application, silver plating on the brasses and white metals has been known for a long time. Silver plating on light weight aluminums should now find sizeable usage in this field.

POST-WAR ENGINEERING
Can Provide More Goods at Less Cost

ENGINEERS not only must win the war but also must lead the post-war effort, according to Everett S. Lee, head of the General Electric General Engineering Laboratory.

"In post-war planning," Mr. Lee says, "the engineer must take his part, for engineers and scientists continue to produce even though there may be defeatism all about. Witness the years 1929 to 1939, a period when the spirit of courage to go forward was too lacking, much to our shame as we look back upon it now. And yet in that period came streamlined trains, television, transoceanic passenger air service, synthetic rubber, fluorescent lighting, colored home movies, new plywoods stronger than steel, many new plastics and resins, polarized glass, glass building blocks, fiber glass for insulation and textiles, synthetic hosiery replacing silk, synthetic vitamins, sulfanilamide and sulfapyridine."

There was no lack in those years in engineering and scientific contributions, Mr. Lee points out, in emphasizing that there will be no lack in the years to come.

"But," he says, "the planning to go from an emergency to an after-emergency period must be such that there are no rapid changes, for it is rapid change which produces surges. Planning for a smooth transition, the replacement of expenditures for arms for war by expenditures for goods for peace, thus becomes a necessity."

Mr. Lee cites the accomplishments of engineers in the field of electrical measurements as evidence that "this transition is not an impossibility."

"There are similar stories," he continues, "in the advances in the auto-

motive industry, the petroleum industry, the extension of electricity to the farm, and the creation of an electrical standard of living in the home. And the story in each case is typified by using the abilities of the engineer for providing more goods at less cost for more people to use."

WELDING PROCESS

Salvages Castings,

Prepares Them for Metallizing

DEVELOPED primarily to solve problems of reclaiming defective aluminum castings, and used with equal success in salvaging bronze, grey iron, malleable, and steel castings, the new Nervous Weld Process is also being used for building up surfaces for press fits, repair of cracked housings and motor blocks, as well as for preparation of surfaces for metallizing.

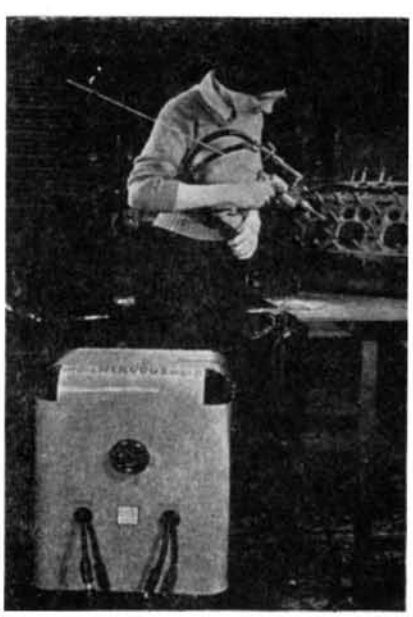
The word "Nervous" is applied to this process to dramatize the vibrating motion imparted to the welding rod by the air operated pistol. This pistol requires approximately 60 pounds of air pressure at four to five cubic feet per minute and is used in connection with a Mogul Nervous Weld machine.

The welding rod passes through the pistol and extends beyond it, feed of the rod being accomplished by means of the pistol trigger. In the bottom of the head of the pistol is a vibrating piston which causes the welding rod to make and break the arc at the working surface, as well as to peen and forge the resulting particles of deposited material. There is no lumping of the welded material since small globules of material are deposited in succession and small particles are welded and forged to small particles. Thus a dense weld may be built up with no great degree of heat.

The same air which actuates the piston of the welding pistol also passes through holes in the nozzle of the pistol, surrounding the electrode with an air envelope which has a cooling effect at the point of weld.

One of the demonstrated advantages of the Nervous Weld Process is that it doesn't create stresses and distortion in the surface being built up. The temperature never rises above 125 degrees, Fahrenheit, yet the deposited material is so dense at the point of fusion that there is no apparent line of demarcation.

The main value of this rapid method of welding is for filling in surface imperfections which have no effect on the structural strength of the article being repaired. This is of particular importance when surfaces are to be prepared for plating or metallizing.



By the Nervous Weld Process, metal is peened as it is deposited in place

RELATIVE POROSITY

Shown by Newly

Designed Vacuum Device

RELATIVE porosities of materials can be determined by an apparatus devised by Stuart H. Hahn and Robert H. Judson of The B. F. Goodrich Company. The porosity is tested by the degree of vacuum in a chamber which is an important part of the apparatus.

Chief object of the invention is to provide a mechanism for determining the relative porosities of various materials by drawing air or gasses through the material and indicating the rate of flow. The apparatus was originally developed for testing the porosity of various types of sponge rubber, but it has many other applications, the company believes.

So small and compact that it can be easily lifted and transported with one hand, the apparatus consists of a vacuum chamber placed in contact with the material to be tested, a constant-speed, power-driven fan for evacuating air from the vacuum chamber, an outlet port for emitting the air, and a pressure gage to measure and indicate the degree of partial vacuum in the chamber. An arm connected with the manually operated switch which starts and stops the fan holds the measuring indicator in position when the switch is turned off.

MOTOR-CAR GAS

Use and Quality Depends

On a Number of Factors

EXPERT opinion expects gasoline demand in the immediate post-war period to be at least 75 percent of recent pre-war requirements, largely because of the decrease in number of serviceable cars which will be available to consumers, according to a survey reported by Alberta H. Adams and B. H. Weil of Gulf Research and Development Company in *Chemical and Engineering News*. Most authorities expect demand to rise to a new high in the second phase of the post-war period.

"Consensus among automotive and petroleum experts indicates that some 20,000,000 of the nation's pre-war total of nearly 30,000,000 cars will remain in operating condition at the war's end, maintaining, with the help of some military consumption and increased commercial and farm use, a volumetric market for gasoline of at least 75 percent of the pre-war level," the survey states.

"A rapid recovery to or above normal

pre-war use is expected to follow as new tires and cars come into production. The immediate post-war cars will probably be the 1942 models, with changes in automobile design expected to come slowly. Hundred-octane automotive fuels are not expected to be required for some years, if ever."

In planning for the post-war period the petroleum industry must be cognizant of the many factors that influence the volume of probable post-war markets for its bulk products, especially gasoline, it is pointed out.

"Probably most important is the number of cars still unscrapped and operating on at least four usable tires at the end of the war. Naturally, the duration of the war is certain to have a large effect on this number, and estimates are as varied as those on the date of the war's termination. A conservative guess might place this number at approximately 20,000,000, or about 70 percent of those operating when the war began.

"The next factor of importance is the determination of how soon more cars can and will be put in operation after the war. Easiest and quickest to put on the road are those needing only reconditioning and new tires. If the rubber is available, as it now appears almost certain to be, molding capacity should be sufficient to put all operable cars back on the road in less than a year, assuming that there will be skilled labor available to operate the machinery.

"The problem of getting 'new' cars on the road is more serious. It is believed that the first post-war cars will be the same models as the last pre-war cars, and that less than half a normal year's production can come off the assembly line in the first post-war year! This means that it will take perhaps two years to furnish replacements for cars lost to service during the war years and that production of the true 'post-war' car of a new design cannot begin much before that time.

"Most authorities predict that changes in the post-war cars will be gradual as they have been in the past. Of particular interest to the petroleum industry are the widespread beliefs that post-war cars will be more economical in their use of fuels, because of some application of lighter-weight metals, greater use of automatic transmissions, and the probable use of gasolines of somewhat higher octane ratings.

"It seems possible that 100-octane fuels may eventually find use, at least as the premium-grade fuel, although this may not be very soon after the armistice. House-brand gasolines are not expected to be higher than 80-octane in the immediate post-war period, and either one or two grades of premium fuels will probably be put on the market, with octane ratings perhaps somewhere between 85 and 90.

"Auxiliary automotive markets will also affect the market outlook, inasmuch as military consumption should drop and commercial, farm, and civilian aviation consumption rise. These trends are likely to be sharp during the immediate post-war period and more gradual thereafter, except for aviation, which may rise sharply for some time.

"In general, prospects for gasoline markets are not particularly dark, even in the immediate post-war period; in the subsequent period of anticipated prosperity, the outlook seems to be good indeed. In the former period there seems to be little chance for a widespread demand for 100-octane gasoline other than for aviation use, although lessened demands for the latter purpose probably will make a large volume of high-octane stocks available. In the latter period, however, it may eventually find an automotive market."

BATTERY SEPARATORS

Made of Rubber, Permit Dry Shipment

A MICROPOROUS, wafer-thin rubber is now replacing wood in the manufacture of storage batteries. Its use as a plate separator makes possible for the first time the shipment of these batteries to all battlefronts in a fully charged condition but without the acid and water heretofore necessary to insure the electrical charge as well as the life of the battery.

This material, developed by scientists of the United States Rubber Company, has millions of tiny cells per square inch. Unlike wood it will not buckle if the protecting acid and water mixture becomes low or completely expended.

Buckling of wood separators which this material replaces was considered by the battery industry to be the prime reason for battery failure. The use of rubber completely eliminates this possibility, for these separators will outlast wood at the ratio of five to one, in acid strength of 1.25 specific gravity.

This compound has higher resistance to abrasion and chemical reaction than wood. The separators are designed to outlast the life of the battery.

After the battery has been completely charged, the acid mixture is taken out of the battery. The plates and separators are then removed and completely dried. After all moisture has been eliminated, the unit is replaced in its regular position. The battery is again sealed and made ready for shipment.

Batteries thus treated retain 75 percent of the original charge after being placed in storage for more than a one-year period.

This method of charging, drying, and shipping makes possible the immediate use of the battery after distilled water and acid have been added.

SURFACE CONDITIONING

Speeded by Use of Special Power-Driven Brush

POWER brushing, by the use of a portable-tool-driven, steel-bristled cup-shaped brush, is reported to make possible the method by which the acres of steel surfaces on the seven-mile-long San Francisco-Oakland Bay Bridge is properly conditioned for the application of protective paint, a job that takes all the time of 15 to 20 men, working year in and year out.

This power-brushing unit, with which each man is equipped, removes fog- and spray-deposited salt, also loose scale and paint, from the steel surfaces prior to repainting. This method is at least ten times faster than hand surface preparation, according to The Osborn Manufacturing Company.

The brush itself is approximately 3¼ inches in diameter, heavily filled with coarse, .020 S.A. wire, the wires extending 15/16-inch out of the cup. Operated in and driven by a portable hand tool, the brush spins at 4200 revolutions per minute. Rotating at this speed, with its coarse wires in contact with the steel surface, the unit speedily brushes away scale and leaves sound, clean metal for reception of paint.

Power brushing conditions surface

TOBACCO SMOKE

Used to Test Filtering Mediums

TREMENDOUS clouds of tobacco smoke puffed out by an automatic pipe smoker are now being used to test the filtering efficiency of special felt used in making respirators for industrial workers, according to the American Optical Company.

The tobacco smoke, employed because of its extremely fine, uniform particles, is first expelled into a small room by a large metal pipe burning tobacco under forced draft. Then the smoke is drawn out of the room and through a strainer fitted with a piece of the felt.

An automatic pipe smoker being used to check the efficiency of filters

Particles of matter remaining in the strained smoke are then measured by a complex scientific device which employs a light beam to illuminate the particles in the air. The concentration of particles is then compared with that of unstrained tobacco smoke to ascertain the filtering efficiency of the felt.

This type of test was described by the optical concern as the speediest and most effective for selecting the best filter material to safeguard the respiratory system of workers exposed to dusts and fumes.

ROUGH SURFACING

Desirable Where Positive Lubrication is Required

SEVERAL years ago Ford Motor Company metallurgists introduced a chemical etching process to make porous the surface of various engine parts. This was done after tests proved that steel surfaces can be made so smooth that they actually repel lubricating oil, resulting in rapid wear, excessive heat, scoring, and subsequent failure.

Experience gained before the war has thus helped to improve the wearing qualities and dependability of Ford-built tank and aircraft engines, numerous parts of which are "rough surfaced" by the same method.

"Rough surfacing" is desirable where positive lubrication is required between parts that are held to close tolerances. Various chemicals can be used for the purpose. An acid phosphate, for instance, etches the surface of the aircraft engine fly weight and deposits an iron phosphate. The resulting porous surface retains lubricating oil at all times. Before the treatment was introduced it was not uncommon for aircraft engines to develop excessive vibration or failure due to the scoring of this balancing device.

The depth of the etch is controlled by timing and by maintaining a fixed concentration and acidity of the etching solution at a given temperature.

Many other parts in Ford-built aircraft engines are "rough surfaced."

These include pinion-gear reduction shafts, valve tappets and valve tappet roller pins, push-rod ball sockets, gear pinion reduction shafts, front driven oil pump shafts, and a number of lesser parts.

Steel cylinder sleeves on Ford automobile engines are "rough surfaced" by honing. This means that a light film of oil can be retained on the cylinder walls at all times.

All "surface roughening" is carefully controlled and measured by a profilometer, a device that measures surface smoothness or contour in micro-inches.

FARM GLUES

Prove Their Value

For Exterior Use

DEVELOPMENTS in waterproof glues for wood point to the post-war potentialities of plywood for use on the farm. Heretofore, the use of plywood has been restricted because it was not strictly waterproof; but the synthetic resin glues such as Lauxite make the use of plywood for farm structures both practicable and economical.

There has been no plywood generally available for farm use during the past months because of war-time requirements. However, just previous to the outbreak of the war, recognition of the practicalities of buildings for the farm with exterior type fir plywood had been increasing. Farmhouses, grain bins, silos, barns, milk houses, brooders, and feeders built from plywood have proved extremely successful. A particularly bright spot on the post-war farm-rehabilitation horizon is the promise of pre-fabricated production buildings—hog and chicken houses and brooders—built and packaged by lumber dealers, and for sale to farmers for quick assembling.

A barn built by the Marine Air Research Corporation incorporates new development in the construction field by using plywood arches and beams as structural parts of the building. The arches of the barn were for a 40-foot span and tests were made to decide whether the roof would carry the load which was designed for 35 pounds per square foot with a safety factor of 2½ pounds. Very few metal connectors were required—only four bolts were used at the ridge.

Once the needs of the armed forces are no longer urgent, exterior type plywood with waterproof glue lines, because of its inherent strength and easy workability, will ably serve the farmer in a number of ways similar to those just described.

ALUMINUM PACKAGING

Offers Numerous Advantages

For Protecting Many Products

THAT nebulous cloud surrounding the post-war packaging world has a distinct silver lining—more accurately speaking, an aluminum lining, for this metal, firmly entrenched in a score of pre-war packaging fields, and aided and abetted by valuable wartime experience, is on the list of preferred materials on the drafting boards of tomorrow's package designers.

Inherent virtues of aluminum in this field include workability and resistance to moisture, heat, light, and chemical action. It is non-toxic and therefore well adapted for use in the food industry. Also, it is bright and attractive in appearance and lends itself well to modern packaging design. Of course, the lightness of the metal is important where shipping costs are a consideration.

Uses for aluminum in this interesting field range from chemical containers to tooth-paste tubes. Before the war, cigarettes, photographic film, and yeast cakes were only a few of the products packaged in aluminum foil. Your morning milk remained free from dust and germs under a gleaming protective hood of aluminum, while your chewing gum and candy bars stayed fresh longer when wrapped in this same material. Tamper-proof aluminum seals on liquor bottles kept bootleggers at a discreet distance and beer rode to town in sturdy barrels fashioned of aluminum sheet.

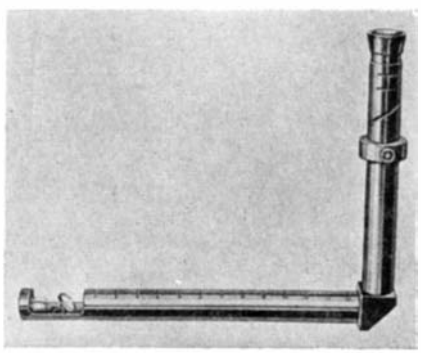
Domestically speaking, these uses for aluminum are now but memories, but aluminum packages are very much on the job on the battle front. Invasion troops carry with them, in their ration kits, plastic coated aluminum foil envelopes containing powdered coffee and dehydrated fruit juices. You will see a lot of this type of package after the war, not only for powdered coffee and fruit, but for dehydrated fruits of all kinds. Aluminum foil keeps out light and moisture—two valuable traits in many packages.—*Aluminum News-Letter.*

New Products

BORESCOPES

ORIGINALLY designed for the internal surface inspection of gun bores, Polan Borescopes are now available for use by private industry.

Borescopes have solved the problem of making the surface of long bores accessible to the human eye in order to inspect for minute cracks or other surface faults which may cause failure in operation. They are recommended particularly for close scrutiny of internal surfaces of bored engine shafts, tubular bodies, hydraulic and other cylinders, and so on and will cover a diameter range from 13/16 to 9 inches, and a bore length up to 30 feet.



Right-angle type of borescope

Polan Industries have developed a complete line of these industrial telescopes. The instruments combine the qualities of a highly corrected lens system and of excellent interior illumination with the demand for rugged design which is necessary for everyday machine shop use. They do not strain the inspector's eyes when operated continuously, and require no special operator training.

SHOT PEENING

TO INCREASE the life of stressed parts such as gears, springs, axles, torsion bars, crankshafts, connecting rods, milling cutters, pneumatic drills, and so on, by shot peening, a line of machines known as Wheelapeening equipment has been announced by American Foundry Equipment Company.

In the Wheelapeening machines, a rain of metallic shot is directed against the part at high velocity. Each shot striking the surface makes a tiny dent or pit, so that the cumulative effect is to stretch the surface layers by cold working, to put them in a state of residual compression. Since failure occurs under tension stress and never under compression stresses, fatigue cracks do not get a chance to start.

Within the Wheelapeening machine a Wheelabrator (airless, centrifugal blast unit) hurls a rain of shot at high velocity onto the surfaces of the parts to be peened. These parts are moved within the device so that all surfaces are exposed to the peening action.

The Wheelabrator is a mechanical unit that utilizes controlled centrifugal force instead of compressed air for throwing shot upon the work. It is completely airless, therefore it eliminates costly compressed air generating equipment. Shot is fed to the center of the bladed wheel from an overhead storage hopper whereupon it is hurled by centrifugal force, under perfect control, upon the work to be peened. Provision is made for continuous reuse of shot, for removal of broken shot and dust, and for addition of new shot to the cycling system.

FUNGUS-RESISTANT COATING

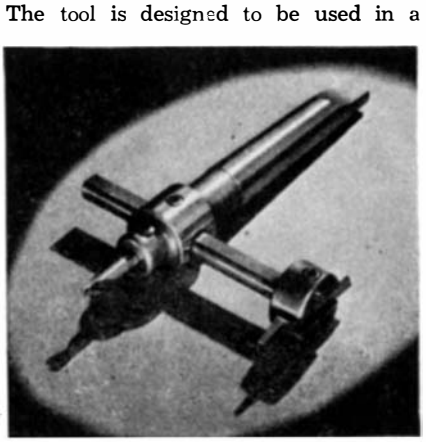
PHENOLIC parts of communications equipment to be used in tropical climates can be made fungus resistant by use of a coating developed by Mass and Waldstein Company. The coating is designed for application on phenolic insulators, terminal blocks, junction blocks, and the fixed windings of motors, generators, and dynamotors.

Marketed as Durad Fungus Resistant Coating #524, this fungus-resistant coating is a varnish and is applied by spray, dip, or brush. It has been successfully tested for dielectric strength, hardness, flexibility, and resistance to salt spray and thermal shock.

"Tropicalization" of communications equipment with fungus-resistant coatings is necessary because the high temperatures and humidity of tropical climates favor the growth of fungi. The growths cover the equipment and absorb moisture, causing short circuits and drifts.

CIRCLE CUTTER

CONSTRUCTED of heat-treated alloy steel, the new Rieger circle cutter has a cross-arm which is adjustable for holes of two to eight inches diameter. A ¼- by ¼-inch tool bit of any desired contour is fastened with a setscrew in the holder at the end of the cross-arm. The tool is designed to be used in a



For use in lathe or drill press

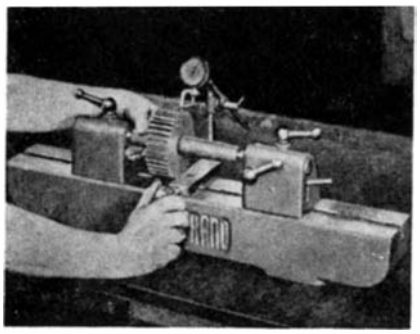
lathe, drill press, or electric drill, being centered in the work with a ¼-inch stub pilot drill.

The tool is said to have ample strength for machining holes in ½-inch plate steel. By the use of a suitably ground bit, the periphery of the hole can be straight, chamfered, rounded, or stepped. Obviously, the tool can be used for machining holes in metal, fiber, wood, and other flat materials.

BENCH CENTER

ACCURACY can be maintained to within limits of .0001 inch in checking for runout on a new improved bench center brought out by the Sundstrand Machine Tool Company.

Precision checking of work between centers is simplified and speeded by "one-handed control" over all movable



Precision checking is simplified

elements, which leaves the operator's other hand free to control the part being checked. Unclamping, positioning, and locking in place of both the heads are easily achieved with a single hand operating the top lever.

The center in the L.H. head is fixed but the center in the R.H. head is spring loaded and can be retracted by the end bar for quick loading and unloading. Front clamp on R.H. head locks the center in position during checking operation. The indicator support is manipulated with one hand when moving it away from the work for loading and unloading and against the work when checking for runout.

WAX

FLOOR wax that can be sprayed on large floor areas, leaving a high-gloss, non-slip finish without buffing, is announced by Turco Products, Inc. The new product, Grip Wax, is designed to speed the application of wax in hospitals, schools, restaurants, factories, civic buildings, and so on, where heavy traffic requires frequent waxing applications.

The anti-skid safety qualities of the material insure secure footing on all types of floors, even reducing the well-known slip hazards of concrete floors, according to the manufacturer.

Grip-Wax is a free-flowing liquid which is easily applied with a light wiping motion or by atomizing spray rather than by arduous rubbing. It sets in a few minutes to a non-tacky, lustrous finish comparable to that usually obtained by vigorous buffing of expensive imported waxes. There is no solvent action on asphaltic tile, rubber, or linoleum. Grip-Wax seals floor pores and joints against water penetration, and tests show its flexibility resists constant traffic blows.

STORAGE FLASHLIGHT CELL

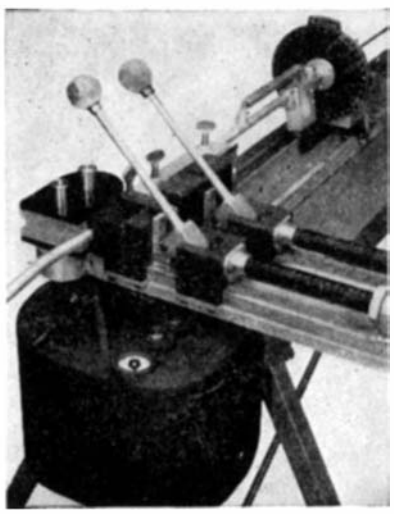
A RECHARGEABLE wet flashlight cell for industrial use, built on the principle of the automobile wet storage battery and especially valuable for operations where long continued and steady usage of flashlight is necessary, is announced by The B. F. Goodrich Company. The company claims that the wet storage cells are more economical than dry cells when flashlight service is required in volume, or where batteries require replacements more than once every two weeks. A freshly charged wet cell will provide for about three hours of *constant* light. Batteries can be used in the standard three or five cell dry battery case with the use of spacer plugs.

The new wet cell requires a special type Mazda Lamp, which comes in 1.9 volt, .6 ampere rating, with screw base and flange base design. This is a 600 mil lamp as contrasted with the 300 mil lamp used with dry batteries. Actual wattage consumed with the wet cell is 50 percent more than with the dry type and since light is directly proportional to watt consumption the wet cells produce a distinctly brighter light than the older type. The light is constant, since the voltage drop between a full charged and discharged wet cell is only .35 volts, while the dry cell drops approximately a full volt. This assures constant top quality light at all times.

TUBE BENDER

CAPABLE of producing 900 to 1000 bends an hour, a new manually operated tube bender has been designed by The Douglas Aircraft Company. An improved form is now being manufactured by Leonard Precision Products Company.

The Leonard-Douglas Bendmaster, as it is named, will handle non-ferrous tubing from ⅜ to 1¼ inch outside diameter tubing, producing from one to ten different bends in a single nine foot length. These bends can be produced to any specified degree of angle



Working end of the Bendmaster

up to 180 degrees and at any radial angle. Special models for tubing up to 20 feet are available.

Set-up time of the new machine averages 7 to 15 minutes. The machine cam arrangement and automatic stops are adjusted according to specifications on the job ticket and the machine is ready for production.

A considerable number of these machines are now in operation in the major aircraft plants on the West Coast. According to West Coast production men, the most important feature of the Bendmaster is its consistent duplicated accuracy of the bends even over extended production runs. Although originally designed for aircraft production, this machine can be utilized in speeding the production of many other industries.

STORAGE BATTERIES

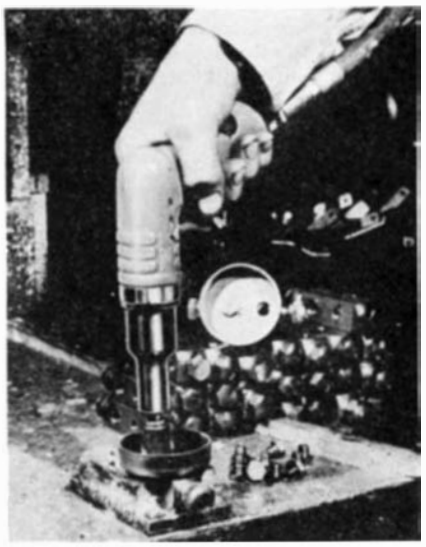
EMPLOYING the "vacuum-pack" principle which has been extensively used for preserving and safeguarding foods, an unusual type of storage battery, developed by the Willard Storage Battery Company, is now being mass-produced for use by our armed forces. Details of these new batteries and their unique packing have just been revealed.

Four batteries—three 36-volt types and one six-volt—are packed in a lead-plated metal container from which the air is exhausted. The batteries retain their charge indefinitely and are ready for immediate use regardless of the elapsed time since their manufacture or the distance they have been transported.

When the batteries are about to be placed in service, the can is punctured by a special filling device and the vacuum inside the can permits the electrolyte to move quickly into the vent holes in each battery. Thus, in a matter of seconds, each battery is filled with electrolyte and is ready to go to work.

IMPACT SCREW DRIVERS

A NEW line of impact screw drivers and nut setters with positive torque control is announced by The Aro Equipment Corporation. A torque regulator, located in the handle, allows the opera-



Air-operated screw driver

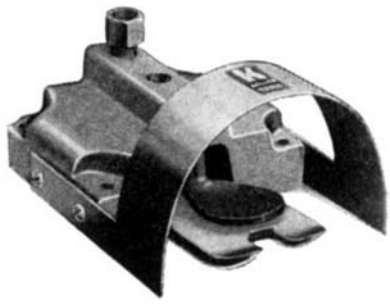
tor to easily regulate the torque necessary to tighten the screw or nut. There is ample adjustment to meet most screw driving and nut setting conditions.

Like the impact wrench described in these columns in October, this pneumatically powered tool operates with a roller clutch impact mechanism having only four major parts—anvil, hammer, and two cylindrical steel rollers. When in operation, the centrifugal force throws the two steel rollers out against the hammer; this transfers the full torque through to the work in the form of a sudden impact. When the selected torque is obtained, the rollers rebound from the anvil face and do not allow the hammer to engage for impact.

THREE-WAY FOOT VALVE

A COMPRESSED-AIR foot valve to be used with air tools, air cylinders, air chucks, flash welders, forging machines, die casting machines, riveting machines, air vises, and all other air-operated equipment is announced by Keller Tool Company.

On tools where it is desirable for operators to have both hands free, it greatly facilitates rapid handling of



Foot valve for compressed air lines

work. Safety of the operator is accomplished by the kick guard which prevents accidental operation.

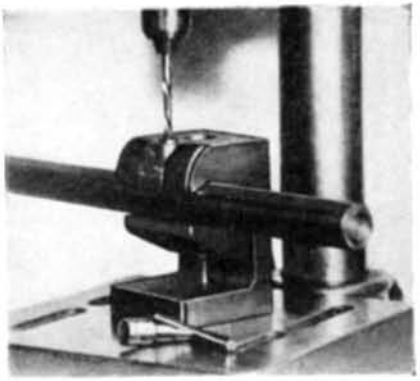
This foot valve is furnished in locking and non-locking types. The pedal lock on the locking type holds the pedal in the open position. A touch of the operator's toe releases the lock.

A simple adjustment of the lever-locking device prevents engagement of the operating pedal and changes the locking type to the non-locking type.

The valve mechanism is simple. Normally the valve is closed with the outlet side open to the exhaust. When the foot pedal is depressed, the exhaust closes and line pressure is admitted to the device to be operated. Upon release of the pedal, the air supply stops and the outlet to the exhaust is again opened.

ACCURATE VISE

A WORK-holding vise, the "Center Drill and Mill Vise," as manufactured by the Universal Engineering Company, embodies features which include accurate cross-center drilling of round stock. No moving parts are involved in this operation which guarantees permanent accuracy. The bushings through which the drill passes are interchangeable, giving a wide range in hole sizes. The vise will hold hexagon stock as well as round. Clamping action of the



Round stock is positioned accurately

vise is the opposed jaw principle, thereby leaving one surface of the work clearly exposed for slot milling and so on. All exterior surfaces of the vise are precision ground square and parallel, allowing it to be used in conjunction with any type of machine tool as a work holder to insure accuracy.

LOW-TEMPERATURE GLUE

A NEW synthetic resin glue for wood, which sets at ordinary room temperature, is known as Cascophen RS-216, and is used with a separate dry-powder catalyst.

Cascophen RS-216 can be stored indefinitely at room temperature. It has a marked "affinity for wood" and bonds at low pressures and on uneven surfaces. It cures in eight to ten hours at 70 degrees, Fahrenheit, or less at higher temperatures. The bond meets the most rigorous joint tests required by any current United States Government Specifications and withstands heat and moisture tests which destroy practically all other glue joints set without high heat.

This new glue is recommended for work where complete durability is required and where joints cannot be heated, such as the gluing of thick laminations for airplane propellers, heavy-duty built-up arches and beams, aircraft spars, and so on.

HYDRAULIC ACCUMULATOR

MANY new applications of hydraulics in the machine tool, automotive, railroad, and marine fields have been

opened with the release of a low-cost hydraulic accumulator, formerly available for aircraft exclusively. Because of the tremendous size and high cost of previously available industrial type accumulators, the advantages of hydraulic actuation were denied to many types of presses, riveters, hoists, elevators, marine steering gear, brakes,

Cross-sectional view of the new hydraulic accumulator with a one-piece synthetic rubber bladder

and, especially, portable equipment. The new accumulator, manufactured by Greer Products Corporation, consists simply of a one-piece seamless steel shell, without welds or joints, containing a completely enclosed one-piece synthetic rubber bladder having an integrally molded air valve. It is made in capacities from 0.333 to 25 gallons.

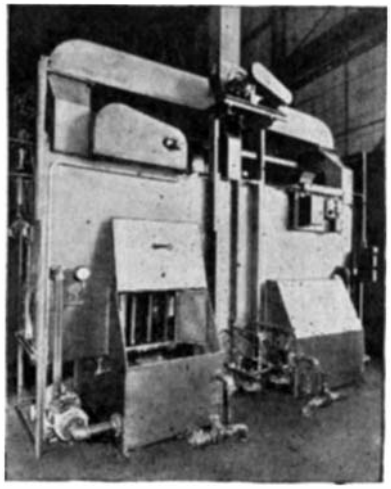
METAL WASHER

DEVELOPED by the Metal Washing Machine Division of American Foundry Equipment Company, a new and improved design in metal washing equipment, the Monorail-Spray Washer, is designed to handle metal parts which must be rotated while they are passing through the cleaning chamber for highest cleaning efficiency. Typical work of this type includes intricate circular parts or those with many ports, crevices, or openings.

A monorail conveyor is provided to carry the work through the path of well-positioned power sprays. Parts are suspended from hooks and can be rotated while passing through the cleaning stages.

Although the standard Monorail-Spray Washer is designed primarily for washing and rinsing operations, it is so constructed that additional units such as drying and rust-proofing sections may easily be added to the machine to suit variations in production setups.

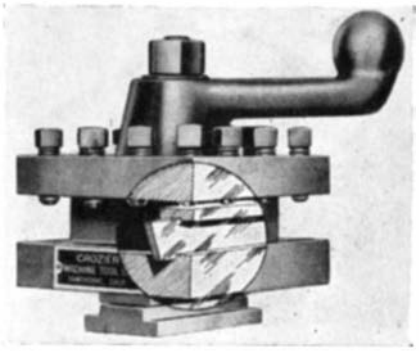
The unit can be equipped for heating with steam, gas coils, or electric immersion heaters. Thermostatic controls are furnished. To carry away steam and vapors, a ventilation ductwork is provided on the top of unit.



Metal parts are rotated while washing

TOOL POST TURRET

AN IMPROVEMENT in tool post turret design is announced by the Crozier Machine Tool Company. The Crozier Tool Post Turret, the first to be made for bench lathes, is now specially adapted for cutting-off operations. One side of the block is channeled to receive a standard beveled section cut-off blade, which is supported at the top by a hardened channeled bar that provides maximum bearing surface for the locking bolts, thus quickly and positively centering and holding the blade in correct vertical position. There is no overhang of the holder and only sufficient tool extends to the required depth of cut.



Rigid, simplified tool post turret

It is stated that this arrangement assures rigidity, materially reduces set-up time, and increases production by chatterless operation.

CELLULOSE HEATER

A NEW electrically-heated tank has been designed by the Aeroil Burner Company, Inc., for heating, melting, and dipping ethyl-cellulose compounds.

This unit features completely uniform, direct heating through the medium of an agitated hot oil bath that completely surrounds the material, and also places heat in the ethyl-cellulose by a new method. As a result, the manufacturer claims that completely uniform, indirect heat is distributed underneath, above, around, and within the ethyl-cellulose itself, without any possibility of localized over-heating, "hot spots," or degradation of the melt.

Both tank and removable cover are completely insulated. Tests have shown an overnight heat loss in the compound of only 10 degrees, Fahrenheit, per hour—with all heat shut off. Two thermostats automatically hold the oil bath at any desired temperature required by the particular ethyl-cellulose formulation being used.

Current Bulletin Briefs

Conducted by K. M. CANAVAN

The Editor will appreciate it if you will mention Scientific American when writing for any of the publications listed below.)

GENERAL SILENTBLOC is a 34-page thoroughly illustrated bulletin dealing specifically with flexible rubber bearings, mountings, and couplings. These units are designed for use with machinery and other equipment in motion to absorb vibration, allow torque action, and correct for misalinement. *The General Tire and Rubber Company, Mechanical Goods Division, Wabash, Indiana.—Gratis.*

IT WAS A TUBE THEY WANTED is an illustrated booklet telling a critical war story about the importance of electronic tubes in intricate and interesting plant operations. Plans for post-war developments are discussed. *Amperex Electronic Products, 79 Washington Street, Brooklyn 1, New York.—Gratis.*

ALOFT IS NO PLACE FOR A. W. O. L. BEARINGS is a four-page bulletin describing the application of a system for sending lubricants under pressure from a central pumping system to high-up and hard-to-get-at bearings on presses, cranes, and other "off the floor" types of equipment. *The Farval Corporation, 3428 East 80th Street, Cleveland 4, Ohio. —Gratis.*

SOUTH BEND PRECISION LATHES is a new eight-page condensed catalog covering engine lathes, toolroom lathes, and precision turret lathes for practically all types of production, toolroom, and maintenance work. All information concerning capacities, speeds, feeds, and dimensions is tabulated for each size and model of lathe. *South Bend Lathe Works, South Bend 22, Indiana.—Gratis.*

HOW ONE COMPANY ORGANIZED TO HANDLE WAR CONTRACT TERMINATIONS is a 12-page circular which presents a step-by-step view of the subject and gives a suggested breakdown of termination duties by departments. It illustrates 14 practice-proved forms which one company designed to expedite its work. The text may serve to alleviate many industrial headaches. *Lyon Metal Products, Inc., Aurora, Illinois.—Gratis.*

CORRECTING WATCH TIME BY WATCH VIBRATIONS explains a simple way to alter the speed of a watch temporarily to correct its time without opening the case. *E. M. Tingley, 221 North Cuyler, Oak Park, Illinois.—Gratis.*

PLASKON is a 16-page illustrated booklet presenting the uses of plastic materials for modern industrial production. Each type of Plaskon resin is thoroughly described, to encourage the correct application of plastics to specific requirements. A special section deals with Plaskon resin glue for commercial bonding of wood, paper, fabrics, cork, and compositions. *Libby-Owens-Ford Glass Company, Plaskon Division, 2138 Sylvan Avenue, Toledo 6, Ohio.—Gratis.*

THE HOW AND WHY OF FLEXIBLE SHAFTING is a 32-page fully illustrated catalog which deals with the possibilities of flexible shafting in a number of industrial fields, gives definitions of flexible shafts, outlines some of the jobs that flexible shafts can do, and presents data on their performance under varying conditions. *Stow Manufacturing Company, Binghamton, New York.— Gratis to requests made on business letterheads.*

HOW TO MEASURE IN MICRO INCHES is a 20-page thoroughly illustrated booklet which deals with the fundamentals of precision measurements and shows how these principles can be applied to production in the daily control of product quality. *Continental Machines, Inc., 1301 Washington Avenue South, Minneapolis 4, Minnesota.—Gratis.*

41 MORE WAYS REMOVABLE STICKERS SPEED PRODUCTION is an eight-page booklet presenting examples of the uses of Kum-Kleen stickers in identifying and marking parts in production. *Avery Adhesives, 451 East Third Street, Los Angeles 13, California.—Gratis.*

TOOLS TO BUILD THE WORLD OF TOMORROW is a 20-page brochure built around a portable electric drill in the design of which some revolutionary applications of plastics have been put to use. This one application foreshadows others. *Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago 6, Illinois.—Gratis to industrial executives who make their requests on business letterheads.*

WOOD AIRCRAFT INSPECTION AND FABRICATION—ANC-19 is a recently revised bulletin designed to speed the production of training planes and gliders. Its contents, however, will be of interest and value to anyone concerned with handling of wood. *Government Printing Office, Washington, D. C.— $1.00.*

HOW TO MAKE PATTERNS AND MODELS WITH GYPSUM CEMENT is a manual prepared to give designers, manufacturers, foremen, and workers in the metals and plastics fields a clear understanding of the latest developments in gypsum cements and how they can help to solve problems of production design and reproduction. *United States Gypsum Company, 300 West Adams Street, Chicago, Illinois.—Gratis.*

FLEET-WELDING is a 48-page semi-technical treatise on a new method for increasing the speed of welding mild steel. A number of photographs and drawings illustrate the technique and 17 tables present procedure data. Request bulletin Number 440. *The Lincoln Electric Company, Cleveland 1, Ohio.—Gratis.*

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted, with the co-operation of the Editors, to make available for you a comprehensive book service. Each month the Editors select and review in these columns new books in a wide range of scientific and technical fields. In addition, they are ready at all times to advise you regarding the best available books on any subject. You are invited to use this service freely. Tell our Book Department what kind of books you want, and you will be furnished with the names of available books, including prices. When inquiring about books, please be specific; remember that we can be of the greatest help only when you tell us just what you are looking for. Books listed in these columns may be ordered from our Book Department. Add 25 cents per book for mailing outside U. S.

TO MAKE CERTAIN that books ordered by or for men in the Army, located in the United States, or men in the Navy, Marines, or Coast Guard, located anywhere, will be delivered, insurance fees should be sent with orders, as follows: To $5 in value, 10¢ additional; from $5 to $25, 20¢; from $25 to $50, 30¢.

ANYTHING A HORSE CAN DO: THE STORY OF THE HELICOPTER

By Colonel H. F. Gregory

THE AUTHOR of this splendidly written book is one of those young, capable, energetic officers who have made the A.A.F. what it is, but with a career in the mastery of the autogiro and the helicopter which is unique. Beginning with the history of the autogiro and the early pioneers (of whom Cierva was the greatest), Colonel Gregory communicates to his readers the thrill of achievement of the Sikorsky XR-4, the first aircraft to convince the world of helicopter practicability. A vivid portrayal of helicopter flying is balanced by a simple exposition of principles in the chapter entitled "The How And Why." More recent direct-lift aircraft are described, and the future possibilities and services of the helicopter are conservatively estimated in the last two or three chapters. (243 pages, 32 full pages of diagrams and photographs.)—$3.10 postpaid.—*A.K.*

WORK METHODS MANUAL

By Ralph M. Barnes

WORK organization and motion economy in industrial processes are here dealt with in a form that can readily be assimilated by shop foremen and supervisors as well as by those workers who have gumption enough to want to know how to do their jobs in the easiest and most efficient manner. Emphasis is upon developing of better methods and the correlation of these methods with operations performed by human beings. (136 pages, 6 by 9 inches, over 100 illustrations.)—$1.85 postpaid.—*A.P.P.*

PRINCIPLES OF PHYSICS—I

By Francis Weston Sears

TEXTBOOK prepared by an Associate Professor of Physics at M.I.T., for use in the first course in physics at that institution. While this textbook is not formidable, it makes few concessions to users who want physics made easy. The user should be familiar with calculus, also with hard labor. Many of its problems are from examinations at M.I.T. This present volume, limited to "Mechanics, Heat, Sound," is only the first of a three-volume set. Part II, now in preparation, will cover "Electricity," Part III "Optics." (Part I, 537 pages, 6 by 9 inches, illustrated.)—$6.10 postpaid. —*A. G. I.*

PHOTOMICROGRAPHY IN THEORY AND PRACTICE

By Charles P. Shillaber

SOLID meat for the engineer, laboratory worker, or student who wants to master the complete technique of photomicrography is here given in complete detailed form. The text deals with adjustments and various techniques relating to the microscope and the illuminating system, the use of sensitive materials, and the preparation of the specimen. (774 pages, 6 by 9 inches, 291 illustrations, plus a glossary.)—$10.10 postpaid.—*A.P.P.*

FOREIGN MAPS

By Olson and Whitemarsh

SPECIALIZED book for those who must deal with foreign maps—it contains all information necessary for their study, explanations of signs and interpretations. This book is the result of teaching cartography in the Army Specialized Training Program, University of Chicago. (237 pages, 5½ by 9¼ inches, 25 figures, 16 maps.)—$4.10 postpaid.—*A. G. I.*

FUNDAMENTALS OF VIBRATION STUDY

By R. G. Manley

ENGINEERS who have never dipped into the important subject of vibration theory will find here an introduction to the subject which will enable them to master more easily the existing standard texts. The treatment is technical and mathematical. (128 pages, 6 by 9 inches, 52 drawings.)—$2.85 postpaid.—*A.P.P.*

THE ELECTRICAL CRAFTS

By William H. Johnson and Louis V. Newkirk

MAIN EMPHASIS in this particular book is on the use and maintenance of standard electrical equipment in the home, although some attention is also

paid to radio and simple elements of industrial electricity. A number of remarkably clear illustrations show the reader exactly how to make and use ciruit testers, to do simple electric wiring, to make simple radio receivers, to construct a telephone intercommunicating system, and to build and use a number of other electrical instruments and appliances. (146 pages, 8½ by 11½ inches, well illustrated with drawings and photographs.) — $2.60 postpaid.— *A. P. P.*

SYSTEMATIC INORGANIC CHEMISTRY

By Don M. Yost and Horace Russell, Jr.

EMPHASIZING the research point of view, the subject matter of this book is devoted to the inorganic chemistry of the non-metallic elements of the fifth and sixth groups of the periodic system. The preface states: "These elements and their compounds, besides being of great practical and theoretical interest in themselves, exhibit, in their properties and reactions, characteristics that are common to many other substances both inorganic and organic." (423 pages, 6 by 9 inches, illustrated.) — $6.10 postpaid.—*A. P. P.*

THE SCIENCE OF CLOCKS AND WATCHES

By A. L. Rawlings

HOROLOGISTS interested in the science underlying fine timekeepers will find here a modern book resembling the famous work of Grimthorpe, long out of print. This is not a book on clock repairing and it is not very elementary. Something for the man who calls himself a "clock maniac," brother in spirit to the "amateur telescope maniac" and just as maniacal. (236 pages, 6 by 9 inches, 61 illustrations.) —$3.60 postpaid.—*A. G. I.*

BLUEPRINT READING

By Fred Nicholson and Fred Jones

WITHIN the limits of printed words and pictures students are here given the next best thing to actual shop experience. The reader is not only shown a number of prints but, immediately adjacent, is given illustrations of the tools, machines, and measuring instruments that enter into the fabrication of the job which first reaches the worker in the form of a blueprint. (141 pages, 7½ by 10 inches, 175 illustrations, plus over 50 blueprints.) —$2.10 postpaid.—*A.P.P.*

WINGS AFTER WAR

By S. Paul Johnston

THE sub-title of this book, "The Prospects of Post-War Aviation," is dealt with calmly and realistically, and with knowledge based on a long and successful career in aviation. Mr. Johnston's style is clear and appealing. The subject matter is well indicated by some of the chapter titles. "Aviation and the Post-War World—Utopia May Not be as Close as Advertised," argues that we must not expect too great advances, that glider trains may be too expensive, that the flying wing has its limitations. Another chapter asks the question: "A

Helicopter in Every Garage?" Other chapter headings speak for themselves: "By Road, by Rail, or by Air?" "Expanded Airports and Airways System, a Necessity?", and so on. In the present uncertain condition of affairs, Mr. Johnston gives a reasonable and well thought out prognostication of aviation's immediate future. (129 pages.)—$2.10 postpaid.—*A. K.*

INTRODUCTORY SHOPWORK

By Mack M. Jones and Aaron Axelrod

TOOLS, operations, processes, and materials are here dealt with so clearly and comprehensively that a reader without any previous experience can readily understand and apply the fundamentals. Correct methods of work are stressed throughout the text. Coverage includes hand tools, machine tools, metal working, woodworking, pipework, soldering, wire and wire splicing, and ropework. (290 pages, 6½ by 9½ inches, 366 excellent illustrations.)—$2.60 postpaid.—*A.P.P.*

PLASTIC MOLDS

By Gordon B. Thayer

EMPHASIS is here placed on the practical aspects of design, construction, and use of the various types of molds used in the plastics industry. This is a second edition of a book which first appeared three years ago and has now been brought completely up to date and greatly enlarged. A new section of Practical Points in Mold Design and Construction has been added. (136 pages, 6 by 9 inches, 81 illustrations.)—$3.60 postpaid.—*A. P. P.*

CONTROL OF ELECTRIC MOTORS

By P. B. Harwood

KNOWLEDGE of motor control is useful if not essential to everyone working with electric motors. From the pages of this book such workers can become intimately acquainted with the characteristics of various types of motors and of the equipment which must be used for control purposes. Problems frequently encountered are discussed in detail. (479 pages, 6 by 9 inches, 244 illustrations and number of tabulations.)—$5.10 postpaid.—*A. P. P.*

TRANSPORT AIRCRAFT OF THE WORLD

By Lester Ott

IN REALLY striking photographs and short text the author presents here a survey of the passenger and cargo aircraft of the United States, England, Canada, the Soviet Union, Germany, Italy, and France. Coverage includes plans now on the drafting board and under test. This is a non-technical reference work for engineers, students, and laymen. (112 pages, 9 by 11½ inches, 144 illustrations, map on end papers.)—$2.60 postpaid.—*A. P. P.*

MAGNETOCHEMISTRY

By Pierce W. Selwood

IN order to keep the size of this book within reasonable bounds the author has adopted the following definition: "Magnetochemistry is the application of magnetic susceptibilities and of closely related quantities to the solution of chemical problems." This is a specialized text designed to assist the student in mastering the principles and practices of an important phase of science. (287 pages, 6 by 9 inches, 80 illustrations and a number of tables.)—$5.10 postpaid.—*A. P. P.*

ESSENTIALS OF ARITHMETIC

By Henry Sticker

NEAT little pocketbook, compact, free from schoolboy repetitions, intended for adults. Explains all arithmetical principles and gives an example for every kind of calculation, worked out, demonstrated, explained. How many oldsters who regard common arithmetic as baby stuff can sit down and, without a struggle, find the cube root of 12,812,-904, for example? Such forgettables are clearly explained. (256 pages, 4 by 6 inches, illustrated.)—$1.60 postpaid.—*A. G. I.*

ULTRA-HIGH-FREQUENCY RADIO ENGINEERING

By W. L. Emery

THEORY and practice are here correlated so that the reader or student can systematically link fundamental principles with practical applications. Scope covers an introduction to high frequency, voltage-regulated power supplies, electronic switching and synchronization, the cathode-ray tube, circuit elements, oscillators, radiation, and so on. Much of the treatment is necessarily mathematical. (295 pages, 6 by 9 inches, 136 drawings.)—$3.35 postpaid.—*A. P. P.*

DIESEL LOCOMOTIVES—ELECTRICAL EQUIPMENT

By John Draney

STARTING with the elementary principles of current electricity, the text of this volume carries through the principles of generators and measuring instruments to a consideration of specific electrical equipment used in present-day Diesel locomotives. The treatment is practical in every aspect and prepared for use by workers specifically concerned with the Diesel-electric field. (388 pages, 6 by 9 inches, thoroughly illustrated.)—$3.85 postpaid.—*A.P.P.*

HERE'S HOW TO FLY

By Gilbert Faust

SIMPLIFICATION of an abstruse subject has been the aim of the author of this comprehensive little text. Into its pages he has packed a tremendous amount of the essential information which a novice should have before attempting to master the mechanics of piloting an airplane. If you plan to fly post-war, this is a good starting text. Or if you are just casually interested in aviation it will give you a grasp of interesting fundamentals. (264 pages, 6 by 8 inches, profusely illustrated, review questions.)—$2.60 postpaid.—*A.P.P.*

Telescoptics

A Monthly Department for the Amateur Telescope Maker

Conducted by ALBERT G. INGALLS

Editor of the Scientific American books "Amateur Telescope Making" and "Amateur Telescope Making—Advanced"

THIS, now that it can be told, is the second half of the story of the recent Roof Prism Program of Scientific American's advanced amateur telescope makers.

In the first account, published in the May 1943 number, it was told how Russell Porter, Alex MacTavish, and your scribe, had discovered in 1941 that the nation's need for roof prisms for military instruments was desperate. Roof prisms (Amici type) were suddenly needed by scores of thousands but there had been no peacetime demand and only two or three precision opticians had learned how to make them. They were about the toughest thing to make in optics; two of their faces had to be within two seconds (1/1800 degree) of a perfect right angle, or 60 times as close as the Porro prisms in binoculars and far closer than all but the most uncommon right-angled prisms.

It was told how this magazine arranged with Frankford Arsenal to be the link between that institution and the amateurs, and how it organized 100 of the more able amateurs and throughout a year and a half coordinated their work while they progressed from single trial prisms to small and then large orders, working at home. Into this program Russell Porter threw the weight of his prestige, inspiration, and all the help he was able to give. The third leader, MacTavish, had foreseen the nation's need for the difficult roof prism and, working alone and without written instructions (none then existed), had ferreted out the technique. He had patriotically turned over to the 100 amateurs, through mimeos issued by Scientific American, all that he had learned, enabling them to start level with him. Who was MacTavish?

"MacTavish" was the alias for Fred B. Ferson, Biloxi, Mississippi, which had to be assigned when the Office of Censorship, after going over the manuscript of the account of May 1943, said: Give all the roof prism producers fictitious names and, for fear of sabotage, omit their locations. "MacTavish's" (Ferson's) photograph has been in "Amateur Telescope Making — Advanced," page 337, for years.

Thus the man who, out of patriotic motives, gave hundreds of tired hours to others and answered hundreds of letters while busy making his own roof prisms, was simply one of the nationwide fraternity of glass pushers—an average three-mirror amateur when he began making prisms. It is ironical that wartime necessity forbade revealing the identity of the amateur who gave the most to the Roof Prism Program.

Here is a summary of the roof prism production of the amateurs—the prisms actually accepted and purchased by Frankford Arsenal and three large wartime military instrument makers. Most of the names look more professional than amateur. This is because assuming formal company names proved easier than to convince a puzzled world that amateurs could make roof prisms.

No conclusions should be drawn because of the large variation in production of the individual amateurs. Some unwittingly began almost too late; others lacked time or strength for the exacting work, which experience proved to be too strenuous for performance in spare hours.

F. L. Frazine, jeweler, St. Petersburg, Fla., 18 prisms.

F. A. Jasset, podiatrist, with F. Richards, Newton, Mass., 24 prisms.

G. E. Gordon, photographer, Natick, Mass., 25 prisms.

F. R. Varela, engineer, Tenafly, N. J., 50 prisms.

A. H. Johns, decorator, Larchmont, N. Y., 165 prisms.

G. Dallas Hanna, zoologist, paleontologist, California Academy of Sciences, San Francisco, with others of the Academy museum staff, made 165 prisms but shifted to emergency repair of Navy optical instruments.

K. E. Dykoski, assistant in astronomy, University of Minnesota, 300 prisms.

The Precision Military Optical Co., H. H. Selby, Encanto, Calif., 700 prisms. Selby later turned to essential war work in his vocation, chemistry.

The Wellsville Optical Co., Wellsville, N. Y., David Broadhead (the "Jim Fogarty" of the May 1943 account) assisted by two part-time employees and by Mrs. Broadhead in the capacity of prism inspector, cleaner, and packer, food provider, and sympathetic listener to beefs and griefs, individual and collective, 1850 prisms. Broadhead's vocation, doctor and bonesetter to the motion picture projectors of S. W. New York State, afforded him considerable spare time.

The Emerson Optical Co., Inwood, N. Y., Ralph Franklin, engineer, and Frank Cameron, assisted by Mrs. Cameron and one employee, were the only ones who made a large number of prisms (1700) in spare time, after doing full days' work in their vocations. For this they paid the penalty of creeping fatigue.

The Optical Associates, of Detroit, L. H. Sampson and several other amateurs, made 4500 prisms—which, however, was only a part of their general optical work. They plan to remain permanently in optics.

The Modern Optical Co., Toledo, 7300 prisms, consisted of Wm. Buchele, an amateur who had made a 20" reflector described in this department October 1939, assisted by his father, son, wife, and brothers, whom he trained to do some of the processes. He remains permanently in optical work.

Ferson-Linde Optical Co., Biloxi, Miss., 11,160 prisms, was Fred Ferson of Biloxi and Paul Linde ("Pavel Uvaroff") of Crossville, Tenn., assisted by one full-time helper trained to do grinding. Ferson remains in optics as head of the Ferson Optical Co., Biloxi, while Linde, in Crossville, Tenn., is doing individual optical jobs on the side, as he had been doing before the war. Like the rest, these two pitched the time-clock into the well and worked from 8 A.M. till 9 P.M. till they were fagged—and then kept going.

The total production mentioned above is 28,420 Amici roof prisms accepted and purchased at prices which ranged somewhat above and below ten dollars each.

What percentage of the total roof prisms produced in the nation the 28,420 represents cannot yet be stated and is not large—probably under a tenth part. Where the amateurs made up for this, and more than made up, was in quality. Their percentage of prisms accepted by Government inspectors was higher than for all or nearly all the professional producers. This is not, however, a reflection on the professional. The amateur was running a small shop and doing his own work, or the finer parts of it, himself. He had high incentive—interest in optics as a science—and, above all, personal pride derived from his telescope making days. The professional seldom could employ men having the same incentive. In other words, had the amateurs greatly expanded they, too, would have had to employ wage earners for the finer parts of the work, and then their level would have had to fall to the common level, which ran from 80 to 90 percent acceptance of prisms submitted; in a few instances higher. Not all the amateurs even equalled this level but most of them considerably exceeded it. Buchele, Broadhead, and others ranged around 98 percent. On their 11,160 prisms Ferson-Linde bettered 99½ percent acceptance by purchasers.

As Ferson pointed out in these columns in May, 1943, the telescope maker is judge and jury of his own work but when optics are sold to others a disinterested, tough, and hard-boiled, impersonal inspector steps in. Suppose, for illustration, the same rigorous standard were applied to the mirrors you make. For one single pit a mirror would be rejected, or for one tiny scratch visible only under a ten-power glass perhaps after you had been shown just where to look. How many mirrors would get by? That is what the prism makers encountered—greatly stepped up requirements (not a bad thing,

however, since compromise would only beget more compromise, then laxity).

The amateur had much more skill compared with the field—a major part of which consisted either of new firms without optical background or old non-optical firms thrown into optical work because it had to be done by somebody—than was sensed at the time. Had this been sufficiently realized nothing would have been allowed to obstruct a plan which Porter, Ferson, and your scribe at first projected: the gathering of the amateurs in one place and in one organization—Amateurs Incorporated. To this, two obstructions arose. One was the simple fact that, until the amateurs' own ability to do this optical work of the toughest kind equally well with professionals had been demonstrated—a thing which required so long a time that the demand for roof prisms was largely filled by the time that they knew they could successfully do it—they dared not quit their regular jobs and make the leap. A second was the fact that a certain professional optician was able to convince authorities that amateurs never could make roof prisms. The man who accomplished this questionable end did so at a critical time when the nation's need for roof prisms has been described as desperate. At best he used bad judgment. At worst his outlook was constricted.

When World War III comes (compare with the history of Rome's three Punic Wars, in the third of which Rome virtually erased Carthage when Carthage was once more found to be rearming) let the amateur hit his optics early, hard, and unitedly, and with no inferiority complex.

SINCE Ferson, starting with average advanced amateur background (three mirrors, a flat, a lens), devoted three years of intensive concentration to optics and learned a lot which daily work of the same kind afforded frequent opportunity to check, this department recently invited him to write out for the benefit of other amateurs and professionals the boiled-down juice of his experience; and since two chapters in "Amateur Telescope Making—Advanced" (those on the Gaviola and Zernike tests) had aroused little interest since their inclusion seven years ago, these have now been replaced by a single 29-page chapter by Ferson, entitled "Prisms, Flats, Mirrors," in a new printing of that book. In the same printing Dr. John Strong has completely rewritten his chapter on mirror aluminization and has included in it some new and valuable working pointers. The book is still Edition 1 but is now the fifth printing of that edition, and is revised to the extent of a total of 39 new pages.

In his 29-page chapter Ferson gives the essential principles of prism manufacture for large- and small-scale production, also for hand production of small batches from a dozen down to pairs and singles—the singles being polished and corrected within annuli of plate glass for easier control by the tyro.

He gives a list of prism-making equipment and some dodges for avoiding too heavy investment on small jobs, compared with the value of the prims.

He tells how to grind a prism to a close angle before polishing, a very pretty and labor-saving art.

He explains how prism face angles are tested.

He explains the exquisite art of correcting, freehand, the polished prism faces. This is the final process and the one calling for the greatest skill, but also is the most interesting one—rubbing off single seconds of arc with a few simple strokes (simple if you know how!).

For prisms, flats, and mirrors, Ferson lays much greater stress on grinding than our art has ever called for before. His intensive experience revealed grinding to be just as important as polishing and no longer a perfunctory, merely mechanical, preliminary process. The practical dividend from supergrinding is the avoidance of such ills as turned edge. Ferson thus pursued one source of turned edge into its hole and dug up the hole—found the basic principle involved and devised a remedy, a part of which includes the use of a channeled glass tool for grinding, a talc-emery mixture, and drying up the wets. One hour per stage also is now held to be too little with Pyrex.

The relation between prisms and flats may seem remote but actually is immediate: prism making is flat making. Prisms have flat faces but, even more to the point, they are blocked in batches in plaster matrices and thus are elements of a single big flat. Before the beginning of polishing, a flat can be ground within half a wave of the ultimate.

For polishing, Ferson finds that scratches are not attributable to hard laps.

He uses onion sack for sub-facetting and a rosin-pine tar mixture for the lap.

The main secret of success is the use of the dummy polisher for keeping the lap itself flat; the same dummy is used in keeping a lap dead flat for hand correcting prisms.

Ferson's work brought out the vital importance of correctly conditioning the rouge after applying it.

Some rules of heat effects are stated.

Finally, in his chapter, Ferson applies his prism and flat technique to mirror work, with the same channeled tool, same drying up of the wets, as precautions against turned edge inherited from grinding. But the dummy obviously can't be used on a non-flat surface. Mirrors are polished face up.

Not all these methods are claimed by Ferson; some are old. Mainly they are modifications of our amateur technique which protracted, intensive work brought out as more important than we amateurs had previously realized. Some of them seem radical, yet 11,160 roof prisms with an acceptance percentage of better than 99½ seems to commend them. Proof of the pudding.

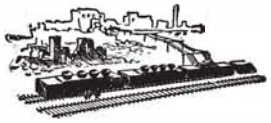
Ferson now does professional work yet remains amateur at heart, still freely giving his experience to the fraternity, as in the new "A.T.M.A." *Amo* means to love. The amateur is one who works for the love of it.

KEEPING UP WITH

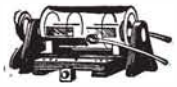
Electricity

SYNTHETIC FIREFLIES... New Westinghouse fluorescent marker lamp rivals the firefly in economy of light generation. Tiny lamp, consuming only 1/10th watt, will prevent mishaps on dark stairsteps. Unlike lightning bug, it can be kept glowing continuously—at practically no cost.

1/50,000,000th OUNCE... That's the weight of a single layer of oxygen atoms the size of an air-mail stamp. Westinghouse research engineers have built a delicate balance that measures the weight of such a microscopic layer of oxide on metal—to determine resistance of special alloys to high temperatures.



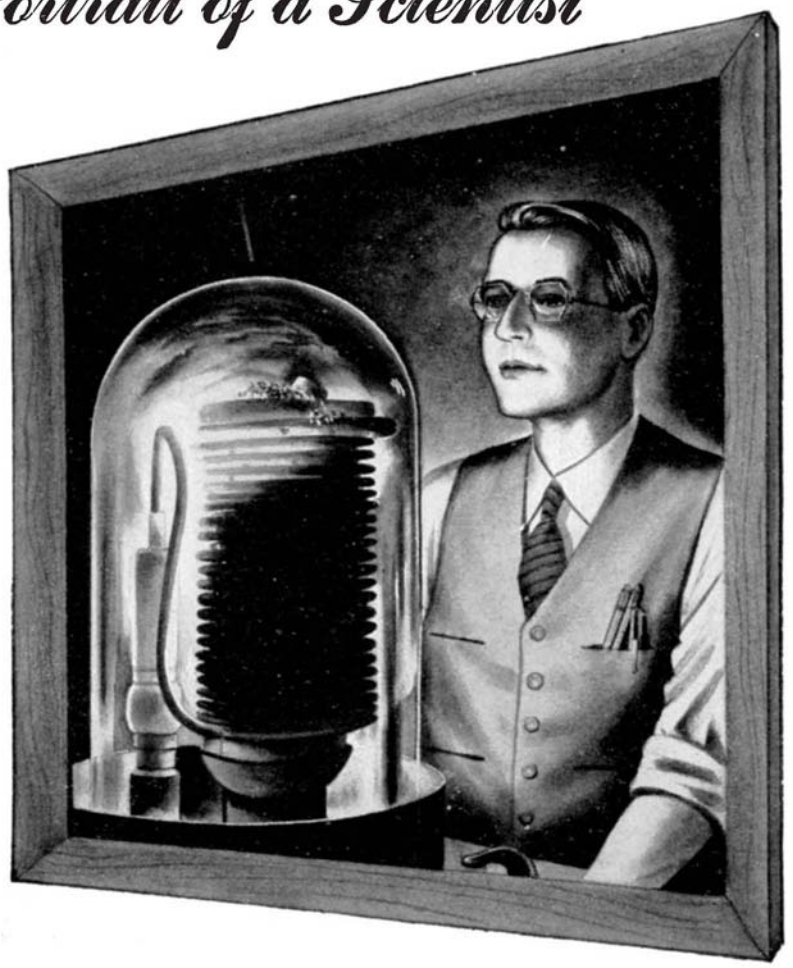
POWERHOUSE ON WHEELS... The retreating enemy knows that the quickest way to paralyze a city is to destroy its powerhouse. Advancing Allies know that the quickest way to restore order is to restore power. A 5000 KW power train, built by Westinghouse, moves in on railroad tracks, hooks up to power lines, starts boiler and generator . . . then lights come on, order emerges.



INSIDE STORY... Transparent Lucite bearings now permit research engineers to visualize performance of lubricating oil in bearings, subjected to varying operating speeds and pressures. Red pigment shows where oil goes and what it does.

PREFORMED PLASTICS... New Westinghouse process in plastics manufacture "beats" resins into cellulose fibre, then shapes mixture over perforated copper form. Plastic is peeled off and dried, then placed in heated mold and pressed into final shape. Saves time in making reinforced plastics of intricate shapes.

Portrait of a Scientist



creating a better yardstick for testing wartime metals

Spectrum analysis provides the *quickest* and *most* accurate method for checking the composition of metals used in making guns, planes, tanks and ships.

Iron has long been used as a *yardstick of comparison* in spectrography—because of the large number of lines in the iron spectrum.

Formerly, the best standard obtainable was *iron only 99.9 per cent pure*—containing impurities that produced confusing lines in spectrographic pictures.

Westinghouse research engineers tackled the difficult problem of producing a purer iron—a *better* yardstick for testing wartime metals.

They accomplished this by fusing the purest iron obtainable in a high-frequency induction furnace, surrounded by an atmosphere of hydrogen gas.

Result: iron 99.99 per cent pure—containing only 1 part metallic impurities in 10,000 parts of absolutely pure iron!

Today, this ultra-pure iron is "mass-produced" by Westinghouse at the rate of 1000 pounds per year—and is used in all parts of the anti-Axis world to improve the quality of war material.

A significant contribution, by Westinghouse, to industry at war and in the days of peace to come. *Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pa.*

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Across the roof-top of the world the champions of international air fleets will race for the supremacy of the skies. As great ocean liners contended with each other on the high seas for freight and passenger preference, so will the *de luxe* air liners of America vie with those of Europe for the traffic of the stratosphere.

Rivalry in size and speed, and in the visible aspects of comparison, may be close. Factors of service and comfort may be universally applied. But for their unseen, glamorous engine rooms, versatile units of Hycon hydraulic systems are now ready to do a score of jobs which mean greater efficiency, reliability, and economy in time and personnel.

This *booster force* of hydraulic power has many potential applications in aerial transportation. Already standard equipment on the Lockheed P-38 and the Douglas C-54, it has variable volume of pressure up to 3000 pounds per square inch. Specify HYCON Pumps and Valves, or complete Assembly Units for the hydraulic jobs in the coming Titans of the Air. Write for full information.

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The compact high-pressure Hycon "Stratopower" pump, furnishing *variable volume at pressures up to 3000 pounds per square inch*—when no longer restricted by wartime needs—will do a great many hydraulic jobs better.

Out of the incredible demands of the war will come miracles of technological improvement to help rebuild a shattered world. More goods must be produced faster and cheaper. New machines will be created and old machines modernized. If you have a problem of actuation in your postwar plan, or the modernization of your present equipment, Hycon will help to solve it. Though our facilities are primarily devoted to production for the armed forces, there are still available for industry Hycon pumps and valves in the 3000-pound range. Write for full information.

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