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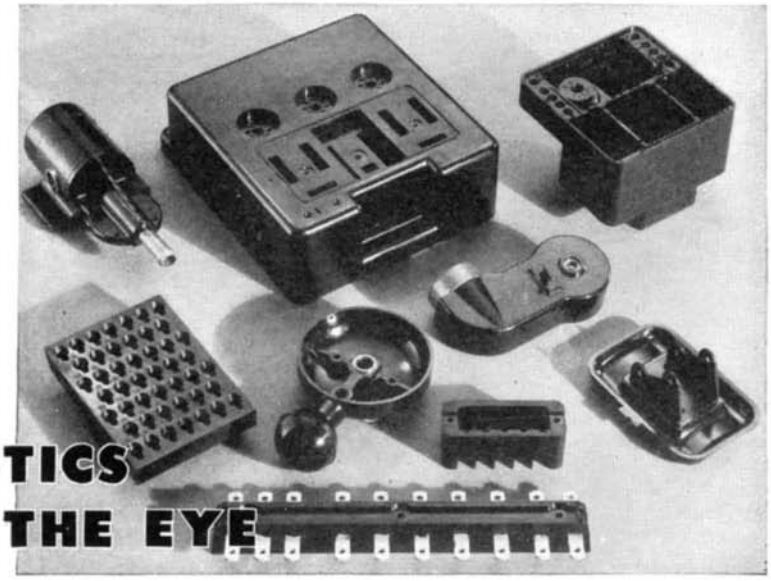
REPORTING THE PROGRESS OF SCIENCE AND INDUSTRY

Photograph by Robert Yarnall Richie

Steel Yields to the Drill . . . See page 241

THERE ARE MORE USES OF DUREZ PLASTICS THAN MEET THE EYE



In the electrical manufacturing field alone there are hundreds of "hidden" applications for Durez phenolic molding compounds. For example, take the molded Durez parts illustrated. They are parts of various Minneapolis-Honeywell electrical control devices. When the complete controls are assembled and in use, these plastic pieces are not all noticeable... bearing out the statement that there are more uses of Durez plastics than meet the eye. Furthermore, this axiom holds true throughout practically all fields of industry. *Chances are there are several "hidden" (as well as obvious) applications for Durez phenolic plastics in the products you manufacture.*

Why Plastics?

Plastics have long been considered a vital material in the manufacture of electrical equipment. For many parts ... such as those illustrated ... experience has proved that they are far superior to any other material.

Why Phenolic Plastics?

Because the phenolics are the most versatile of all plastics, alert design engineers have learned to start with this group in searching for the plastic that fits their job. Such properties as high dielectric strength, arc resistance, dimensional stability under temperature extremes, impact strength, and heat resistance... to mention a few... make these ideally suited for many of the thousand-and-one small parts that go to make up the industrial or consumer electrical unit of today.

Why Durez Phenolic Plastics?

During the past 26 years Durez laboratory technicians have actively participated in the successful development of thousands of products of which phenolic plastics have been an integral part. Combine this rich background with the fact that there are more than 300 versatile Durez phenolic molding compounds and you can readily understand why leading manufacturers everywhere look to Durez for the plastics that fit their jobs.

Experienced Assistance Available

The benefits which the experienced Durez staff and a wealth of proved product development data can offer to you and your custom molder are available for the asking. Durez Plastics & Chemicals, Inc., 16 Walck Road, N. Tonawanda, New York. *Export Agents: Omni Products Corporation, 40 E 34th St., New York 16, New York.*

PLASTICS THAT FIT THE JOB

Scientific American

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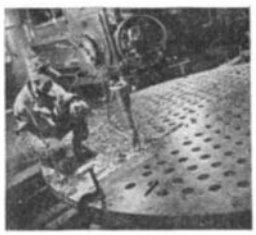

Industrial Drama: Coolant bathes a huge drill as it bores its way inexorably through the metal of a bubble tray for a fractionating tower being fabricated in the plant of the Wyatt Metal and Boiler Works.

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of June, 1896)

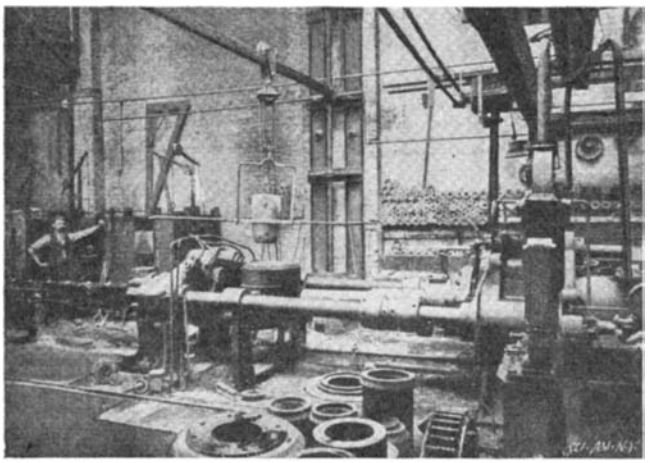
FLUORESCENT LIGHT — "The Edison fluorescing lamp produces light at the rate of 0.3 of a watt per candle power. When this is compared with 3 watts per candle power for incandescent lamps, and ½ watt per candle power for arc lamps, it will be seen that there must be great economy in the fluorescing lamp."

RAIL JOINTS — "The great increase which has taken place in late years in the weight and strength of steel rails on trunk lines has made the problem of providing a strong joint a much simpler matter than it was in the days of the old fifty pound iron rails. But though the difficulties have been lessened, they have not been removed; and any analysis of the labor expended by a section gang upon a stretch of first-class track laid with one hundred pound steel rails would show that even here a large proportion of it was devoted to 'keeping up the joints.' "

LATHE — "An automatic copying lathe with automatic screw feed has been designed for turning from patterns all kinds of irregular shapes, such as spokes, neck yokes, singletrees, hammer, hatchet, pick and ax handles, shoe lasts, gun stocks, and other similar wooden articles. . . The pattern which guides the path of the cutter head and governs the shape of turning should be an exact duplicate of the shape desired to turn, but the size of the article turned may be varied, either larger or smaller, from the same pattern."

AUTO RACE — "The Cosmopolitan Horseless Carriage Race was run on May 30, the winner being Charles E. Duryea, of Springfield, Mass. There were nearly thirty vehicles entered for the race, but on the morning of Decoration Day only six appeared to compete for the prize. Four of these belong to the Duryea Motor Company, Springfield, Mass., one was the Booth-Crouch carriage and the other was the Roger carriage, a French invention. The winner covered 13 miles in one hour, five minutes, and 42 2/5 seconds."

EXTRUSION — "The invention of Mr. Alexander Dick deals with all kinds of metallic sections, by forcing metal heated to plasticity through a die under hydraulic pressure. . . It is true the principle of extrusion has been applied to the production of continuous lengths of leaden pipe and wire, and of leaden rods for the manufacture of small arm projectiles; but in the present case the metal is operated upon at a very high temperature, that of plasticity, or about 1,000 degrees, F. The process consists in placing the heated metal in a cylindrical chamber, at one end of which is a die. Upon pressure being applied at the opposite end, the plastic metal is forced through the die. . . The edges of the openings in the dies are beveled, so as to give free access to the metal under pressure and to more perfectly condense it. The metal is forced out of the container through the die by an 18 inch hydraulic ram, working under a pressure of 4,480 pounds per square inch."



Producing metallic bars by extrusion

LAKE STEAMERS — "The shipyards of the Great Lakes had ninety vessels of various classes and dimensions under construction when the season opened this spring. . . Nearly fifty of the new boats are to be of steel, which is now supplanting wood for all vessels of large size."

INVENTORS — "It is unfortunate that the person who claims, or is accorded by the public, the title of inventor should be popularly regarded as possessing powers which border on the miraculous; for, as a matter of fact, the most successful inventors have ever proved to be men of a practical turn of mind and of clear vision; who loved to pursue their investigation on logical lines, laying the foundation broad and firm as they proceeded; men who were marked above everything else by unwearying patience and perseverance that was unconquerable."

ACETYLENE — "It is stated that acetylene is being tried in some of the tram cars in Paris, and with promising success. . . As the lighting power of acetylene gas is something like fifteen times that of coal gas, the cost is stated to be less than that of illuminating the cars by petroleum."

POWER GENERATION — "One of the novel electrical developments of the West has been the operation of electric lighting plants by means of artesian wells. The latest of these is at Chamberlain, S. D. In the Chamberlain plant, the water impinges on buckets arranged radially on the rim of a well known type of Western wheel. This wheel is mounted on a shaft which carries a large driving pulley, and the pulley belts to a five hundred incandescent light alternating current machine."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

(Condensed from Issues of June, 1846)

CUT-OFF — "A circular piece of common thin iron plate, or sheet iron, being adjusted in a lathe, or by other means put into a violent rotary motion, will readily cut off a file, a cutting tool, or tempered steel spring, without drawing or reducing the temper."

WIRE PROTECTION — "The Legislature of Connecticut has passed an act for the protection of the telegraph within that State, and imposing a penalty of a heavy fine and imprisonment on any person who shall injure the line."

RAILROADS — "Several of the great lines of railroad in France are advancing with great rapidity, and portions of them are opened from time to time for use."

FIREPROOF — "A store with walls of brick or stone, rafters and beams of iron, a roof and floors and ceilings of iron and tin, would be in no danger of fire without, and very little from within."

NIAGARA — "It appears that a motive power of the single cataract of Niagara would be sufficient to move all the artificial machinery of the earth."

Yes, or alike as two telephone handsets made by the same process. Yet, pins or handsets — no two could ever be made exactly alike. Dimensions, weight, performance — all vary every time due to variables in manufacture. How can these variables be *controlled?*

Back in 1924, Bell Laboratories' mathematicians and engineers teamed up to find out, forming the first group of quality-control specialists in history. They invented the now familiar Quality Control Chart, designed inspection tables for scientific sampling. They discovered that test data mathematically charted in the light of probability theory were talking a language that could be read for the benefit of all industry. Western Electric, manufacturing branch of the Bell System, applied the new science to its large-scale production. In war, it was used by industrial and government agencies of the United Nations in establishing and maintaining standards for military matériel. A Quality Assurance Department, a novelty back in the nineteen-twenties, has come to be indispensable to almost every important manufacturer.

Scientific quality control is one of many Bell Laboratories' ideas that have born fruit in the Bell System. The application of mathematics to production helps good management all over the industrial world — and furthers the cause of good telephone service.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.

Previews of the Industrial Horizon

By A. P. Peck

WOOD FACES TROUBLE

OFTEN dealt with in the pages of Scientific American have been the various aspects of wood production and use. Right now it appears that wood faces a two-forked impasse. First is the all too familiar cost of production *versus* price control. But in the long view this must be considered as a passing phase. Far more important is the second fork: Growth. In 1945, for example, almost twice as many board-feet of lumber were cut from American forests as were grown. Obviously such a situation cannot continue for very long. Of course, the wood industry in general is completely familiar with the facts of the case and is doing something about it. But what is being done is not by any means enough. More industrialists must realize the importance of wood in our national economy, and add their strength to adequate plans for the restoration and perpetuation of our forest resources.

Above all, wood must not be thought of simply in terms of lumber. Wood offers a vast storehouse of raw materials for a number of industries other than those concerned with building materials. Pulp and paper come next to mind, but then there are such other diversifications as textiles and textile sizings, plastics, dyes, insect repellants, perfumes, resins, essential oils, gums, alcohols, sugar, and a thousand and one other materials for the chemical and allied industries.

Faced with even this abbreviated list of wood products, the problem looms large. Our forest lands are far from producing their maximum yield. Our research laboratories have only scratched the surface of the potentialities of wood. Our forests can and must become our largest source of raw materials for the greatest number of industries. But they can reach that goal only by intelligent application of scientific principles of adequate reforestation.

This subject of reforestation is one that has been bandied about for generations. Now the limit is approached. An understanding has been reached of the importance of the forests of the United States, but all too little has been done about it. Many industries, old and new, depend on wood. If for no other reason than for their contribution to these industries, the forests of the nation must be put in shape for maximum productivity.

THREAD DESIGN

UNDER the above title was published an item on this page in our February 1945 issue. It was concerned with the necessity for standardization of screw threads on an international basis. Now, with the war over, this industrial problem remains as large as ever. During the war, production of many items was hindered by the differences between British and American standards for threads. But now something is being done about it. As the result of months of technical effort on the part of national engineering committees, a working foundation has been laid for unification of the basic screw threads to be used by industry in the United States, Canada, and England. The new screw-thread form, paving the way for closer international unification of industry, retains the best features of former standards. The recommendations of the engineering committees should be adopted by the national standardizing bodies of the countries involved. Screw threads may seem trivial in themselves; actually they are of the utmost importance to industry.

LIQUID METAL

MERCURY, unique among metals because it is liquid at normal temperatures, has a future as bright as its own surface. Two recent developments lead the parade. One of these is the mercury dry cell developed for war uses and now being groomed for exploitation in hearing aids, portable radios, and other compact electronic devices. The other is the so-called mercury clutch for fractional-horsepower electric motors that gets such motors up to speed with minimum current consumption and reduced wear and tear. The clutch holds promise in such applications as washing machines, refrigerators, vacuum cleaners, and similar devices.

Then, there is the use of mercury in electric switches, fluorescent tubes, pharmaceuticals, fungicides, wood preservation, mercury-arc rectifiers, and so on. True, the liquid-metal industry seems to have lost a big market in anti-fouling marine paints to the plastics industry, but a new mercury-copper combination for this purpose bids fair to recapture at least a large part of the lost business.

In any event, mercury production is rising; new applications are being found for it; the potential supply appears to be practically unlimited; and its material peculiarities lend themselves well to industrial investigation.

"WHEN CAN I GET ONE?"

TREMENDOUS indeed was public interest in private planes exhibited recently at the National Aviation Show (New York); hundreds of orders were placed for various types of planes and the most-asked question on the part of buyers and would-be buyers was "When can I get one?"

Whether the favorable acceptance of the models displayed at the Show can be accepted as a barometer for the future of personal planes is something that only time can prove. But there is no question about the fact that private flying is going to expand rapidly in the near future and that one of the big fields for small planes is going to be their use by industry. Already a number of industrial organizations own ships and use them to save time for their executives who must travel long distances between plants or to conventions and the like. This use of non-commercial planes is and will continue to be a solid backlog for aircraft manufacturers. It does not depend upon thrill-seekers, but rather upon the inherent values of aviation itself.

On page 252 of this issue, Dr. Alexander Klemin gives essential and pertinent facts about personal planes. Future articles by Dr. Klemin will take up other aspects of private flying so as to present to our readers a complete and unbiased view of the advantages and disadvantages of this most modern form of transportation.

FOR FUTURE REFERENCE

BY 1965 cork oaks being planted in the south and southwest should be producing; they represent intensive efforts to establish an age-old industry in the United States, making this nation independent of the rest of the world for its supply of cork in all forms. . . Steam generators, for use with oil or gas and ranging in size from five to 200 horsepower, are available in completely assembled units; they can be in full operation within a matter of hours after arrival at the plant. . . Magnesium, once considered a flammable metal useless for applications where intense heat is generated, is now being produced in alloy form that will resist the elevated temperatures found in gas-turbine compressors; it is corrosion resistant and has strength-weight properties superior to commercial aluminum alloys; the metal is still in the experimental stage. . . An Incentive Division of the Office of Domestic Commerce has been set up to study bonus, incentive-pay, profit-sharing, and other systems used by industry to promote production; its own greatest output will undoubtedly be red tape.

Laminated spar flange for a Fairchild airplane being removed from press. Here high-frequency energy simultaneously molds the wood and sets the glue quickly

ELECTRONICS

Conducted by KEITH HENNEY

Joints In A Jiffy

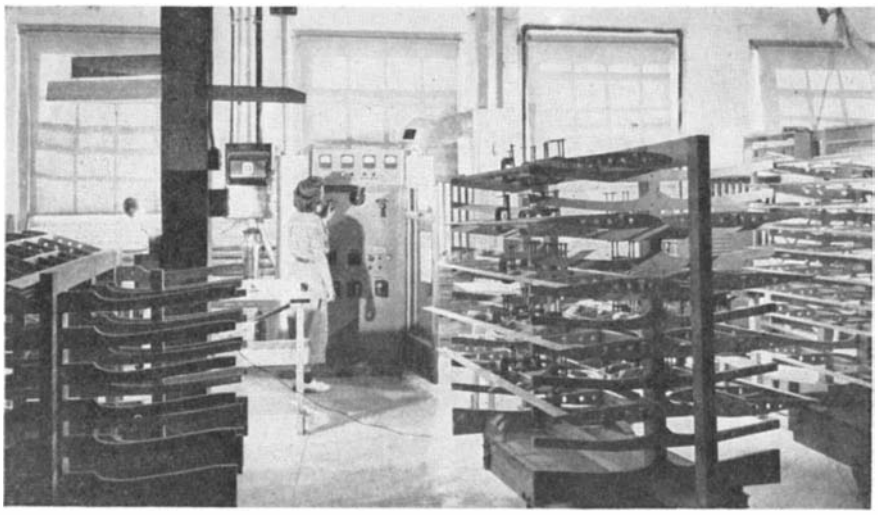
Electronic Heating to Set Glued Joints Moves Wood-Products Assembly into the Mass-Production Class. Marked by Uniform Heat Throughout the Joint, High-Frequency Techniques Slash "Clamped-Up" Time, Cure Interior Glue Lines Without Danger of Over-Curing Near the Surface

By JOHN MARKUS
Associate Editor, *Electronics*

THE HITHERTO baffling problem of getting a uniform degree of heat quickly to all of the glue lines in a piece of furniture or a thick laminated-wood section has been solved by harnessing the electron. Electronic heating, as used for wood, goes by many other names—radio-frequency heating, diathermic heating, dielectric heating, and high-frequency heating—all referring simply to the use of high-frequency alternating current to generate heat.

Its application entails the use of two plates or electrodes, between which is placed the wood to be heated. A high-frequency alternating voltage is applied to the plates. At one instant the top plate is electrically positive and the high electrical stress in the wood tends to move the molecules in one direction. On the next electrical alternation, the lower plate is positive and the molecules are urged in the other direction. For a frequency of 30 megacycles, this is repeated thirty million times per second, and the friction between the molecules results in heat. The higher the frequency, the greater is the friction and the more heat generated.

Since the heat is generated in the wood itself, it is unnecessary to place the work in an oven. The electrodes are at relatively high voltage, however, and must be surrounded by a cage to protect the operator



Use of 15-kilowatt RCA generator at Wurlitzer plant upped wing production to seven times former rate, cut curing time from six days to a mere matter of minutes

from electrical shock. Since the wood need not be touched by the electrodes, it may be heated while moving on a conveyor between the electrodes, provided the spacing between the electrodes and the work is not too great.

Heating can be obtained either by a combination of low frequencies (on the order of three megacycles) and high voltages (15,000 to 18,000 volts) or high frequencies (up to 30 megacycles) and lower voltages (3000 to 4000 volts). The selection of the proper combination of voltage and frequency is a complicated one. The thinner the piece being processed, the lower must be the voltage to prevent arcing between the electrodes. Also, for a given amount of heat, a four-fold increase in frequency will reduce the required voltage by half.

BONDING METHODS—To see why electronic-bonding techniques have been so important to develop, it is helpful to review the three classes of bonding materials or glues which are in general use: casein glue, urea-formaldehyde resins, and phenol-formaldehyde resins. The first two classes will set at room temperature in about six to eight hours, although this time can be reduced by the application of heat. The third class, and the most durable, requires either room temperature coupled with a long setting time (measured in hours) or high heat of 200 to 280 degrees, Fahrenheit, for the rapid setting (measured in minutes) necessary for production.

There are two general methods of applying heat to a glue line. The first—non-electronic—is to apply a heated platen to the surface of the wood and allow the heat to soak in from the outside. The second—the electronic process just described—causes the wood to heat uniformly throughout its thickness.

In the furniture industry, curved-laminated sections for radio cabinets, pianos, and similar pieces of furniture can be assembled with electronic heat, and made lighter, stronger, and cheaper than when present methods such as slotting, steaming, bending, and reinforcing of a solid piece of wood are used.

An electronic spot-gluer, resembling an automatic pistol, has recently been developed for temporary spot gluing, or tacking, of veneers to hold them in place while laying them up on a mandrel to form curved plywood assemblies. This unique device applies high-frequency currents over a small area of the topmost veneer to form a temporary bond by partially setting the glue between the veneers at each point to which it is applied. Spot-gluing eliminates the need for the tacks or staples ordinarily used, which leave holes in the veneers and must be pulled out and re-set as each sheet of wood is added.

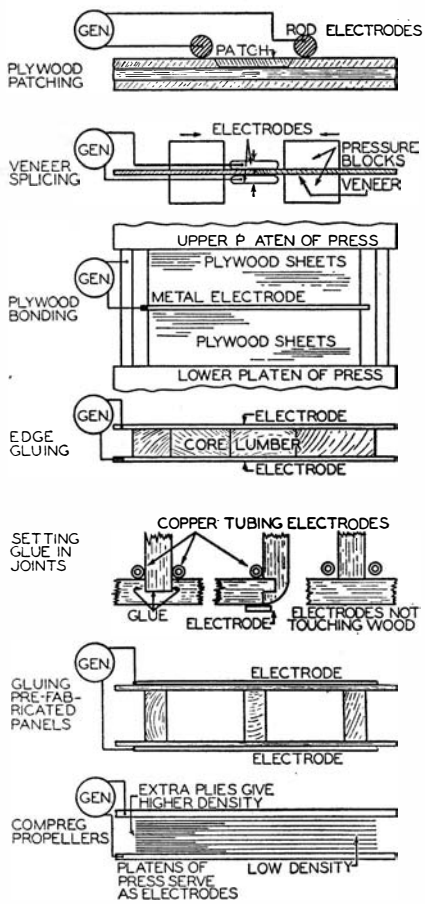
FURNITURE—Thus far, the principal application of electronic heating in the furniture industry has been edge gluing to make core lumber—the name given to the multiple pieces of solid wood placed between two pieces of veneer to make such large flat surfaces as desk tops, doors, chair seats, and table tops. The two electrodes are placed above and below the stock. Power is applied for five to 125 seconds, giving a glued board that can be taken out immediately and banged on the corner of a bench with assurance that any failure will be somewhere else than at the glue line. This obviously makes for an extremely rapid and efficient production process, readily adaptable to continuous production of core lumber.

When using high-frequency heating, it is not necessary to set up all the glue area. If, for example, 30 percent of the glue face area is set up in the machine, this will usually be sufficient to hold the pieces of stock together without further clamping. Then, a number of hours later, the remainder of the glue line will set up at room temperature and the finishing operation can follow.

Where production volume justifies the expense of setting up electrode fixtures and jigs for specific corners and joints in the article to be manufactured, high-frequency gluing can provide decided economies through increased production speed and consequent lower labor costs. Either contact electrodes or air-gaps can be used, but contact electrodes always provide the highest speed and efficiency if it is practical to use them.

The use of dielectric heating to set glue in the rounded corners of furniture is considerably faster than conventional slotting and bending, and requires no block to be glued and clamped overnight. Several 15-kilowatt generators are now being used to set laminated chair and table frames in this manner in about one minute.

In one application of high-frequency heating to the manufacture



Typical applications for curing glue electronically. Set-ups must be engineered for requirements of each job

• LOOKING AHEAD •

Timber sizes appear to be getting smaller; but the demand for wood products grows apace. . . Glue technology promises to fill the bill for making "big ones out of small ones". . . . Fast electronic heating reduces time of setting from hours to minutes. . . Opens way to new fabricating techniques. . . Furniture, prefabricated panels, plywood, laminated timbers can benefit. . . No mystery —just applied electronics.

of bed foots and bureau tops, the saving per day was found to be $160 for materials and $112 for labor, due solely to the change to high-frequency heating. These figures constitute a total saving of $68,000 per year, confirming the statement often heard that high-frequency equipment, if properly applied, will easily pay for itself in a year.

VARIED APPLICATIONS — Resin-impregnated and compressed wood is known commercially as Compreg. If resin-impregnated only, it is called Impreg. These woods found a number of war applications, one of which was the production of aircraft propeller blades which are reported to have a strength per unit weight in excess of that of steel.

The manufacturers of Compreg and Impreg envision considerable use of the material, particularly in the form of veneer, for such things as table tops and general furniture finishing, because it is extremely hard, almost impossible to nick, and relatively impervious to alcohol and other stains. Also, by using different lengths of veneer and pressing them between upper and lower platens that remain parallel, a material of varying density may be obtained. This enables the design of beams with varying strength to meet specific load conditions. In making wheels, propellers, and other products that will be subjected to centrifugal force, the low-density material is placed near the periphery and the strong high-density material at the hub. Electronic heating is particularly advantageous for uniform and fast setting.

While there has been little use for electronic heating by individual contractors in the fabrication of houses, a great deal of interest has been shown in such heat in the manufacture of pre-fabricated wall panels. These are normally made up of 3/16 to 3/8 inch plywood placed on each side of one by three or one by four inch studs, the space between being filled with insulating material. The panels are made in various shapes up to about four by eight foot rectangles, and glue in joints can be speedily set from the outside by application of high-frequency energy through appropriately shaped and positioned electrodes. Uses of electronic heating for drying wood have been found, but only where the part to be dried is extremely small, such as broom handles, knife handles, and smoking-pipe pre-forms. Here—in contrast to large-scale timber drying —the path for the water to get out of the wood is short and the high-speed advantage of dielectric heating can be adopted with economy. Another application is re-drying the entire flitch in the production of fancy veneers, since the total moisture to be removed is less than 10 percent and the material itself is thin.

PLYWOOD—One lumber industry application that has begun to be successful is the use of dielectric heating for veneer patching. When a knot-hole or other imperfection is found in the top veener, a piece is cut out of the top veneer surrounding the knot-hole. The piece is of exact shape to match pre-cut patch, which is then laid in place. The two heating electrodes are held side by side against the top veneer, and the current flows through the glue line in a very short time. With only a few hundred watts of power, such patches can be set in five to fifteen seconds.

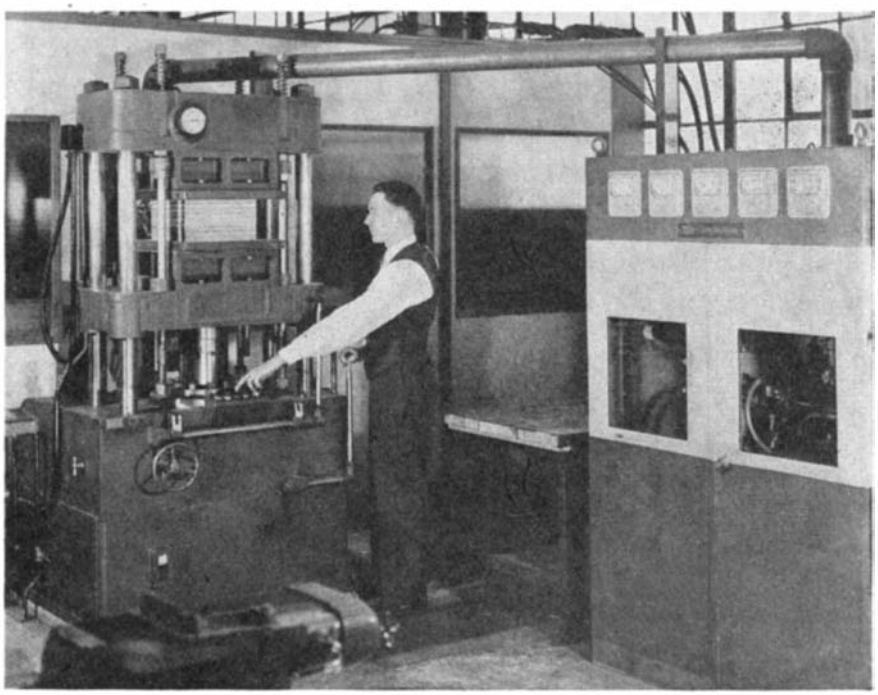
The manufacture of plywood in large batches has come in for considerable attention and at least one such installation in the United States has been in operation since 1942. Here, two batches of four by eight foot plywood, each batch one to two feet in height, are heated simultaneously with rather high-power generating equipment.

Considering the growing scarcity of large cross-sections of timber, and the inherent lack of uniformity of lumber, the more efficient production of plywood, bonded in minutes instead of days by the use of electronic heating, assumes tremendous importance. Plywood is uniform in quality throughout a given piece, eliminating the need for such large safety factors as are required when timber is employed.

Previously, it was uneconomical to produce sections of plywood thicker than about one inch because of the impossibility of effectively setting the adhesive in the interior before the resin near the surfaces became over-cured. With electronic heating, however, practically any thickness of plywood can be made with the assurance that all of the glue layers will be cured uniformly. As an example, 148 sheets of impregnated birch veneer have been glued successfully using a phenolic-resin adhesive.

High-frequency heating has been used extensively in the manufacture of aircraft wing spars, PT boat girders and ribs, boat keels, and other comparatively large items. The sandwich method is used and electrodes and presses 20 feet long are entirely practical.

Now, extensive use of electronic



Plywood press receives high-frequency energy from Westinghouse generator at right. Heavy sections may be bonded since heating is even through all layers

heating is expected in the manufacture of pre-fabricated laminated girders and arches for auditoriums, aircraft hangars, and stages. Similar techniques were used during the war to make sections of wooden airplanes, skis, balsa-wood life rafts, lead pencils, and shuffle boards.

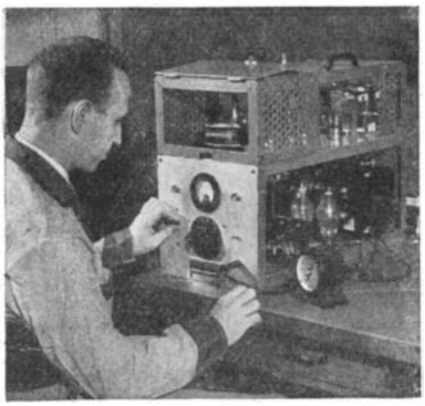
NOT MAGIC—There is no great mystery in using electronics to speed up the setting of glue lines and produce more durable wood products. However, the successful application requires the services of an experienced engineer who not only understands high-power radio equipment, but who has a thorough understanding of basic electrical engineering. In addition, he must understand the theory and application of bonding agents, wood technology, and the application of fluid pressure. In practice, once the operation is set up and the proper safety interlocks provided, the electronic equipment can be operated by a locally trained technician.

Electronic methods heat wood products and glues so rapidly that their use has in many instances reduced process time from hours to minutes. Production rates are increased and costs reduced, rejects are fewer, wear and breakage on molds and presses is lower, and less expensive molds can be used. Intelligent use of electronic heating can therefore be considered a valuable advance in wood-products technology.

RUBBER COOKING

Time Reduced by Electronic Process

HEAT required for the marriage of molecules of raw rubber and sulfur during vulcanizing is produced electronically in a process now being perfected by The B. F. Goodrich Company, that holds promise of revolutionizing the tire-making industry. Electronic heat makes the molecules join together in minutes instead of hours, at a lower cost and with more uniform product quality. The new technique has already been tried on a variety of rubber products, with heating frequencies ranging up to 40 million cycles per second, and in some instances curing times have been cut to one eighth that required by former methods.



Rubber part, between disk electrodes, is vulcanized quickly and uniformly by electronic generator that changes 60-cycle line power to high-frequency power ranging up to 40,000,000 cycles

TRAIN SPACER

Advises of Obstructing or Overtaking Trains

THE DISTANCE between two trains moving toward or away from each other, on the same or adjacent tracks, is indicated up to a maximum range of eight miles by a radio distance indicator called Radin. The system has already been tried by the Rock Island Lines, and a permanent installation has been made on their crack Golden State Limited.

This new electronic instrument utilizes the phase change of a radio signal with distance from a transmitter as a means of measuring distance. At the front and rear of each Radin-equipped train is a transponder. This unit sends out coded signals in response to a radio challenge from another train and converts corresponding signals from the other train into distance indications so that engineers of both trains know exactly how far apart they are. If the trains are approaching each other, knowledge of traffic schedules for that section of line would tell whether the trains were safely on different tracks. Radin was developed by Sperry Gyroscope Company.

TAXI RADIOPHONES

Give Two-Way Communication Even in Shielded Areas

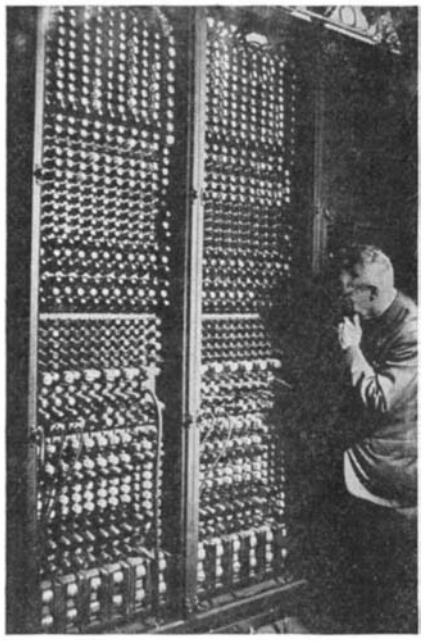
DEMONSTRATIONS of radio transmitter-receiver sets in Chicago taxies recently started cab companies scrambling to place orders for frequency-modulation equipment. The sets are designed for use in the 152-162 megacycle waveband allocated for vehicle two-way communication. One manufacturer, Galvin Manufacturing Corporation, has received orders from over 50 companies for an estimated total of about 500 cab radiophones, at a price of around $500 per unit.

The demonstrations showed perfect reception within a 15 mile radius of the station—ample for coverage of practically any city in the world. Operation was also satisfactory in places unsuited to ordinary broadcast-band sets, such as the steel-reinforced lower levels of sub-surface roadways and tightly screened railway station ramps.

ELECTRONIC CALCULATOR

Uses 18,000 Tubes to Solve Complex Problems

CAPABLE of solving scientific problems so complex and difficult that all previous methods of solution were considered impractical, an electronic robot, known as Eniac—Electronic Numerical Integrator and Computer—has been announced by the War Department. It is able to compute 1000 times faster than the most advanced general-purpose calculating machine built, and solves in hours problems which would take years on a mechanical machine. Containing nearly 18,000 vacuum tubes, the 30-ton Eniac occupies a room 30 by 50 feet. Originally developed to compute lengthy and complicated firing and bombing tables for vital ordnance equipment, it will solve equally complex peace-time problems in nuclear physics, aerodynamics, and scientific weather prediction.



Tubes are mounted in removable racks

Research laboratories of several industrial firms have expressed active interest in the machine. These include manufacturers of electron tubes, jet engines, gas turbines, and other types of engines. The first problem put into the machine would have required 100 man-years of trained computers' work but Eniac took only two weeks. Two hours of this was electronic computing time, the rest of the time was devoted to review of the results and details of operation.

Beryllium: Workaday Metal

Well-Established as a Practical Engineering Material, Beryllium has Shed its Cloak of Mystery. Expensive and Hard-to-Work in the Pure State, It Alloys with Other Metals to Provide Properties Otherwise Unobtainable. Main Use—So Far—is in Beryllium-Copper Combinations

By FRED P. PETERS
Editor-in-Chief, *Materials & Methods*

THE PRE-WAR "wonder metal," beryllium, is still the subject of considerable wondering. Many industrialists wonder if it's really a miracle material, harder than tool steel and nearly as light as magnesium—wonder if it will, therefore, take the place of all other hard and light metals. Some wonder if beryllium-copper, its most important alloy, will capture the markets for strong bronzes, alloy steels, and so on. Still others wonder if there's enough of the metal for all these uses, whether beryllium is any good at all, and if the price situation will change.

The answer to these questions about beryllium's present position and future possibilities may be found in its history and current applications. They show that beryllium has passed from the "rare earth" to the "important alloying metal" stage; that it is not a miracle or magic metal, but is an increasingly useful engineering material. Beryllium alloys mightily aided victory by serving in a number of highly critical war-application spots. Now, there is enough of it for all current uses and despite the unlikelihood of an early drop it its price, beryllium can look forward to a bright and increasingly important future.

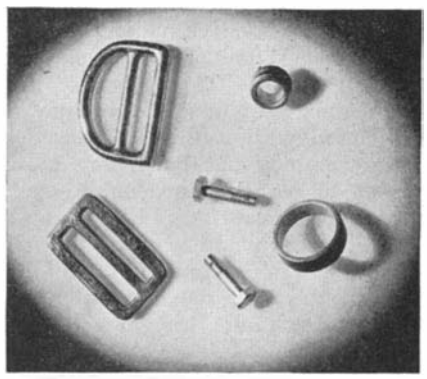
PRODUCTION — Beryllium was "discovered" by Louis Vauquelin in Paris early in the last century, and beryllium and copper were first alloyed in 1897. However, the commercial beryllium-copper alloys of today, and especially the use of heat treatment to achieve the exceptional mechanical properties characteristic of them, have all evolved within the past 20 years or so. Pioneers in the commercial production of beryllium and its alloys were Brush Beryllium Company, and Beryllium Corporation of Pennsylvania. Beryllium-containing alloys—chiefly beryllium-copper—in various fabricated forms are now produced by a number of additional manufacturers.

As late as 1941, beryllium ore production was only 2500 tons; by 1943 it was in the neighborhood of 6000 tons. Much of this ore production in 1943 was used to make 3000 tons of beryllium-cooper; a recent estimate of present capacity for beryllium-copper production is approximately 10,000 tons.

Again, in 1935 the price of beryllium metal was $200 per pound. Through production expansion, and because the copper-beryllium master alloy may be produced directly from the ores without having to make beryllium metal separately, the present price of the base alloy is down to $17 per pound of contained beryllium. Fabricated beryllium-copper now costs upwards of $1 per pound. But there seems to be no technological reason to predict a further lowering of the price in the near future.

Clearly, beryllium's future is closely tied to that of its most important alloy, beryllium-copper, which is now widely used for springs, diaphragms, electrical contacts, bearing bushings, non-sparking safety tools, gears, ball-bearing cages, plastics molds, and similar items. Yet there are other important, though "small tonnage," applications of beryllium metal, such as beryllium-aluminum, beryllium-nickel, and even beryllium-steels in either the fully established or "under-development" stage.

BERYLLIUM METAL — Possessing a number of highly interesting properties, pure beryllium's commercial utilization is sharply limited by the great difficulty and expense of working the metal. It is, for example, the only stable light metal—density 1.84, as compared with magnesium's 1.74—with a high melting point. Beryllium melts at 2350 degrees, Fahrenheit, magnesium at 1200 degrees, Fahrenheit, aluminum at 1240 degrees, Fahrenheit.



Photographs courtesy Instrument Specialties Company

Beryllium-copper forgings meet needs for corrosion resistance, toughness

Beryllium possesses an extremely simple atomic structure, so that the pure metal is virtually transparent to X-rays. This property has led to its use as the "window" in X-ray tubes and elsewhere in X-ray or diffraction apparatus wherever it is necessary to have a material through which X-rays will readily pass. The thin disks, strips, and other shapes

• LOOKING AHEAD •

Great strength at elevated temperatures is available in beryllium-alloys. . . . Precision instruments can be made better with beryllium-alloy springs because of low "elastic drift". . . Specialized applications of various alloys are coming into use. . . New treatment methods can control hardness, strength, and elasticity. . . New markets opening up.

used for these windows would be virtually impossible to form out of commercially pure beryllium, but if the metal contains small amounts of titanium and zirconium, sheets 0.004 inches thick are easily produced which have good brazing properties and will hold a vacuum for several years.

Possible acoustical applications are indicated by beryllium's excellent sound-transmitting ability, which is reported to be twice that of aluminum or steel. Its great oxidizability at high temperatures, plus its affinity for other gases than oxygen, has led to its use as a "getter" in vacuum tubes. The cast pure metal looks like steel and is hard, corrosion-resistant, relatively brittle—and very expensive.

In conjunction with radium, beryllium is useful as the source of neutrons for bombarding U-235 to produce plutonium—one of the steps in the manufacture of the atomic bomb.

Finally, as a metallurgical-addition agent—aside from its uses as an alloying element in copper and nickel alloys and steels—beryllium serves in amounts from 0.005 to 0.05 percent to de-oxidize, de-gasify, and control the grain size of aluminum and magnesium alloys and to increase their corrosion resistance.

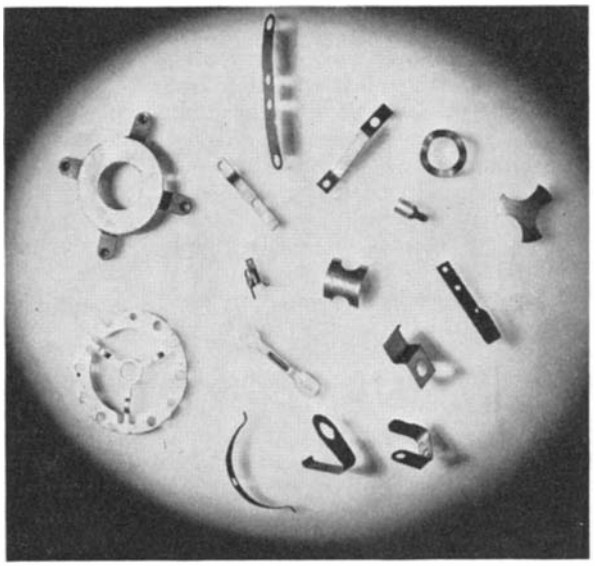
WITH COPPER—Beryllium-copper, the outstanding combination of the beryllium family, is today well established as an important engineering material. There is no more "mystery" or "magic" properly associated with it than there is with the common age-hardening aluminum alloys, the hardenable aluminum-bronzes, the heat-treatable steels, or any other alloy that displays an interesting combination of properties obtainable through heat treatment under known conditions.

Beryllium-copper, as commonly used, contains about 2 percent beryllium, ½ percent nickel or cobalt to aid in controlling grain size, and the balance copper. The alloy can be worked and fabricated in the soft or annealed state—or it may be formed in the cold-worked state—and then heat treated to give a combination of properties not available in any other material. Resulting tensile strengths in excess of 200,000 pounds per square inch make the alloy akin to hardened steel in mechanical strength. But beryllium-copper is much superior to steel in corrosion resistance and electrical conductivity, and is also non-magnetic. Its fatigue strength is greater than 65,000 pounds per square inch, a respectable value among all the engineering materials.

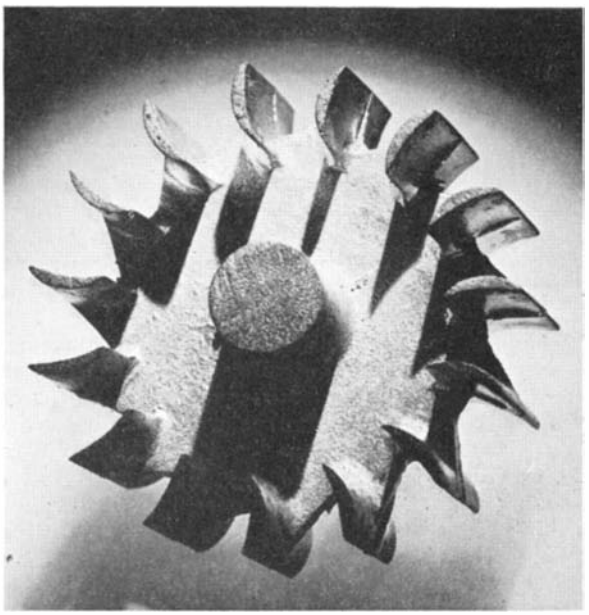
SPECIAL PROPERTIES—An unusual characteristic is the resistance to "elastic drift" possessed by heat-treated beryllium-copper. Drift is a form of "cold creep"—actually the failure of a metal to return to its original length after it has been stressed within its elastic limit. Poor drift properties are detrimental to such products as calibrated springs, which should return to their original positions and dimensions after each stretching. Correctly heat treated, beryllium-copper shows the lowest drift of all commercial spring materials, and has therefore rapidly increased in use for fine instrument springs, diaphragms, Bourdon tubes, and like applications.

Where strength combined with great toughness is essential, as in special types of bearings and bushings, gears, spring shims and washers, aircraft gun mounts, cowl-flap hinges, ball-bearing cages, and similar locations, beryllium-copper offers, in many users' opinions, the best properties available among all the copper alloys.

Again, for electrical parts, beryllium-copper provides a combination of high conductivity—both electrical and thermal—strength and fatigue resistance at high temperatures, and excellent corrosion resistance. These properties have led to its use for high-strength current-carrying springs, vibrator arms, resistance-welding electrodes, circuit-breaker parts, and in other spots requiring very-high-conductivity copper alloys that must also possess high-strength. For uses such as these, copper-beryllium alloys containing only 0.1 percent beryllium are being studied and show real promise for future uses.



Springs of beryllium-copper will withstand stresses twice as high as are safe for phosphor-bronze springs. For optimum use of alloy's special characteristics, the heat-treatment must match specific applications



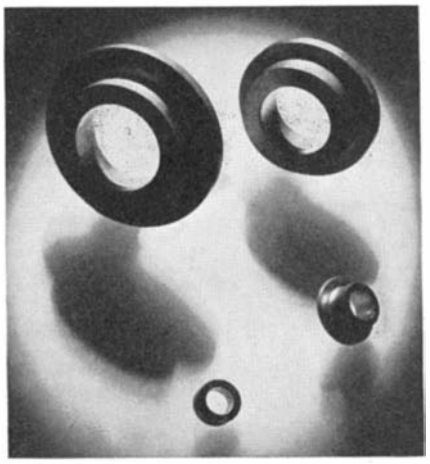
Unmachined impeller casting of beryllium-copper. Ability of this alloy to make sound, dense castings in intricate patterns is only now being recognized

FABRICATION — Beryllium-copper has received most publicity as a wrought material, but the use of beryllium-copper castings is on the increase as materials-and-process engineers learn more about their ad-

vantages. The alloy has excellent casting characteristics, giving dense, sound castings. When this is coupled with the high strength of the alloy after heat treatment, a product is obtained that often competes successfully even with steel forgings. Beryllium-copper castings, an addition to their impact strength and other favorable mechanical properties, are corrosion resistant and have high conductivity—advantages which recommend them over other materials for various special-characteristic products.

There is no standard heat treatment for beryllium-copper. For years, the traditional heat treatment was to anneal at 1400 to 1500 degrees, Fahrenheit, quench in water—this leaves the material soft and workable—and then to age-harden by heating for about two hours at 575 to 600 degrees, Fahrenheit. With such treatments, beryllium-copper developed good strength properties sufficient for most of its early uses and for many of its applications today. In recent years, however, study of the effect of heat treatment at different temperatures and times by metallurgists at Instrument Specialties Company, has shown that even better properties are obtained by age-hardening at higher temperatures for shorter times; for instance, 650 degrees, Fahrenheit, for 20 minutes or 700 degrees, Fahrenheit, for 12 minutes. It was also indicated that individually pre-determined cycles may be chosen for a given lot of material with a particular amount of prior working to produce maximum fatigue strength, minimum drift, maximum hardness, or special combinations of two or more properties. The heat treatment that produces the maximum hardness available in the material, for example, is not the same as the treatment that results in minimum elastic drift, so that, where feasible the hardening heat treatment should be selected according to service requirements of the product.

OTHER ALLOYS — Even stronger than beryllium-copper, and better for elevated-temperature applications, but not yet widely used commercially, is beryllium-nickel—nickel containing two to three percent beryllium. It may be heat treated to tensile strengths higher than 250,000 pounds per square inch and hardnesses of Rockwell C 53, with other properties comparable in many ways to those of beryllium-copper. It is considerably more expensive than the latter and thus is finding only specialized applications, particularly those requiring exceptional corrosion resistance or retention of hardness up to about 700 degrees, Fahrenheit.



Aircraft engine bushings, machined from bars, support high unit loads

The "beryllium-steels" are the most recent development in the beryllium field, with several companies actively investigating their high-temperature properties for gas-turbine and jet-engine use. One such steel, which contains 12 percent chromium, 8 nickel, and 1 beryllium, age-hardens to its maximum properties at 1300 to 1400 degrees, Fahrenheit, and is regarded as excellent for springs and other parts that must retain their strength at red heat.

Aluminum-casting alloys—developed especially for precision castings—containing beryllium plus copper, and sometimes cobalt—0.2 percent beryllium, 3.8 copper, 1.3 cobalt, and the remainder aluminum—have recently been developed with high-strength properties coupled with unusual oxidation resistance and thermal stability.

Although not itself a metal, beryllium oxide fills an important part of the beryllium market. It is one of the best very-high-temperature refractories—successful uses at 3600 degrees, Fahrenheit, have been reported. It is also a good electrical insulator at high temperatures, with unusual resistance to thermal shock. Other uses for beryllium oxide include high-temperature crucibles and shapes, fluorescent-lamp phosphors, furnace linings, radio-tube filament-heaters, refractory supports for electrical heating elements, and so on.

In view of the vast amount of beryllium in the earth's crust and the increasing body of sound technical knowledge about the metal and its alloys that has in recent years replaced the "mystery" concerning them, it is reasonable to predict future applications and markets for these exceptional materials far greater than they currently enjoy.

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ALUMINUM AUTOMOBILES

May be Produced by Spot-Welding

ONE TROUBLE with making all-aluminum automobile bodies in mass production is that aluminum alloys will not stand the severe deep drawing needed to produce attractive contours. Therefore, instead of making large sections in one piece as with steel, it has been suggested that several smaller pieces be made and then assembled. A spot-welding technique has now been worked out to allow the successful joining of several stamped-aluminum sections, and a few auto makers have definite plans to bring out aluminum bodies in their next models.

TINNED STEEL

Holds Paint Film; Reduces Corrosion

THIN TIN coatings on steel under paint are reported to protect against corrosion and perform the functions of a phosphate surface treatment. Some experimenters claim that they are easier and cheaper to apply than the phosphating. The tin coatings tested varied from ½ ounce up to 2 ounces of tin per square foot, the latter giving a very superior protection. The tin is applied by electrodeposition. Such treatment may be found on future motor-car bodies, steel window frames, refrigerators, ranges, and steel furniture.

RIVALS OF URANIUM

Promise More Radiation Energy at Lower Cost

KNOWLEDGE and developments concerning energy-radiating materials are expanding rapidly. Polonium, a pure alpha-ray emitter, is now available in quantities for scientific and industrial purposes. Suited for applications where effects due to penetrating gamma radiations must be avoided, it can be used in large quantities without danger to personnel. Polonium can be supplied in high purity as a solution and furnished co-precipitated with beryllium as an efficient neutron source. In addition, it is learned that lithium is at least theoretically able to yield two to nine times as much energy as uranium. Boron, a cheap element, could yield 25 percent more energy than uranium, according to some investigators.

Private Plane Prospects

With Many Design, Marketing, and Usage Questions Yet Unsettled, the Personal-Airplane Picture is Nevertheless Beginning to Clear. Industrial Users—Now Counted as the Best Market—Will Find a Wide Selection of Planes Adaptable to Nearly All Business Needs

By ALEXANDER KLEMIN
Aeronautical Consultant; Research Associate,
Daniel Guggenheim School of Aeronautics, New York University

WHERE DOES private flying stand today? What are its immediate prospects? What equipment is available and what does it cost? What difficulties are involved? What service, direct and indirect, does private aviation offer American industry and business?

Many agencies, both governmental and private, have directed considerable research towards finding the answers to these questions. Plane manufacturers want to know what the public seeks in a plane, how many can be sold, and at what prices. Sales-and-service agencies must determine marketing areas and plan their scopes of operation. The government must be able to apply judicious regulation to private flying, aviation personnel, air-traffic, and airports. And industry—probably the largest immediate user of private planes—must examine the advantages of company-plane ownership, and relate them to the commercial scene.

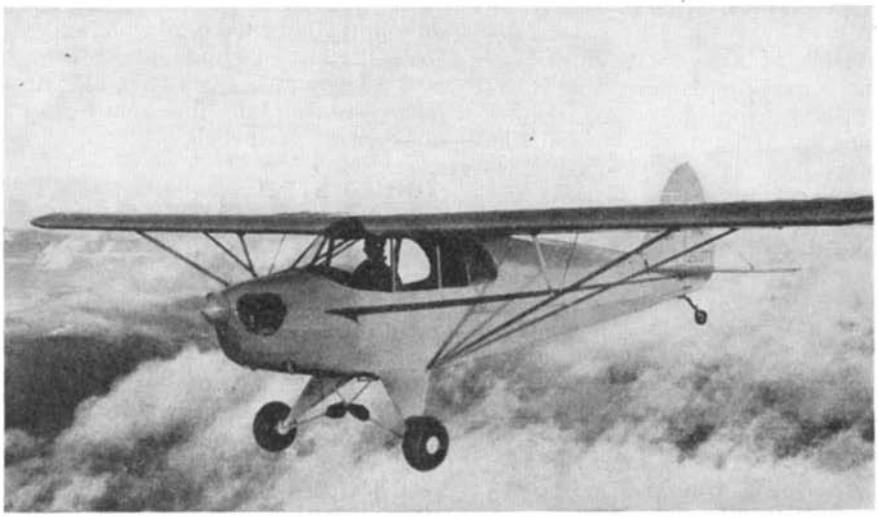
One question seems to be fairly well answered. The immediate prospects for private flying are most encouraging. Parks Aircraft, a large mid-western sales-and-service agency, reports that the demand for private airplanes in the $2000 to $6000 bracket far exceeds the ability of industry to supply them in the next 24 months. Orders are coming in faster than new airplanes can be delivered, although plane manufacturers are already in excellent production. Engineering and Research Corporation, builders of the Ercoupe, for example, have a backlog of over 11,000 orders for 1946.

There is a tremendous demand from ex-service men for moderately priced airplanes. Manufacturers, however happy they are because of this demand, do not believe it will last. When these young men have settled down to civilian occupations, they are most likely to sell their

• LOOKING AHEAD •

Continued growth of "personalized" executive air travel. . . Private plane sales to enthusiastic "first-buyers" will peak, then drop back to a lower, but still good, level. . . Roadable planes, now in test stages, on market eventually. . . Majority of planes of conventional design for next four or five years. . . Then an infiltration of what the public hoped for on first "post-war" markets.

Cessna (left) is aerodynamically conventional, features metal construction and unusual type landing gear. Piper Cub (below) is refined version of the reliable pre-war models



planes than to buy new ones. Young men and women who did not fly in the war, and members of flying clubs, may take their place. More mature purchasers of personal planes, with incomes of over $10,000 a year, will probably provide a moderate market for the four-seater. But, because industrial utility can best overcome high costs, commercial aircraft builders look to industry and business, and to some extent to agriculture, for the most valuable market during the next few years.

IN INDUSTRY — Many companies have already recognized the advantages of having their own planes. Executives can save time, arrive fresh at their destinations, supervise plants more intimately, iron out difficulties in closing contracts, and so on. Salesmen can cover more territory, and emergency parts can be supplied with greater rapidity by company aircraft. Some pharmaceutical companies have found private planes valuable for delivering drugs and other aids quickly to the scene of a disaster. As a typical example of private industrial plane operation, Socony-Vacuum has a whole fleet of airplanes for its pilot-salesmen, and considers it as incongruous for an aviation salesman to travel in anything except an airplane as it would be for an automobile salesman to go about in a horse and buggy. The Socony fleet includes Beechcrafts, Fairchilds, Cessnas, and Stinsons, 2 to 14 place, with power plants ranging from a single engine of 65 horsepower up to two engines of 1200 horsepower each. Each plane is equipped with two-way radio and blind-flying instruments. For convenience, these planes are based at various fields throughout the country.

In stall and spin-proof class, Ercoupe (above) is easily flown. Republic "Seabee," at left, features utility of amphibian design

DESIGN—For the present, light-aircraft design is still marked by many honest differences of opinion on basic features. Some manufacturers like high-wing monoplanes, some like them low, but the once-vigorous controversy about wing position has quieted somewhat. Two other controversies are now in full swing. One is the tricycle landing gear, with a nose wheel at the front of the fuselage, versus the conventional landing gear. Here, opinion seems to favor the tricycle gear with which a pilot can safely make cross-wind landings.

With respect to control systems, the second point of dispute, there are two well-defined camps. Many experienced pilots prefer three independent controls—rudder, ailerons, elevators. They want a maximum of maneuverability, and independence of action with enough "up elevator" to stall and spin the airplane if desired.

For the younger school of pilots, stall-spinning is a useless anachronism. The preference here is simplified controls that limit the upward travel of the elevator so that the plane cannot be stalled. In addition, either the rudder and aileron are coördinated, or else the rudder is eliminated altogether. In either case, the foot pedals are removed and the skill required in coördinating ailerons and rudder is no longer required. Although these limitations rule out extreme acrobatics, the proponents of simplified controls feel that stunting has no value in ordinary flying. The inherent safety of simplified-control systems is indicated by the Civil Aeronautics Administration ruling which permits a student to solo after only five hours on a spin-proof, two-control airplane.

PLANES TODAY — The $700 air flivver, predicted a number of years ago, is not here yet. But, for those who are considering the purchase of an airplane, there is a fairly good range of selection. At the $2000 end of the scale, the reliable, well-designed two-seaters, such as the Piper Cub with a 65-horsepower Continental engine, offer cruising speeds of about 75 miles per hour, ranges in the neighborhood of 200 miles, 50-pound baggage capacities, and 12 gallon fuel tanks. The stall- and spin-proof Ercoupe, also a two-seater but faster and more expensive, is powered with a 75-horsepower Continental, and is priced at $3050. It cruises at 110 miles per hour, has a range of 500 miles, and carrys 65 pounds of baggage and 23 gallons of fuel.

Further up the price scale, the four-seater category includes the $5000 Stinson Voyager (150 horsepower, cruising speed of 125 miles per hour, and 40 gallons of fuel), the $5375 Bellanca Cruisair with the same power but a higher speed of 145 miles an hour, and the more luxurious Fairchild F-24 with a 175-horsepower Ranger in-line engine at a price of $8875.

In the twin-engine executive-plane class, the Beechcraft D18S—six to eight seats, two 450-horsepower Wasp Juniors, single engine safety, a cruising speed of 200 miles per hour and a range of 900 miles—is offered for $59,500. Moreover, there are some excellent single-

engine and twin-engine amphibians available. Unfortunately, there are many reasons why it is still impossible to buy a four-place airplane for $1000; these reasons include moderate production volume plus high cost of engines, accessories, and equipment. But manufacturers state that present prices are considered reasonable by purchasers and that, as production goes up, delivery prices will go down.

FINANCING — Following directly from the present high cost of personal airplanes is the practical question of purchasing airplanes "on time." Many of the banks and installment companies which finance automobile purchases are equally interested in financing aircraft. The actual terms of sale are generally one third down and the balance in 12 months, while the usual bank interest rate is 5 to 6 percent.

Aircraft financing is similar to automobile financing, but it has some peculiarities. For one thing, all matters of transfer of title and recording of liens are handled by the Civil Aeronautics Administration in Washington. The credit statement is similar to the one used in buying furniture, but it has to be accompanied by an "Application for Hull Insurance." It is worthwhile to note that under the "Participating Lightplane Policy," the plane owner takes 25 percent of any loss while the company takes 75 percent. Such participation is an added incentive for the pilot-owner to be careful.

Buying on time means insurance, and it cannot be said that aircraft insurance is cheap. Cost varies with conditions, types of policy, and so on. The purchaser may have to pay between 10 to 15 percent of the cost of the plane annually. Companies specializing in aircraft insurance are now engaged in a safety campaign, with a view to subsequently reducing the rates.

Regarding the over-all cost of private plane operation, Mr. John H. Geisse of the CAA recently reported: "In the pre-war period, it cost just about $1000 a year to operate a small, $2000-airplane for 100 hours. The cost per mile was just under 13 cents for this usage. A major factor in these costs was the cost of insurance. The substitution of automobile insurance rates would drop the cost to $600 per year, and less than eight cents per mile. Because of the high insurance rates and the hangar charges, the annual overhead is high and hence the costs per hour are affected materially by annual usage. Increasing the annual usage from 100 to 200 hours per year in the case given, with pre-war insurance rates, reduces the cost per hour from ten dollars to six dollars and at 1000 hours per year, the cost drops to about $2.75 per hour or about 3½ cents per mile."

PLANES TO COME—After the first post-war efforts to get conventional or semi-conventional private planes onto the market have leveled out, it may be expected that more radical designs will make their bid for public acceptance. Some of the more interesting of these "dream" planes include several roadable models in which the wings either fold or are removed at the airport, so that the plane may pinch-hit as a reasonably satisfactory automobile. Actually, it is extremely difficult to combine the best characteristics of an automobile with those of an airplane. Inevitably, the hybrid loses some efficiency on both sides, but roadable planes have been flown and many authorities maintain that private flying will come into its own only when the automobile-airplane has been perfected.

Aiming at substantial improvements in vision and comfort, minus the usual propeller noise, many manufacturers are investigating pusher-propeller designs. Some would mount the propeller at the extreme after-end of the fuselage and use gearing and shafting to couple engine and propeller together. This has been done successfully on larger planes such as the high-speed Douglas "Mixmasters."

Other suggested power and propulsion ideas would provide jet-driven propeller blades with the exhaust gases exiting at the blade tip. Here it is claimed that a rudimentary combustion chamber at the propeller hub would be all that is necessary for a simple, cheap, and light power plant. As with most jets, fuel consumption would be high but it is felt that economic and other advantages would outweigh this.

Not content with three or even two-control systems, engineers at Consolidated-Vultee are experimenting with the Spratt wing which is mounted on a universal joint above the fuselage. One control —the stick—moves the entire wing in a manner that accomplishes the combined functions of rudder, elevator, and ailerons.

A considerable portion of the doubt regarding private aviation centers about the question of safety. Again referring to statements of Mr. Geisse of the CAA, it is reported that accident figures for stall- and spin-proof planes now stand at 4,000,000 miles flown per fatal accident. Using 5000 miles per year as about the maximum that a private pilot can be expected to fly, it would take one pilot a reassuring 800 years to accumulate this mileage!

METAL-BALSA SANDWICH

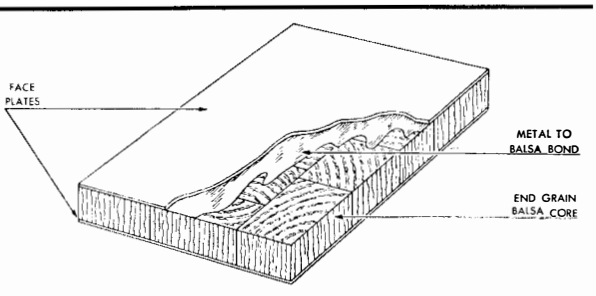
Combines Lightness, Strength, and Formability

CONSISTING of thin sheets of high-strength aluminum alloy, separated by a thick, low-density core of balsa wood, Metalite, a new structural material, is described as forming a light, rigid unit. The grain direction of the balsa core is set at right angles to the much thinner metal faces. Bonding of core and faces is done in one operation, under moderate heat and pressure, in a mold of the desired shape.

Because of the thickness gained by the light core, the bending stiffness of a completed panel is many times greater than that of the single sheet of metal of the same weight according to the makers, Chance Vought Aircraft. The panels also provide great resistance to failure either by local wrinkling or under transverse-shear loading.

Metalite, it is reported, eliminates skin wrinkling of aircraft surfaces under load, and because whole panels can be fabricated with scarcely an external break, parasite drag may be reduced to a minimum. It is anticipated that designers of ground transport and, perhaps, domestic equipment will also find the material useful.

Thickness and rigidity, without a proportionate increase in weight, are added to metal by light balsa core



Factories On The Move

With Forethought and Planning that Rival the Best-Laid Strategies of Armies, Industry is Shifting to New Sites. Local Skills, Water Power, Climate, and Other Once-Vital Factors Yield to Emphasis on Markets, Tailored Transportation, and Community Outlook

By EDWIN LAIRD CADY

• LOOKING AHEAD •

Scientific management planning grew slowly at first; blossomed fully under the pressure of war. . . Now, the same type of thinking that boosted production is being used to integrate processes and products with the economic warp and woof of the market area beyond plant walls. . . Modern industrial planners have far greater freedom from technical bugaboos than did the tycoons of yesterday; however, subtle under-surface factors must be recognized and evaluated.

IF PLANS which hundreds of industrial managements laid down during the war are carried out, then industrial plants soon will be on the move as never before. Eastern managements plan to move west, westerners east, northerners south, southerners north, big-city plants to small towns, rural plants to big towns, mid-city shops to the suburbs, and suburban ones to the center of town.

Large companies and small ones alike are involved. General Electric Company long since announced a program to move production units out of its huge Schenectady works and scatter them among small towns at least 100 miles away. A power-transmission equipment maker and a precision-castings producer have both pulled up stakes in small towns, moved to where their plant windows almost are illuminated by the bright lights of Times Square.

Opposite to all this, big companies like E. C. Atkins Company emulate the suburbanite who wrote an advertisement to sell his house, read back his own copy, and decided that if the place was that good he had better keep it. They add up all the factors on both sides of the moving-or-staying question, and decide to stay. But in staying, they still will make changes. They will modernize buildings, readjust shipping facilities and methods, try to obtain where they are everything that they could get by moving.

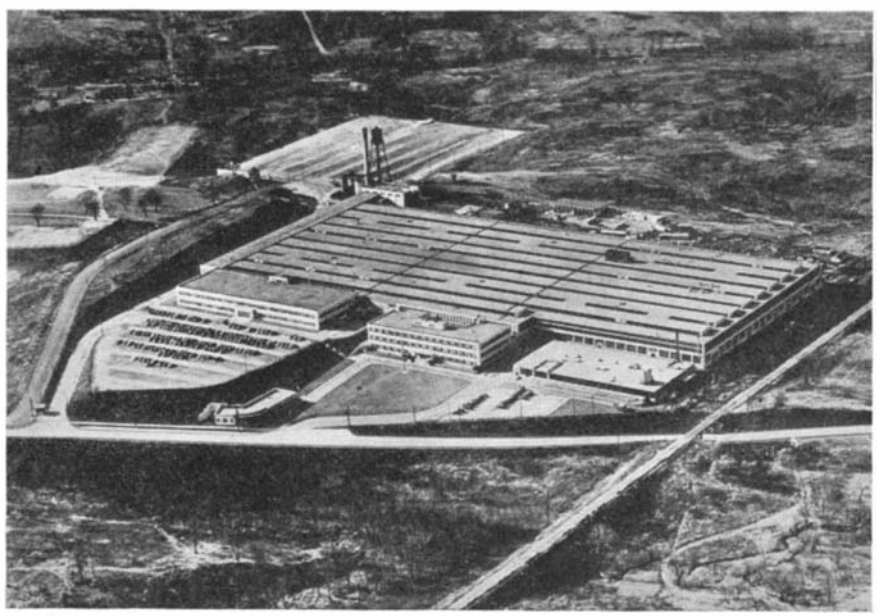
Behind the trend toward re-locating plant facilities is the solid fact that the points by which industrial locations are judged are changing.

LOCATION TECHNOLOGY — Climate is an example. Plants once located where the climate was hot for vat impregnating of wood products, cold for foods storage, moist for cotton spinning, dry for air-drying of chemicals, and so on. But now, factories are so easily re-climatized —specially air conditioned—and their air conditions are kept so sensitively adjusted to the needs of processes, that it makes much less difference what the weather on the outside may be.

Water is a similar case. From soda pop to fine chinaware, there used to be thousands of products which were good or bad in accordance with the chemical conditions of the water supplies where they were made. But now, all "critical" water is specially conditioned no matter where it comes from.

Labor factors also have changed. Industry has learned that so-called "cheap" labor can be highly expensive. Anyway, national laws and nation-wide labor unions are seeing to it that this consideration is no longer very important. And the speed with which almost anyone can be trained to work in a modern plant was so well demonstrated during the war that the concentration of specialized craftsmen in localized areas no longer means as much as it used to.

MARKET STUDIES—Now, markets for finished products are taking over as the number one consideration in plant locating. This factor is not new, of course, but the scientific



Located "downtown" for years, Emerson Electric has moved to the outskirt location and modern plant shown here. Space for cafeterias, employee recreation, and new medical facilities are important supplements to expanded manufacturing activity

thoroughness with which markets are studied today is not more than 15 years old.

These market studies are co-operative affairs. A maker of chlorine products for household and factory disinfection is making such a study right now. Wholesale grocers and other distributors are helping with it; they are telling just how the transportation costs and speeds from various locations would influence them when considering the purchase of these products. Railroads are telling what they can offer in spur-track facilities and in land rentals. Builders of special automobile trucks and bodies are looking at the delivery problems, offering tentative plans for the fleets that would be needed for short distance delivery from loading platform to city points, or for longer distances. Communities are deciding whether they want the plant or not, what buildings and land locations they have, what they will offer in tax concessions and in financial help.

Every one of these studies is based upon the factors of how much disinfectant can be sold, to what consumers, at what distances from the plant, and at what distribution costs. Competition is considered too. There is no point in putting the plant in a community which already is so well served that only cut-throat methods will get the business. Rather, a series of plants will be located in communities that need the product.

Studies like this one are being made everywhere. And what a community learns from studying the problems of a chemicals company, it can apply when extending invitations to other industries. As a result, communities know themselves and their industrial needs as never before.

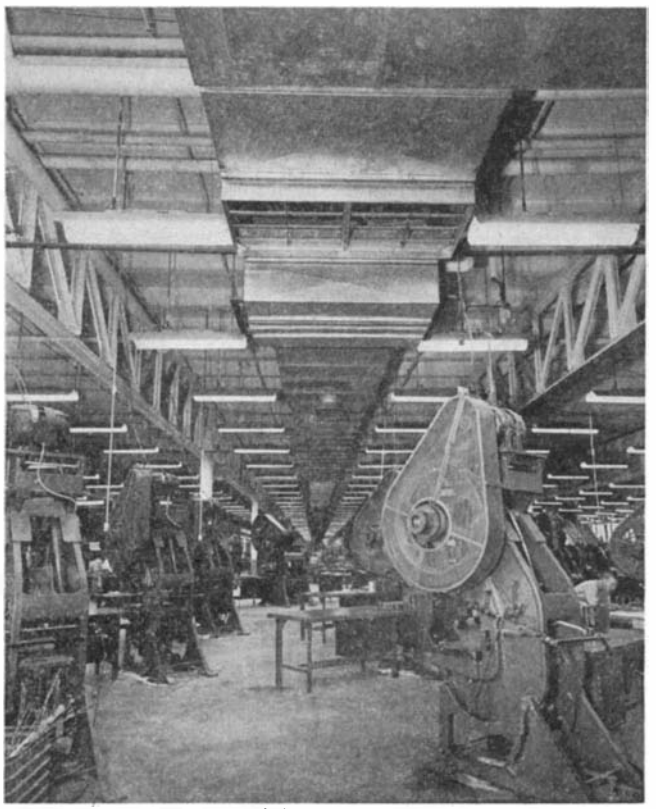
The city of Cleveland has an extensive advertising campaign to attract "end-product" industries to its district. Many years ago, it began to build up as a center for the production of steel, aluminum, and other materials. Now, it wants to fabricate more of these into consumer products, cut down on freight costs to fabricators' plants, and let its metals-melting plants get more of their scrap materials from their own back yards. Numerous other communities are following the same idea. They know what industries they need to support and augment their present ones, and they are as discriminating as they are aggressive in going after them. But back of every such campaign is a series of scientific studies of markets and distribution costs for the goods to be made.

TRANSPORT — The transportation picture is changing. The change is not as rapid or as thorough-going as it might be, of course. Commodity classifications for freight still exist, excepting for air freight, and they still will be hampering the economics of plant locations and of marketing as long as carriers and politicians can make capital of them. But cutting steadily into the tendency of the commodity-classification rate to confine some industries to some localities is the specially designed freight car, ship, truck body, and even airplane.

These specially designed vehicles turn common carriers into materials-handling devices. They make overland transportation part of the production line.

Everyone has seen the motor trucks that mix concrete as they transport it, the refrigerated freight cars for perishable foods, and is familiar with the lake ore freighters which are materials-handling plants on hulls. Not so familiar are the special cars and trucks designed to ripen fruit en route from farm to city, and to permit air-drying or even chemical processing of materials while in transit. But the engineering theory of "processing while in transit"—of using specially air-conditioned cars to give paper the right moisture content while en route to the printer rather than forcing the printer to store the paper in a special room while the air conditions it, for example—is finding wide applications and will find still wider ones when some of the present transportation unit designs get into production and extensive use.

Courtesy Albert Kahn Associated Architects and Engineers, Inc.



Boeing Airplane Company Photo

Unobstructed light and clean air make large window areas (left) practical. Air conditioning—note overhead ducts—and high-level artificial lighting installations (right) allow the selection of plant locations to be predicated on market rather than climatic factors

Combining with all this is the dependability of modern production equipment. Factories do not have to keep their machines in factory towns where maintenance supplies are to be had quickly. They can take them almost anywhere and depend upon trouble-free operation.

RAILROADS HELP—Plywood companies are taking their veneer-sheet-cutting operations out into the woods, avoiding the costs of shipping whole logs into their highly integrated central factories. This procedure is made possible first by the dependabilities of the processing machines which operate in the forest plants, and second by highly intelligent action on the part of the railroads. The railroads allow a "milling in transit" rate by which the mills pay only one freight cost—that from the woods to the consumers—and ignore the fact that the sheets stop en route to go through the central plants for gluing and for special processing.

Another excellent business operation by the railroads is the building of special industrial districts. These districts are zoned as carefully as any residential district. Part of the zoning is to make sure that the factories in question will have good markets locally and along the right-of-way served by the road. Another part is to make sure that each plant has enough land and space, properly laid out for efficient manufacturing, plus a little extra in which to grow, but not enough extra to hold industrial land out of use. The railroad then runs service tracks to the points where spur tracks must begin, thus saving the plants the cost of running long spurs at costs averaging from $5.00 to $8.50 per foot. As operated by the M-K-T and other forward-looking lines, this method leads to well-balanced industrial communities worked out on thoroughly scientific business management bases.

WHY PLANTS MOVE — There are many reasons for moving plants. One company found that its district had insufficient water supplies for adequate fire prevention, moved to a location on heavier mains. A small manufacturer of transformers located "in the back yard" of a copper-products jobber, has instant access to highly varied raw materials. A company which makes extensive use of electricity for welding, brazing, and induction heating got so much practical advice from an engineer of the Commonwealth Edison Company that it moved closer to his office so it could consult him more often.

Scrap disposal is a problem. The difference between profit and loss on the disposal of kraft and other paper scrap often lies in the distance from a consuming market. Companies which have large supplies of unsaleable scrap often move to waste land on the outskirts of large cities. One such company bought a badly eroded farm, used its waste to fill and block up the gullies, added good top soil and then sold the land for residential properties. Many swamps have been filled in with industrial waste and then sold at good-land prices. A wise management can make quite a large secondary profit in this way, and if it is filling up gullies or otherwise moving its waste down hill, can at the same time minimize the handling costs of its scrap.

The problem of whether a plant should move or not often becomes most acute when it has increased the value of its land and built up a community about itself. If it moves without finding other employment for its workers who live nearby, then it drags down the values it has built and must take several years to build equivalent ones in a new location. If it does not move it may suffer the penalties of heavy traffic congestion in a built-up community, and of obsolete buildings and machines.

Many a plant is moving for no other purpose than to break old habits. The management may need new machines but be unable to get financial backers to dispose of the old ones unless it moves a long distance and does not take them along. When a building scientifically designed to be a tool of production is needed, it may be cheaper to start with a bare field than to tear down present buildings and rebuild.

In case after case, there seem to be more reasons for moving, or for establishing branch plants, than for not moving. The long-term part of the reconversion job will find plenty of industries on the move. But the re-locations of today are quite different from the opportunistic ones of a few years back. The "grab any plant on any terms" spirit of the old chamber of commerce is gone. Modern moves are made on the basis of cold scientific planning, with railroads, power companies, and communities as well as plant managements helping with the planning, and with little encouragement for the plant which does not look before it leaps.

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INDUSTRIAL DIAPHRAGMS

Take Advantage of Properties Of Synthetic Rubber

THE DIAPHRAGM as used in mechanical engineering consists generally of a disk or other shaped piece of flat and non-rigid material held firmly at its periphery but with its middle portion free to move as far as the elasticity of the material permits.

Diaphragms of leather, of extremely thin metal sheets, and of rubber and fabric laminates, are an old story as pump parts and as the activating members of air speed gages. But coming rapidly into the industrial field are diaphragms made of the new synthetic rubbers and their laminates.

One such application is an oil shield for anti-friction bearings. Used as the end cap of a closed-end housing, the material will expand with a slight diaphragm action when the oil in the bearing is running hot from high bearing speed, but will contract to restore full oil volume to the races and retainers when the bearing speed and temperature are reduced. Thus the diaphragmic action provides an automatic pressure-relieving reservoir for heated oil and prevents the lubricant from being forced past the seal at the shaft end of the bearing.

Other new uses are in highly sensitive proportioning gages for hot or cold gases. Here the extreme uniformity of the synthetic rubber allows close and dependable control, while the resistance to heat, dryness, and corrosive fumes provides long life.

DESTRUCTIVE VIBRATION

Absorbed at Source by Metal's Grain

VIBRATIONS are inescapable because any running friction in a bearing and any dynamic unbalance in a part may cause them. They are damaging because they force loads and speeds to be kept down and they set up fatigue factors that are destructive to metals. Where they cannot be reduced below the damage points by eliminating their causes, they must be dampened. A method whose use is growing rapidly is to make the vibration producing parts out of metals having such grain characteristics, or out of forgings having such directional strengths, that the vibrations are caused to do work within the metal itself and thus are dampened at their sources.

Chemical Crop Insurance

Like the Weather—Insects, Rodents, Weeds, and Other Crop Criminals have Long had Little Done About Them. Now, Spurred by War and Famine, Chemistry Turns Tongue-Twisting Terms into Literally "Down-To-Earth" Products that Protect Plants Against Nature's Scalawags

By HOWARD C. E. JOHNSON, Ph.D.
Chemical Editor, *Chemical Industries*

TODAY, world-wide food shortages emphasize all too grimly the importance of agriculture. Farming is not the haphazard process it once was. Although crops are still subject to all the vagaries of the weather, some of the other dangers—diseases, pests, and weeds—are being reduced by the contributions of chemical research. These dangers can be controlled or eradicated, and crops can be improved. As with other business, however, investments in time, money, and experiment are necessary, and farmers must spend millions on fertilizers, insecticides, fungicides, and other chemical aids. But the money will be returned, with interest, in the form of more and better foods for a hungry world, if the correct investments are made.

INSECTICIDES—Only within the past few months, several promising insecticides have been introduced to the market. Some of these are chemical relatives of DDT. One has just one chlorine atom less than DDT and is called DDD. Said to be equal to DDT in most respects, and superior in some, DDD is cheaper to manufacture than DDT. A commercial formulation of it is now undergoing tests and will soon be introduced to the market.

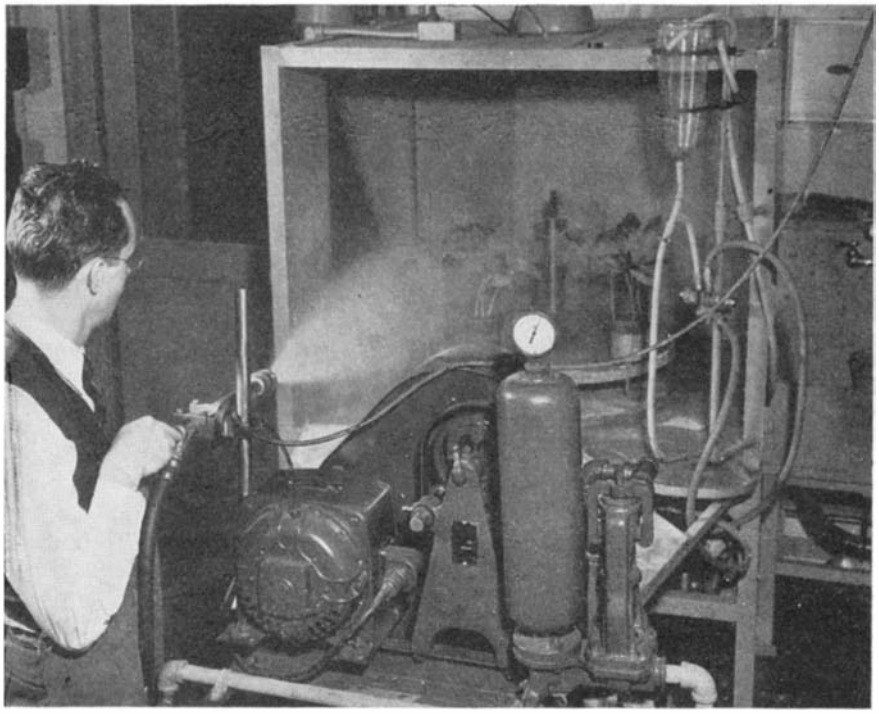
A fluorine analog of DDT, called Gix, was manufactured in Germany during the war. Gix was claimed to be more effective than DDT, but it is much more expensive to make. Less effective than DDT, but considerably cheaper to make, was Lucex, made by chlorinating the side chain of ethyl chlorobenzene.

The English, meanwhile, developed a different type of insecticidal material by adding chlorine to benzene under the influence of sunlight. Potent against insects, this compound, called 666—benzene hexachloride—exists in four different forms, or isomers, which differ only in the geometrical configuration of the atoms. One of these isomers, the so-called gamma isomer, which occurs to the extent of 10 to 13 percent in the mixture, was found to possess the greatest insecticidal activity. The concentrated material is known as Gammexane. Reports indicate that 666 may find use as an aphicide and in the control of cotton insects. It is also toxic to the African migratory locust, house cricket, German cockroach, oriental cockroach, body louse, bed bug, cabbage caterpillars, winter-moth caterpillars, clothes-moth caterpillars, various flea beetles, mustard beetle, blossom beetle, apple-blossom weevil, pea and bean weevil, grain weevil, hide beetle, wasps, ants, various mosquitoes, houseflies, various fleas, poultry red mite, sheep tick, and woodlice.

Gammexane, or 666, may be applied as a dusting powder with gypsum as a diluent; dissolved in an organic solvent and diluted with kerosine for spraying; emulsified

• LOOKING AHEAD •

Fewer "bad" years as farmers adopt chemical means of crop protection now becoming available. . . More food, in spite of dwindling farm labor supplies, because losses are lower. . . Fruit held on the trees until markets and shipping space are ready. . . Surer planting with chemical germination tests. . . Substantial reductions in rodent populations are a result of new poisons.



Testing spray rig—proper application is important for most insecticides

in water; or volatilized from a hot plate to give a smoke. Although 666 is very stable to heat, it breaks down in the presence of alkalies to give hydrogen chloride and trichlorobenzene. It cannot, therefore, be mixed with lime, or other basic compounds for dusting.

This insecticide is now being tested intensively in the United States.

Although the foregoing compounds have received the most attention, several other new insecticidal materials have been studied. The hexaethyl ester of tetraphosphoric acid is claimed by the Germans to be an excellent substitute for nicotine for use against aphids. In the United States, a chlorinated hydrocarbon called 1068 has been introduced to the market. Like 666, it is also recommended for control of aphids and cotton insects. In addition to encouraging the search for new materials, experience with DDT also led to improvements in methods of application. The "aerosol" method, where the material is dissolved in a liquified gas such as Freon, has been found to be as effective in the field as in tents and buildings. The active ingredient is dispersed in a very fine state of sub-division by volatilization of the gas, giving excellent coverage and speed of kill. In some cases, however, long-lasting activity is lost.

FUNGICIDES — Although dithiocarbamates and the closely related thiurams were developed and patented several years ago as fungicides, they have only recently come into general use. Fermate and Zerlate, iron and zinc compounds of the first material, are both coming into wide use to treat various plant fungus diseases. Oxidation of the dithiocarbamates gives the thiurams which are used as turf and seed fungicides.

Isoquinoline lauryl bromide, made under the name of Isothan Q15, has been studied as a fungicide for apple scab. And heptadecyl glyoxalidine, known also as compound #341, has shown effectiveness against apple, cherry, and rose diseases. The Germans developed a material for treatment of oat and rye seeds which appears to be completely effective when the seeds are soaked for 30 minutes in a 0.1 percent water solution of the compound.

PLANT HORMONES—A few years age, it was found that apple and pear dropping in the fall could be retarded by spraying with synthetic growth regulators. About the same time, it was discovered that these substances would also promote the growth of roots.

Affecting the life cycle of a plant much as hormones affect the cycle of the human organism, the synthetic regulators were called plant hormones. Recently, they have been found useful for fruit setting, blossom thinning, fruit ripening, delayed budding, early flowering, prolonging dormancy, delaying abscession, grafting, producing wider angles between the trunk and branches of fruit trees, inducing seedless fruit, and selective weed killing.

Courtesy Du Pont Company

Flies, reared to full health and vigor in Pest Control Laboratory, are used to evaluate knock-down and killing power of experimental insecticides under standardized conditions

The compounds found most effective were the aryloxy acetic acids. One of these, 2,4-dichlorophenoxyacetic acid, known commonly as 2,4-D, has attracted considerable interest as a selective weed killer. Generally speaking, 2,4-D kills broad-leaved plants and is harmless to grasses when applied at the rate of 200 to 300 gallons of a 0.1 percent solution per acre. Dusts and aerosols have also been tried, but they are more difficult to control and wasteful of material. Although the sodium salt of 2,4-D is soluble in water, the commonest commercial material is the acid itself, formulated with a carrier or emulsifying agent.

The chemical kills most field, pasture, and lawn weeds without harming lawn grasses or cereal grasses such as corn, wheat, oats, rice, or barley. As shown in the accompanying table, many other weeds are also killed and continuing studies are broadening the usefulness of the new herbicide. Commercially, 2,4-D is available in three different types of formulations: the acid itself, which must be dispersed in water; water-soluble salts, either sodium or triethanolamine; and esters, such as methyl or butyl, which must also be dispersed.

The mechanism of selective weed killing is still being studied. It was thought at first to be a hormone action, causing the plant to "grow itself to death," but many excellent plant hormones do not behave similarly. Apparently, the herbicide attacks the chlorophyll of the plant in some way not yet clear. Acting as a "systemic" poison, it kills not only the tops but the roots as well.

Other uses besides that of a herbicide are being discovered for 2,4-D:

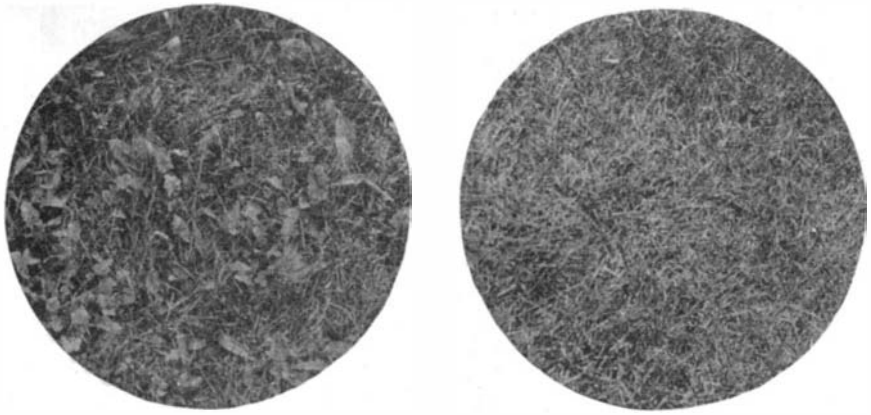
Weeds Killed by 2,4-D Chemical Plant Hormone

Field and Pasture Weeds

Poison Ivy	Bull Thistle and other Thistles	Wild Mustard and other Mustards
Poison Oak	Chickweed	Burdock
Bindweed	Poverty Weed	Fleabane
Morning Glory	Nut Grass	Ragweed
Honeysuckle	White Top	Water Hyacinth
Sumac	Russian Knapweed	Pigweed
Sassafras	Spreading Dogbane	Klamath Weed
Black Locust	Bitterweed	Primrose
Choke Cherry	Blueweed	Dog Fennel
Cocklebur		

Lawn Weeds

Dandelion	Heal-all	Ground Ivy
Plantain	Knotweed	Purslane
White Clover	Chickweed	Oxalis
Pennywort	Hawk Weed	Wild Garlic
Wild Carrot	Speedwell	



After treatment with 2,4-D in a 0.1-percent mix, weed-choked lawn (above) is entirely clean (right). Hormone is effective on many broad-leaf weeds

It was recently reported, for example, that the methyl ester keeps stored potatoes from sprouting.

The English have also developed a similar material differing from 2,4-D only in that one of the chlorine atoms is replaced by a methoxy group. It is sold under the name "Methoxone."

Another compound which is useful as a blossom thinning agent as well as an insecticide and fungicide is the sodium salt of dinitro-ortho-cresol, formulated and sold as "Krenite." It has been used to thin apple and peach blossoms, and, moreover, is recommended for the control of various aphids, budmoth, peach-leaf curl, raspberry blight, sooty blotches on pears, and apple scab. Except in a few special cases, the material is applied as an insecticide and fungicide to dormant plants —before any appreciable amount of green tissue shows. To control apple scab, Krenite is sprayed on the orchard floor in the spring to kill the mold spores wintering in the dead leaves.

Still another German development with valuable implications is the use of triphenyl tetrazolium chloride as a reagent for testing the fertility of seeds. The compound is used as a 1 to 2 percent water solution. Cereal seeds—wheat, oats, corn, rye, barley, and so on—are soaked in the solution for six to eight hours except in the case of oats, which require 24 hours. The germ cells of the seeds that will germinate turn red. Seeds thus tested are not harmed, for the material is non-toxic.

RODENTICIDES— Insects and molds are not the only villians who prey upon the farmers' crops. Rats, for example, cause $500,000,000 damage a year, mostly on farms.

A new rodenticide, known as "1080," has been developed by the United States Fish and Wildlife Service. Chemically, it is sodium fluoroacetate. Extremely poisonous, and without identifying odor or taste, it is extremely hazardous in the hands of anyone except an expert. But "1080" is as deceptively innocent to rats as it is to man, and the animals do not disdain food that has been treated with it. It will be made available, however, only through experienced pest-control establishments.

Indications are that the compound will also be helpful in keeping down the population of unwanted mammals in the western states. With gophers as a target, poisoned grain can be scattered effectively in such small quantities that grazing cattle or sheep will not be harmed. Or the poison can be introduced into the bloodstream of an animal, whereupon the carcass becomes lethal to coyotes.

Alphanaphthyl thiourea, commonly called ANTU for short, is a chemical which kill rats upon contact.

A war-developed German rodenticide called "Castrix," is claimed to be one fourth as toxic to rats as strychnine. Castrix, however, is non-toxic to chickens and other fowl at the concentration used. When grain is impregnated with a 0.1 percent water solution and used as bait, it is effective against mice and to a lesser degree against rats.

Thus, the war against the destroyers of food goes on, and although the problems are far from solved, chemistry is providing an ever-growing arsenal of efficient weapons.

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ANTI-ROACH FLOORS

Eases Roach Problem in Food Handling Areas

FINELY divided metallic copper incorporated in magnesium oxychloride cement, familiar in flooring compositions, has lately found a new and important value. Floors of this composition, long known to suppress the growth of fungi, particularly that of athlete's foot, now have been shown to be offensive to cockroaches. Tests indicate that roaches scrupulously avoid floors of this composition and will not cross them to reach food. Apparently the composition is disagreeable to the insects only on contact.

MAN-MADE TAN

Alleviates Loss of Chestnut Extract

CHESTNUT trees, the chief source of sole-leather tanning agents, appear doomed to extinction by blight in this country. However, efforts by Monsanto Chemical Company chemists to evolve a synthetic tan are now said to have resulted in a product superior in some ways to the natural product.

It is of interest that a large proportion of the sole leather tanneries in this country are located in Pennsylvania because the chestnut grew abundantly in that region. The ground logs and bark are "brewed," like tea, with hot water and the infusion concentrated to obtain the tannins. Now, most of the trees are killed off, but natural tannins are still being made from the dead trees.

The new product, called Exan, is said to impart to sole leather a fine, smooth grain as well as tightness, firmness, pliability, and excellent water-, wear-, and abrasion-resistance.

LOST SPRAY-PAINT

Recovered and Re-Used with Emulsifier and Solvents

ONE THIRD or more of the paint and lacquer that leaves the spray gun is normally lost in spray-booth applications. But a major portion of this loss may now be recovered by a war-developed process, said to yield reclaimed coatings which are the equal of new paints and lacquers.

Paint normally caught in the curtain of falling water that protects the spray-booth walls is precipitated in the form of a water-and-paint (or lacquer) sludge. The free water is separated from the sludge, and the solvent which has been lost by evaporation is replaced by a mixture of an emulsifying agent—sulfonated castor oil or the like—and an organic solvent or mixture of solvents, such as acetone, xylene, butanol, butyl acetate, or naphthas. The mixture is then agitated, resulting in a water-in-oil emulsified coating which is ready for re-use. The process is controlled by the Meckler Chemical Corporation.

Molding Unlimited

Known by Various Names, Impression Molding Removes Many of the Barriers that Have Stood in the Way of Producing Plastics Products in Large Sizes. It Also Eliminates the Need for Expensive Molds and Heavy Machinery. Production Processes Can Be Fast and Continuous

By CHARLES A. BRESKIN
Editor, *Modern Plastics*

OF ALL the plastics developments that either started or received their greatest impetus during the war years, impression molding perhaps holds the greatest promise and, at the same time, is subject to the greatest controversy within the industry. Since even the name has come in for its share of discussion, it might be well to start off this probe into the most promising fields for its application with a description of just what the term "impression molding" embraces.

All of those plastics processes—variously known as flexible-pressure molding, fluid-pressure molding, contact-pressure and low-pressure laminating—that use materials for which pressure requirements are very much lower than in conventional production methods, come within the scope of impression molding. Since the pressure necessary to hold in the volatiles and to position the material during processing is eliminated in the impression-molding method, the only pressure requirements are that the materials be held in firm contact with each other and with the mold, and that the desired surface finish be produced.

The effect of this marked reduction in pressures is to make possible the production of many types of plastics parts that are either impossible or impractical using conventional high-pressure methods. With high pressures, the molds, presses, and machines must be built to withstand great stress. This naturally sets up rigid limits on the size of a part that can be produced by either injection or compression molding. While, theoretically, there is no reason why a small boat, for example, cannot be compression molded, the cost of molds and presses increases at a disproportionate rate as size goes up. Thus, compression molding of a boat becomes prohibitively expensive.

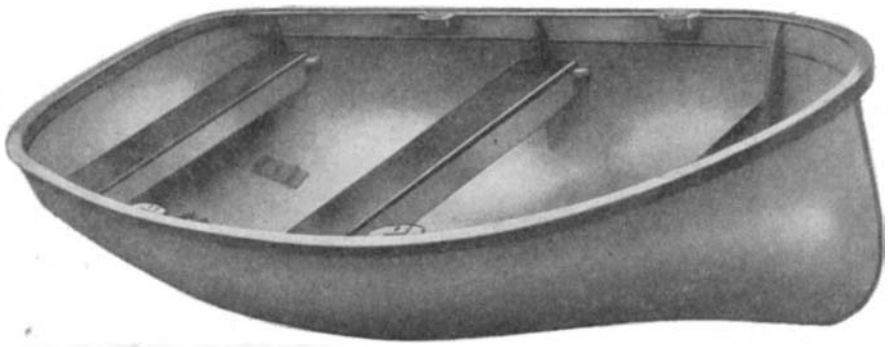
With impression molding, on the other hand, molds and equipment can be made in large sizes without increasing the cost to an impractical point; this follows naturally from the fact that only low pressures are involved. The ability of this method to utilize light molds made of wood, sheet metal, or cast resin makes possible the production of short run or experimental parts—usually prohibitively expensive in compression or injection molding where steel molds are standard equipment. Of course, steel molds can be used also for impression molding where fairly large production runs are in view.

During the war, when impression molding received its most extensive application to date, cost was not a controlling factor. As a result, the methods that were developed now seem to use a lavish amount of hand labor—and hand labor must be kept to a minimum if impression-molded products for civilian use are to be more than expensive specialties. Economical operation of an impression-molding plant will depend to a large extent on efficiency in handling, laying up, and moving raw materials and finished products which are apt to be bulky and large in unit size.

R. W. Crawford and I. B. Nathanson of Product Development, Plastics Division, Monsanto Chemical Company in a recent evaluation of the place of impression molding in civilian life found that the most successful method of judging where

• LOOKING AHEAD •

Decorative plastics wall panels will be made in large unit sizes. . . Plastics luggage will invade the medium-price field. . . Boat hulls will be made in one piece. . . Adoption of impression molding will call for new designs offering new advantages. . . Advancing technology will open many new fields to this important plastics development.



Courtesy Monsanto Chemical Company

With low-pressure molding, one-piece molded boat hulls become economically practical

and how this process would find widest use was to consider individual fields and individual applications in relation to present materials and alternates.

PANELS—Wall paneling promises to be one of the first uses to which impression molding will be put on a commercial scale. The special advantages will lie in the fact that such panels can be made continuously—not limited, as in high-pressure laminates, by the size of the press platens—and that they can be produced on a much shorter cycle than can high-pressure panels. The ease of application and economy of these panels should broaden the field for decorative plastics laminates.

Present impression-molded wallboard consists of one or more layers of woven cloth or paper impregnated with a resin content of about 50 percent by weight and cured into rigid panels by a continuous process. While types under development at this time are essentially decorative rather than structural, there is no reason why this type of material should not find use in transportation equipment as well as in building construction. Furthermore, semi-structural and load-bearing panels can be produced using a corrugated

core and phenolic resins in the faces. The utility of these panels is further increased by the availability of flame-proof resins which—when used with inorganic textiles or cotton or rayon—give a fire-resistant laminated product.

BOATS—One of the fields in which the practicability of impression-molded products is being intensively studied is that of boats. The particular advantage of this process here is that it makes possible the construction of one-piece hulls. Already, boats are being produced from sisal fiber treated with low-pressure phenolics, and experimental work is being conducted using a sandwich-type structure with a honeycomb plastics core. No interior structural members are contemplated in this hull. Of course, the practicability of impression moldings in the marine field can only be determined from actual service records which will take several years to compile after a number of boats have been fabricated and placed in use.

LUGGAGE—There is no better proof of the utility of the impression-molding process for luggage than a new suitcase that has just made its appearance on the market. Introduced in the medium-price field, this traveling case, produced by the Foreval Plastics Company, makes use of six different materials. The core for the sandwich structure is expanded cellulose acetate, produced by E. I. du Pont de Nemours and Company, Inc. The inside skin and one outside skin are Fiberglas cloth, a product of Owens-Corning Fiberglas Company, while the second outside skin is a glass fiber mat turned out in various colors by the Glass Floss Company. The adhesive used in gluing the strips of the sandwich are Bakelite urea-formaldehyde resin; the resin used to impregnate the glass cloth and glass floss skins is a styrene copolymer made by Bakelite Corporation. The vinyl chloride extruded bumpers and scuff-proof corners are also a Bakelite product.

The finished weight of this suitcase is 5½ pounds. But, in addition to its light weight, it has eye appeal as well as high strength and abrasion resistance. Of course, impression moldings of any type cannot compete in the lower price bracket, where the largest luggage volume lies, with bags made of low-grade plywood covered with varnished cloth.

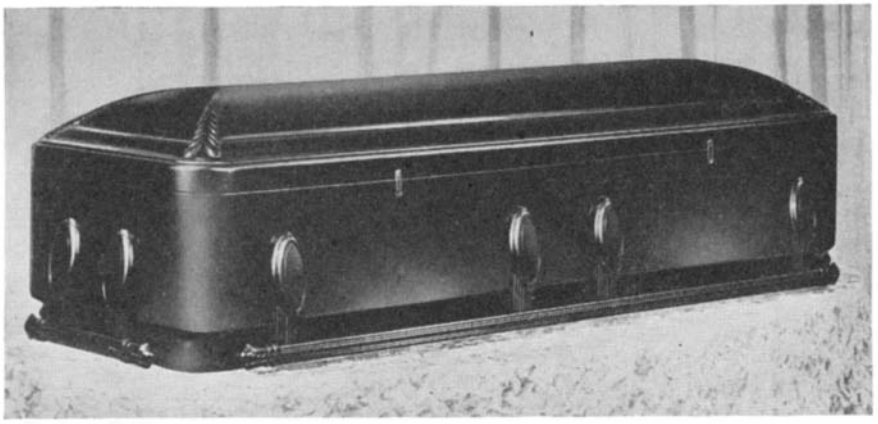
VERSUS METAL—The competition which impression molding must meet in the toy field is with drawn and stamped sheet steel. Since such things as the bodies for express wagons can be stamped out of medium-gage steel sheet at low cost, it is unlikely that impression molding will offer enough important advantages over metal to justify what would without doubt be a higher cost.

It would seem, then, that the opening for impression molding in the toy line will come from the development of entirely new playthings. Of course, there are a few exceptions to this, as in the case of doll carriages which can well be designed for production by this new method to sell somewhere near the price now charged for wooden or woven-wicker doll carriages and similar units that command relatively high retail prices.

Again, in the automotive field, the competition is also with stamped and drawn steel parts. It would seem that impression molding has not much chance, on a price basis, for such parts as fenders, door panels, and so on. This is particularly true in view of the fact that steel is an accepted and proved material for these end uses. However, it is possible that impression molding may find applications in such auto-body work as station wagons, which are now put together virtually by hand, and present indications are that it will be used experimentally in at least a few parts of some of the new conventional cars.

PROS AND CONS—There are many other possible uses for impression molding in refrigerators, radio cabi-

Light traveling bag (left) is made of low-pressure type laminates. Its sections (right) have cores of an expanded cellulose acetate, are covered with glass-fiber cloth and glass-floss skin. Plastics adhesives and small parts bind the whole together



Courtesy Columbia Rope Company

Impression molding produces fine finishes as seen on this plastics casket

nets, caskets, tables, and bookcases, to name but a few. Except in such cases as inner shell units and door liners for refrigerators, the most important stumbling block to the adoption of this new process in these varied applications is the question of public acceptance of the rather radically new designs which would be necessary to adapt the parts to impression molding.

Then there is the lighting field, which holds promise of making good use of impression-molded articles. It is entirely feasible that with a proper choice of filler and use of transparent resins, light transmission and diffusion can be controlled to meet specific design specifications. Shields of this type would share with other plastics the quite obvious advantages of light weight and ease of installation and cleaning.

It would seem that rumors of impression-molded sink basins, bath tubs, and toilets are still very much in the future. All indications are that presently available laminates do not have the high water resistance necessary for them to withstand long immersion at frequent intervals.

However, the true test of what fields will successfully adopt impression molding, and what fields will not, can come only as products are created and tried out. And much of this work will be done within the not too distant future.

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PLASTICS SEALS

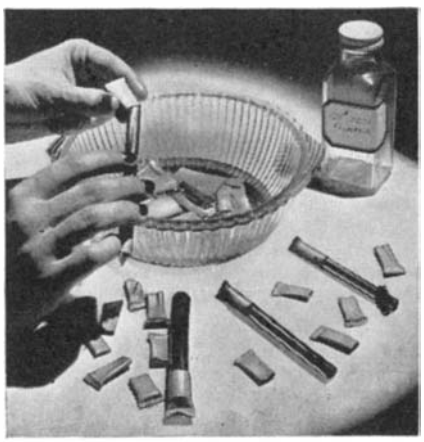
First Expand
Then Contract

SEALING the ends of metal tubes against air, water, or dust, and, perhaps, sealing the ends of other types of products is accomplished by the use of special vinyl compounds which are first extruded in the form of tubing. This is then cut and crimped at various lengths for sale as sealing caps or cut and sold without crimping for ultimate use as sealing sleeves.

Sold with the plastics pieces is a solution in which the plastics caps or sleeves must be soaked for a five-hour period prior to use. In the solution they expand half again as large as their normal size. While still dilated they are placed in position over the tube where they shrink to form an airtight fit.

The water-resistant material was developed to keep dust and moisture from the interiors of metal tubing in refrigerator condenser systems during manufacture. But new uses are cropping up daily. As sleeves they seal the joint between two telescoping tubes in condenser systems. Or their bright colors (red, blue, green, yellow, orange, white, and transparent) may dictate their use as lead markers for wires and cables. Good insulation properties make them ideal as coverings for bus bars, wire cleat insulation, and noise dampeners on machinery.

Special heat-resistance requirements can be fulfilled by different formulations of the compound. The caps can be crimped or the sleeves cut at any length, with a trade mark added if desired, and can be produced to specified diameters and thicknesses to meet the individual needs of the manufacturer. The plastics and methods of use were developed by General Electric Company.



After soaking five hours in dilator, seals slip on easily, shrink to fit

SMALL BRUSHES

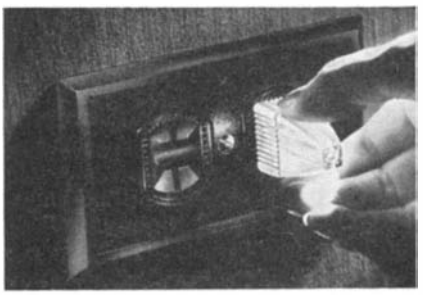
Now Made with
New Synthetic

BRISTLES of vinylite monofilaments are the latest element in the brush field. First appearing in nail brushes, they are expected to be used in a variety of other small cleaning brushes.

NIGHT LIGHT

Has Plastics Case, Uses
But Little Electricity

WHILE it won't serve as a beacon to guide you home on a dark night, Nite-T-Lite, which consists of a



Plug-in safety light

1/10-watt bulb enclosed in a translucent Styron case that plugs into an ordinary light plug, will light the way into darkened rooms. Manufactured by Little-Fuse, Inc., this attachment gives off a soft glow without using much electricity. The advantage of the ribbed polystyrene case is that it will withstand very heavy handling yet is easily assembled with the other components of the light.

COLORFUL

Heavy-Duty Plastics for
Household Appliances

WHEN washing machines, vacuum cleaners, electric irons, and sterilizers are once more in free supply, the chances are that a large proportion of the agitators, housings, and other parts will be produced in a range of standard colors from a new shock-resistant melamine-formaldehyde molding compound developed by the American Cyanamid Company. Tough enough for heavy-duty applications, this Melmac 3020 can be produced in the colors which are so important to the public acceptance of plastics. White, blue, green, red, and ivory molding compounds are immediately available.

Successor to the Sextant

Loran, a Far-Flung Mesh of Radio Position-Lines Marking the World Air and Sea Lanes like Numbered Streets and Avenues, Bids Fair to Supplant the Venerable Chronometer and Sextant with a Cathode-Ray Tube. Handicaps to Celestial Navigation Have No Effect on Loran

By HARLAND MANCHESTER

• LOOKING AHEAD •

With an eye to the day—yet to come—when men will challenge the sky and the seas without fear of the elements, science has forged a worthy weapon in Loran . . . Its implications, extending beyond the more obvious ones of safety and convenience, are of prime importance in air-shipping where payloads must always bow to the fuel margins needed for safety. . . And afloat, the Loran maps are as significant as the works of Bowditch; the mariner is no longer forced to grope along on dead-reckoning when the skys are obscured.

OUR C-47 took off from Floyd Bennett Field, Long Island, set out in an east-northeasterly direction, and was quickly engulfed in the fog. No land could be seen. We were headed for Charlestown Airfield, Rhode Island, and our only guide was an array of dancing green streaks on the glass cathode-ray screen of a little black box. The pilot had been told to obey nothing else.

At the navigator's table Lieutenant Commander Read showed me a new kind of aerial road map. It was covered with intersecting lines which diced coast and sea into roughly rectangular chunks. Each line bore an identifying number. These were not the familiar imaginary lines of latitude and longitude. They were much more tangible. They were really there where the map showed them to be. The "electronic fingers" from the little black box reached out and found these highways, and the dancing green streaks counted out the numbers on their route markers.

Commander Read touched his pencil to the map. "We're heading down this line," he said. "We'll stay on it past Montauk Point, then when we get to this intersection off Block Island, we'll make a 90-degree turn to the left and follow that line to the Rhode Island airport."

Down the line we flew, as casually as though we were driving along a parkway and planning to turn north at Route 7. Now and then Read manipulated knobs and got a "position fix" to keep us on the course. Soon he made a cross on the line opposite Montauk.

"That's where we are," he said. We couldn't see the Point, but we took his word for it. He turned the knobs again and two hairpin-curves of light stood side by side on the scope. They edged closer together.

"When they overlap," he said, "we'll be at the intersection."

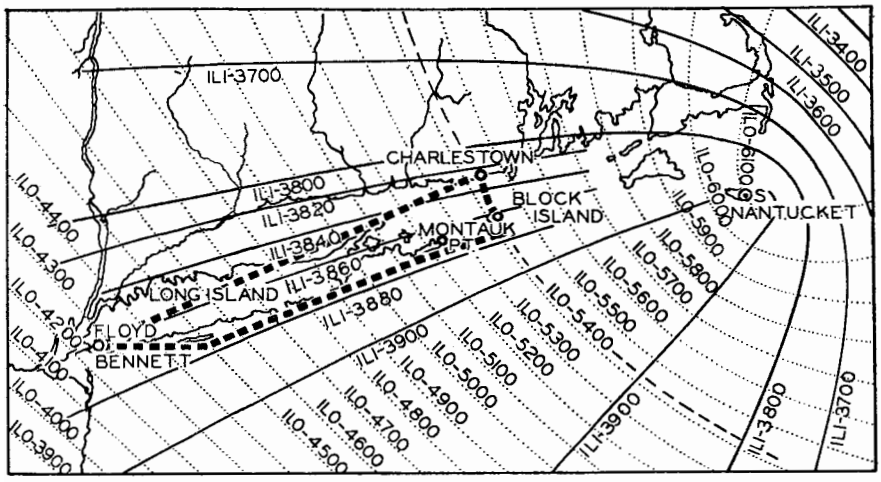
Soon they matched, and Read told the pilot to make a left turn. A few minutes later we dropped through the overcast to about 500 feet. There was the airport. After 150 miles on these invisible streets, figuratively "painted on the air" by radio pulses, we were only 100 yards to the left of the airstrip.

This is Loran, (short for LOng RAnge Navigation) one of the greatest triumphs of the American physicists who pooled their talents to fight the Axis. Before Loran was brought forth by M.I.T.'s great wartime research center, the Radiation Laboratory, navigators on ships and trans-oceanic planes had to "shoot" the sun or stars and calculate their positions in the traditional way. This took so much time that it was not geared to the needs of fast-flying planes. When weather blacked out celestial bodies, even that aid was gone. Fuel was wasted, planes were endangered, and operations were limited. Radio beams, radar, and other systems have been used in various ways for position-finding, but no other electronic method combines the range, precision, and reliability provided by Loran. Loran tells the navigator where he is, in three minutes or less, and operates 24 hours a day in all weather.

Ten years ago, Loran was technically impossible. Five years ago, it was incredible. Yet before the end of the war, 3000 ships and 30,000 planes were navigating by Loran's

Interior of Loran transmitting station where operators maintain constant watch on timing equipment. About 150 such installations could cover the main travel routes of the world

United States Coast Guard photo



Path of flight described in article. By paralleling ILI-3880 line until just after intersection with ILO-5400, navigation was simplified. On return trip, in clearer weather, pilot diagonaled (see upper broken line) across Loran lines

vast network of radio-highways which, in effect, are fixed permanently in the air. Lines like those we followed to Rhode Island now gridiron most of the Atlantic and the Pacific, covering more than 40,000,000 square miles of the world's navigable waters.

Attracted by its war-time record in saving lives, fuel, and craft, post-war commercial vessels and trans-oceanic airlines are rapidly adopting Loran. The *Queen Mary,* the *Queen Elizabeth,* and the *Gripsholm* use it regularly, and all over-seas planes of American Airlines System, American Overseas Airlines, Trans-Canada, and Royal Dutch Airlines depend upon it. The basic principle of Loran can be set forth fairly simply.

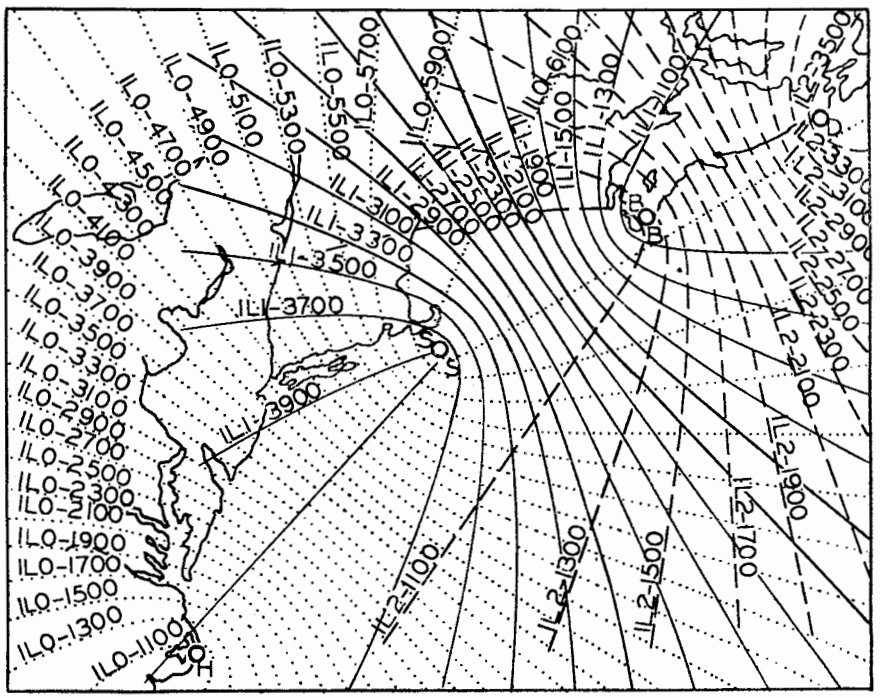
HOW IT WORKS—To begin with, Loran has nothing to do with radar. The super-short waves of radar, some of them no longer than a cigarette, travel in straight lines like light waves and dash off into space when they reach the horizon. Consequently, while radar waves can reach the moon, the earth's curvature limits their ordinary service range to about 250 miles. Long radio waves, which hug the earth's surface, are essential to Loran. So 160 meters (the old amateur band) was selected. These waves provide "highways" which reach out over the sea as far as 800 miles in the daytime and 1600 miles at night.

Loran sending stations operate in pairs, and anyone with a bathtub can find out how a station pair sets up the fixed highways which now girdle much of the globe. Dip both forefingers simultaneously into the water a few inches apart and you set up two circular patterns of ripples. If you watch closely, you will see that, while the ripples move steadily outward, the points where the ripples intersect one another appear to remain stationary. The ripples sent out by Loran's twin radio pulses behave the same way, and the numbered Loran "highways," which appear on the millions of new navigation maps, are simply hyperbolic lines drawn through these apparently stationary intersection points. Thus, a method has been found of taking radio waves which travel at 186,000 miles a second, and making them seem to stand still.

Each Loran broadcasting team is composed of a "master" and a "slave" station, located 300 to 400 miles apart. The master leads off in emitting short bursts of radio energy, only 40-millionths of a second long, and the slave, triggered precisely by the impulses from the master, follows suit a known fraction of a second later. This slight delay prevents the possibility of having two highways marked by the same signals, and makes the station signals easier to identify.

Soon after our take-off, Commander Read selected on the dial the most convenient station pair in the area, the team broadcasting from Nantucket and Nova Scotia. A procession of upright green lines marched across the scope. Using a trick borrowed from television, Loran dishes up radio signals so that you see them on a cathode-ray screen, instead of simply hearing them. Each line represents a different Loran station, just as you have a choice of many stations on your home radio. Two of the lines stood still. This was the pair he had chosen. Turning knobs to project on the screen a series of graduated scales, Commander Read quickly added up the difference between the two time signals and jotted down the result, which was 3878 millionths of a second. Then he looked at the printed Loran map and found the highway nearest to his reading. It was labeled "3880," and we were just a bit north of it. Since a single Loran reading shows only the highway on which the plane or ship is traveling, but not the exact spot on the highway, a second reading is necessary.

To get his second "fix," Read selected Cape Hatteras and another Nantucket station, whose lines in-



Section from Loran map of north-east coast of United States. Area from which map at top of page was taken is located just above ILI-3900. Note hyperbolic radiation of Loran signals and way in which intersections give fixes on lines of position. Actual maps use colors, not broken lines, and are more complicated

Courtesy Sperry Gyroscope Company, Inc.

Using newest Loran receiver (left), Captain H. G. Nordenson plots the course of the M/S *Gripsholm* on Loran chart. Wide commercial use of Loran is expected

tersect 3880 at an angle. Their green signals promptly halted for measurement. He could now mark our exact position on the map. The whole job had taken him less than a minute. Whenever the wind blew us off our chosen Loran line of flight, the error was easily corrected by another reading. Even when the weather cleared on the home flight, the navigator didn't bother to check our position by looking out of the window. Loran was easier and quicker, he said.

TIME IS ESSENCE — What makes Loran possible is the amazing preciseness of its timing equipment. It is an electronic scalpel which slices time into millionths of a second, a stop watch which freezes these incredible fragments in their tracks, and a projection machine which turns them into visible symbols that any trained man can interpret. It has been calculated that a clock of comparable accuracy would run five to ten years before it would lose or gain as much as a single second.

This accuracy was reflected in its everyday war-time use. Pacific pilots, homing to San Francisco, knew that if they followed Loran line 2055 they would pass over the north end of Golden Gate Bridge, while if they hopped over to 2075 they would cross the south end.

One war-time Loran line ran from the American air base in the Marianas some 1400 miles to Tokyo, and B-29's rode it back and forth in their shuttle-service." With a well-marked path to follow, they left their customary reserve fuel at home and were able to add as much as a ton and a half to their bomb loads.

A ship stationed off the Aleutians kept its position accurately through two weeks of foul weather by means of Loran. Plane carriers off Okinawa, when weather barred celestial observation for three days, used the vibrating green lines to hold position for homing fighters. Half a dozen Loran stations gave good service guiding planes across the "Hump" between Burma and China. And in the Atlantic battle against submarines. Loran was widely used to enable a ship and a plane to keep a rendezvous.

BEGINNINGS—Loran got its start in November, 1940, when the National Defense Research Committee decided to try out a suggestion made by Dr. Alfred L. Loomis, the versatile genius of Tuxedo Park, New York. A chain of four stations, stretching from Delaware to Greenland, began operation in the fall of 1942. They were an immediate success, and the Navy set up training courses for station operators and navigators. Much equipment used in actual service was built by research men in the Radiation Laboratory, then large orders were placed with manufacturing firms. The first airborne receiving set came in two units, weighed 75 pounds. Later both bulk and weight were halved, and the present one-piece set weighs 35 pounds.

Meanwhile, in England, R. J. Dippy, a former school teacher, had been pioneering independently in a British version of the system, identical in principle, called "Gee." Mr. Dippy's position lines were much shorter than Loran's but they aided the RAF in flights over Europe. While the Radiation Laboratory profited by British experience, Loran can be fairly called an American invention.

Loran's greatest value is for guiding ships and planes over vast, unmarked stretches of ocean, but a special system called SS ("sky-wave synchronized") Loran was developed during the war to throw radio streets over land. During the final months of the war in Europe, the Germans learned how to detect tell-tale signals from planes which used radar. So SS Loran, which could not be spotted because the sets in the plane only receive, do not broadcast, was used for the night bombing of Berlin and other targets. Since the signals of SS Loran travel by bouncing sky waves, the method is effective only at night when sky waves are strong.

V-J Day found the Radiation Laboratory scientists experimenting with a new Loran system designed to give coverage simultaneously over land and ocean areas. A chain of three experimental stations was installed on the east coast which covered most of the United States east of the Mississippi and a large part of the Atlantic. Navigation tests by the Army and Navy were successful. These stations were moved to western Canada to guide the snowmobile caravan of Canada's "Exercise Musk-Ox" in its 3000-mile scientific trek through little-known Arctic terrain. The 47-man expedition, which set forth on February 15, was fueled and provisioned almost daily by a fleet of planes. Loran gave the explorers their exact position, which they radioed to air bases, enabling the planes to drop supplies within a quarter of a mile of the caravan.

WORLD ROAD MAPS—An essential part of the Loran project has been the printing of 2,500,000 big, elaborate "road maps," in which the labeled radio highways appear in various colors for easy recognition.

In the office of J. A. Pierce of Harvard, former head of the group of scientists which developed Loran at the Radiation Laboratory, I saw a master map of the world dotted with 70 red pins, representing Loran broadcasting stations whose gridiron of navigation lines nearly girdles the globe. In the conversion from war to peace, some of these stations are being dismantled and others installed where they will best serve

peace-time traffic. One of the appealing features of Loran is its relative cheapness. The cost of the war-time system is generously set at $130,000,000, and that includes research and development and the building of some 40,000 receiving sets which became surplus goods when the war ended. It is estimated that a network of about 150 stations would be enough to cover all the traveled areas of the sea, and the air above it, throughout the world. Each station would cost about $100,000 to install, and the maintenance of the whole system might run to $20,000,000 a year. International cooperation will, of course, be necessary, and world-wide standards were discussed in a conference in Dublin last March.

IN WAR AND PEACE—Loran gear was whipped together quickly in response to war's demands, and despite its remarkable service, it can already be called obsolete. New Loran equipment which is even more accurate and easy to use already exists. Sperry Gyroscope Company has started delivery of sets to the Navy in which readings are fully automatic, eliminating all chances of human error in adding figures. The navigator selects a station pair and the set does the figuring, showing a "highway number" which can be found at once on a Loran map. And this is only the beginning.

Like most new inventions, Loran can do its part in making any future war more devastating, and Mr. Pierce recently startled the Institute of Radio Engineers with an awe-inspiring picture of pilotless aircraft and bombs directed to their targets on Loran's accurate "highways." A Loran line can be thrown at night to cross any target within 1600 miles, he explained, and an intersecting line can be set up over the target to release the projectiles for descent. Bomb-loaded aircraft could be dispatched independently from dozens or hundreds of launching sites toward this line, to which their Loran receivers would be sensitive. When they reached the "highway," each would alter its course and ride the line to the target.

But the great future of Loran is in guiding peace-time traffic. Girdling the globe with its invisible streets, it is bound to make travel faster, safer, and cheaper in the years to come.

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LIGHT PLASTICS

Will Float on Water, Retain Flexibility

AMONG the plastics developed by Dow during war-time for secret military uses and for cable sheathing, Styraloy has properties which place it in the field between rigid plastics and rubber. It is lightest in weight of all Dow plastics—it will float on water—and its flexibility at low temperatures is an outstanding characteristic.

When combined with synthetic rubber, Styraloy imparts more flexibility at low temperatures, better electrical properties, and lower water absorption. It also provides more uniform flow and better surface finish, which means lower fabrication cost.

AMERICAN-MADE CARS

Needed in Huge Numbers to Meet Foreign Demand

WAR-TIME losses created a tremendous international market for automobiles, and in 10 to 20 years the world's pre-war car population may be nearly doubled, according to James Stanford writing in *Ethyl News,* publication of Ethyl Corporation. Moreover, the whole western hemisphere "is nearly 100 percent American in its automotive preferences," and many of the other nations also prefer machines made in the United States.

To sell and service the 14,300,000 overseas vehicles in use in 1940, car dealerships and service stations extended as far north as the little Finnish city of Rovanamieni, inside the Arctic Circle, and as far south as the Chilean town of Porvenir in Tierra del Fuego—the islands off the southern tip of South America. Present figures indicate only 6,100,000 foreign registrations of American-made cars.

The article tells of people in Peru fitting parts from one car into another, and car parts into trucks. Tubular metal bedposts were used for parts, and gears were cut out of pieces of steel, using hand saws and files in efforts to keep cars going.

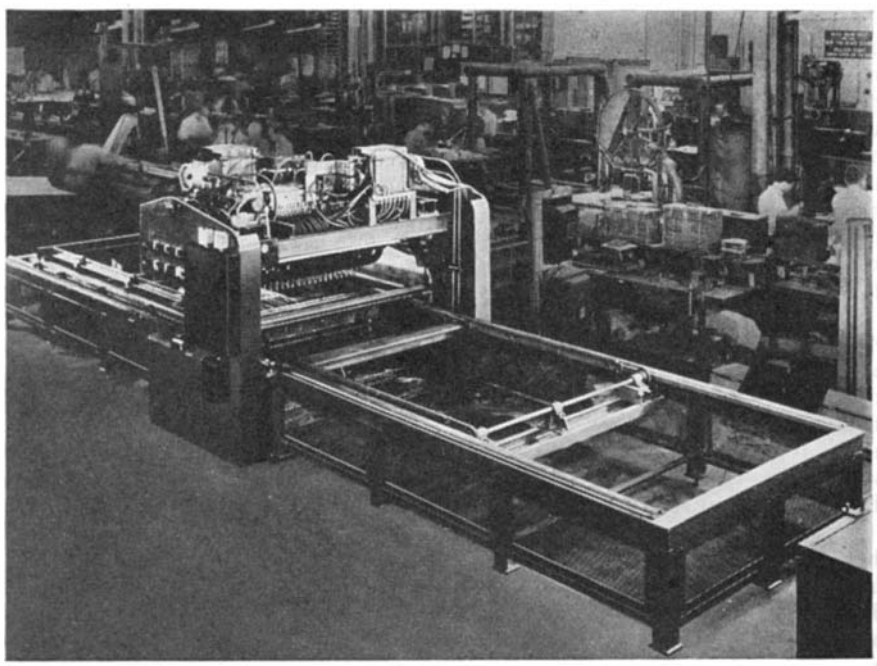
Europe's need for motor vehicles is great, and the market for American machines girdles the world, Mr. Stanford's article points out.

SPOT-WELDER CONTROLS

Built as Units, Boost Multiple-Welding Speeds

A NEW welder-control unit is said to permit automatic-assembly welding rates up to 900 spots per minute. Designed to meet the requirements for fully automatic multiple-spot resistance welding of a large number of joints quickly and in one operation, the control is claimed to reduce the production limitations of such welding to the time required to load and unload the welding machine.

Called the Ultra-Speed unit, the control distributes welding current to a single welding point or to groups of points successively by means of a screw-driven carriage that depresses push rods to engage contacts in a manner similar to running a finger over a piano keyboard. At the same time, another element of the carriage engages adjustable-stroke plungers to control individually the length of time the welding current flows for each weld. All welding points bear on the work simultaneously under welding pressure before the first weld is formed, and remain until the last weld is completed, eliminating



Welding current feeds to single points or groups of points automatically

the separate "squeeze" and "hold" times usually required for each weld. Thus 20, 50, 100, or more joints can be made in slightly more time than the total of the individual "weld times"—at a few hundreths of a second each. Unit construction of the control, built by the Progressive Welder Company, permits combination of such units to accommodate as many welding guns as required for various assemblies.

VISION CHECKING

Speeded by New Sight-Screening Unit

INDUSTRIAL efficiency and safety will be promoted by a new vision-checking program which quickly spots those employees who need an eye examination and correction, according to the American Optical Company, who have instituted the program in their own plants.

Dr. Paul Boeder, director of the company's Bureau of Visual Science, says that the program was developed on behalf of industry because surveys disclosed that one out of every three industrial workers is handicapped by deficient vision which costs American industry millions of dollars in production and other losses. "Industrial eye accidents," he declares, "cost $20,000,000 each year in direct compensation and medical expenses, and inefficient eyesight is responsible for many of the industrial accidents which cost $400,000,000 annually."

Pointing out that most industrial operations demand efficient vision, it is said that inspectors and engravers should have keen eyesight, machinists and assemblers of precision parts need good eye coördination because they use their eyes at close range over long periods, and drivers of motorized equipment should possess good depth perception to perform their work in safety. When employees lack the necessary visual qualifications for specific jobs the result may be lowered production and increased accidents.

Fourteen eye functions are tested in a few minutes. Portable checker saves time, does not take employee from job

Detection of the visually unfit under the new program, it is explained, is made with the aid of a newly developed sight-screening instrument which utilizes polarized light to check vision. The device is portable and can be carried directly into a factory for checking each employee's visual performance.

Data on 14 different visual functions can be obtained through the device in three or four minutes. From this information the eyesight specialist determines the employee's need for eye care, particularly as it affects his job. If required, a complete eye examination is then provided so that the employee receives the benefits of the necessary professional services essential for developing visual efficiency, safety, and general comfort.

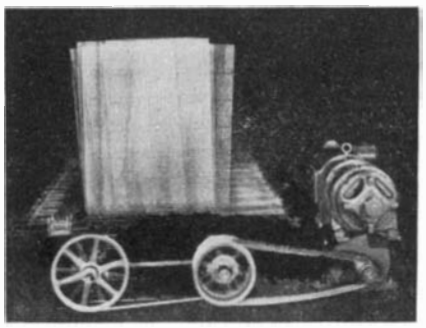
Dr. Boeder reports that American Optical's new plan for promoting industrial safety and visual efficiency also includes the development of visual programs designed to meet the specific needs of different industries; promotion of investigations to establish visual-placement standards for various job classifications so that an employee's eye capabilities may be better utilized; and recommendations for improving environmental conditions affecting vision, such as poor illumination, glare, smoke, and fumes.

TEST TABLE

Proves Packaging by Simulating Freight-Car Motions

VIBRATING and shaking like a freight car, even to the pitch and toss, to test packages and products to be sure they will arrive in good condition and will "work" without home tinkering, a new test table will give the equivalent of a coast-to-coast freight trip in a one-hour test.

Two eccentric shafts, one under each end of a strong table, cause the table to vibrate with a circular motion in a vertical plane, and with a displacement about the same as the maximum deflection of average freight car springs and at a frequency similar to their natural frequency. The shaft at one end of the table can run either synchronously or out of phase with the shaft at the other end, or at a different



Packages get equivalent of coast-to-coast freight trip in one-hour test

speed. As a result, the table has a mixed motion and a "pitch and toss" in addition to its vertical and horizontal movements. The rhythm is similar to freight cars. The package repeatedly bumps a fence secured to the table, giving it shocks similar to car bumping or train jerks. Smaller packages may be stacked or larger boxes strapped down to duplicate actual freight car loading methods used.

INSECTICIDES

Play Vital Role in Human Affairs

INSECTS will inherit the earth unless man abandons war and turns his martial energies to killing pests, Dr. H. L. Haller of the United States Bureau of Entomology and Plant Quarantine warned in a recent address delivered before the American Chemical Society. Pointing out that in the United States alone, insects destroy about one tenth of each year's food and fiber crops, Dr. Haller estimated the annual loss as two billion dollars.

Speaking authoritatively as chief chemist of the Entomology Bureau's Division of Insecticides, Dr. Haller declared that despite great advances in insect-destroying techniques, 20 percent of America's annual cotton output has been ruined in the last decade by six of the more common insects attacking this crop. "Likewise," he continued, "four of the more common insects attacking corn have reduced the average per acre yield of this crop by 13 percent. Much the same situation exists with respect to vegetable and fruit crops."

Not all insects are harmful, however, Dr. Haller noted. In fact, he said, of the 600,000 known species only about 6000, or 1 percent, are considered dangerous, and of these only about 70 kinds are responsible for most of the agricultural losses in this country. Insects are agents of pollination of many flowers and hence are responsible for the growth of a large group of fruits and vegetables. He further noted that some insects kill others which are harm-

ful, and that some form important sources of chemicals such as beeswax, cochineal, silk, and shellac.

In view of these facts, it was emphasized that man must learn to live with insects in general, while attempting to control or eradicate those dangerous to his food, economy, and health.

Discussing the various types of chemicals used to control pest and plant diseases, he named lead and arsenic compounds as the major agricultural insecticides, and copper, sulfur, and mercury compounds as the chief weapons for guarding crops against fungi. The war-time development, DDT, will find considerable use in both agricultural and household insecticides, Dr. Haller predicted. Since the use of inorganic compounds such as arsenic and lead may leave residues that constitute health hazards, the trend in the development of new insecticides has been directed towards utilization of organic compounds.

Organic, or carbon-containing, insecticides may be divided into three broad classes—those of animal origin, those of plant origin, and those prepared synthetically—he continued. The first class consists of fish oils, glue, and petroleum oils; the petroleum oils being most important. Of several hundred plants tested for insecticidal properties, Dr. Haller reported, only a few have shown enough promise to be of commercial value, the most important being tobacco, pyrethrum, and the rotenone-bearing plants, derris and lonchocarpus. Although DDT has received the most attention among the new synthetic insecticides, another, named benzene hexachloride, has been found very effective against certain pests.

LATEX FOAM

Will Find Many Industrial Uses

EXPERIMENTATION and development in the rubber industry has produced a material known as latex foam with a multitude of uses ranging from seating and sleeping cushions to fracture padding for medical use, W. L. Jantzen of United States Rubber Company said in an address at a recent meeting of The American Society of Mechanical Engineers. Comparing the latex foam with other types of spongy rubber, the speaker said:

"The important difference is that the latex foam is completely porous—the skin surfaces of latex foam are filled with tiny pores just like human skin—and the internal structure of the material is a homogeneous mass of interconnecting air cells. Thus the latex foam is porous through and through—water will run through it, air easily passes through it and to prove this you can blow smoke through it. This perhaps is one of the chief reasons for its success and adoption for seating and sleeping—it is able to completely dissipate body heat."

Application of the material to seating purposes revealed that its supporting qualities make unnecessary the use of solid material, cores of appropriate size being run through the latex foam, the speaker said. He noted also that, while the texture does not permit use in the uncovered state, tests have shown that fabrics wear better over such cushions than on conventional cushions. The material also may be combined with springs.

Discussing uses for latex foam other than seating, the speaker said:

"In the sheet form and of soft density it is being used as fracture padding by doctors and hospitals. It is used in operating table and examination table pads. It is molded into invalid ring cushions and bed pillows. It served as lining in metal helmets during the war; it provided cushioning for sights in certain telescopic instruments; it provided linings for cases housing delicate instruments."

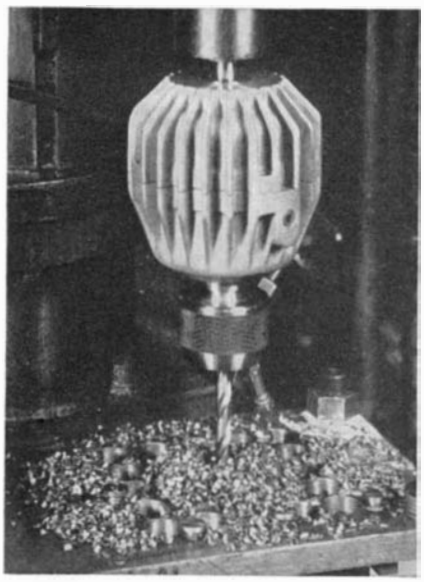
New Products and Processes

CHIP BREAKER

Frees Drill for Deeper Cutting, Eliminates Hazard

INTRODUCED as an aid to longer drill life and higher operating speeds, an improved drill chip breaker operates at each revolution of the drill. In operation, the short chips accumulate around the mouth of the hole, eliminating the long, whirling spirals that would otherwise be thrown about the machine. Drill coolant is said to flow readily past the broken chips.

Advantages claimed for the Ex-Cell-O Drill Chip Breaker include: faster drilling, rounder and smoother holes, less drill breakage from chip-clogged holes, greater safety, and the elimination of periodic drill withdrawal to clear chips.



Long, spiral cuttings are eliminated

As described by the manufacturer, the unit may be used in either vertical or horizontal positions and, where space permits, on multiple spindle heads.

POINTING COMPOUND

Repairs and Waterproofs Brick and Concrete Surfaces

AVAILABLE in large quantities for industrial use, and in convenient smaller quantities for applications around the home, a new cement pointing compound can be applied at putty consistency or thinned out and used as a waterproofing wash. It dries quickly and is reported to seal repaired exterior surfaces completely against water.

This new material, known as "Brix-Fix" and developed by the Greater New York Waterproofing Company, is produced in four colors—red, gray, white, and black—so that repairs can be made to match the surrounding surface. To use, the dry powder is mixed, as it comes from the container, with water to attain the required consistency. Heavy mixtures are applied to holes, cracks, and voids with a trowel or pointing tool; thin mixtures can be brushed on.

Plant maintenance men and home owners alike will find the compound easy and convenient to use, since all necessary ingredients except water are ready mixed. After all loose mortar is removed from the surface to be repaired, the area is thoroughly wet down with water and the mixed compound is applied. After drying, it can be painted if desired.

MASONRY BLADE

Improves Cutting of Construction Materials

ABRASIVE masonry-cutting blades that are said to overcome objections to earlier blades have recently been placed on the market. Advantages claimed for the "Jade" blade, made by Champion Manufacturing Company, include: longer life, lower cost per cut, quick cutting, and elimination of operator eye-strain. The blades are offered in 12- and 14-inch sizes.

CIRCULAR SAW

Has Magnesium Frame, Passes Through Doorways

A LIGHT-WEIGHT portable 12-inch radial saw, made principally of magnesium, weighs approximately 200 pounds complete with carrying frame and 1½ horsepower electric motor. Its compactness allows it to be carried through a 30-inch doorway. With a 3 by 16-inch crosscut and 20½-inch wide ripping capacity, it is reported that the portable saw will handle the kinds of work usually done by heavy stationary saws.

The American Saw Mill Machinery Company states that the Monarch Uni-Point saw's main feature, in addition to lightness, is its "one-point cutting" principle with which the saw blade always travels through the guide fence and cuts the lumber at the same point on the table. When making a cut, the saw assembly and hardened-steel arm move forward on ball-bearing rollers. At the completion of each cut, the assembly moves back and the entire table top is clear for layout, measuring, and so on.

Permanent accuracy of the entire machine is said to be maintained by five simple adjustments, and because operating adjustments are kept at a minimum, it is claimed that the saw will save considerable time on the job.

INDUSTRIAL TIRES

Made of New Synthetic, Resist Floor Contaminants

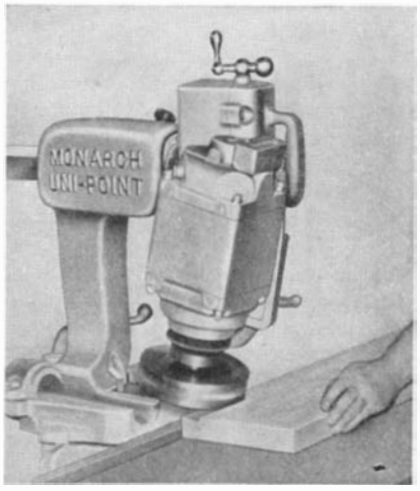
IN ADDITION to resisting the destructive action of oils, greases, and brines, a new synthetic rubber compound for industrial tires is reported to have less rolling resistance than regular construction industrial tires. As compared with either natural or GR-S government synthetic rubber tires, The B. F. Goodrich Company says the new synthetic stands up better against cutting and chipping.

DETERGENT

Comes in Concentrated Form, Cleans Many Materials

A NEW multi-purpose car-wash and household cleaning agent is a synthetic detergent derived from petroleum and free of animal and vegetable fats, greases, or acid. It is non-inflammable.

On automobiles and other vehicles, the product, called Ethyl Cleaner, is



Attachments (above) permit notching, routing, shaping, sanding, dadoing, boring, and like jobs. Light-weight frame adds portability—saw may be taken to job (left) by its operators

described as equally effective for windshields, windows, upholstery, chrome fixtures, tires, canvas tops, and the metal body.

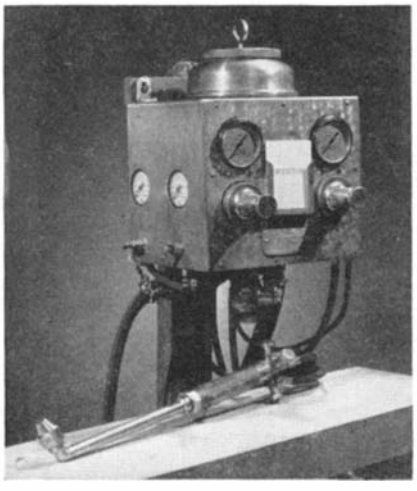
Among the home uses for which its manufacturer, the Ethyl Corporation, recommends the detergent is the cleaning of painted, enamelled, and porcelain surfaces and finishes, as well as tile, windows, refrigerators, stoves, upholstery, and rugs. It is also recommended for washing fine woolens since the detergent leaves no scum or other residue.

Ethyl Cleaner is offered in concentrated liquid form; a 24-ounce bottle produces about 120 quarts of cleaning solution when water is added to it. Mild to the skin, the cleaner contains no abrasives or caustics, does not attack surfaces or finishes, and is said to clean readily in any temperature or type of water. The new product also appears to possess unusual "wetting out" qualities which permit it to saturate the article or surface being cleaned very rapidly.

FLAME TOOL

Projects Flux-Alloy Mix in Controlled Atmosphere

UNUSUAL welding and metal- or plastics-surfacing processes may be accomplished with a new flame tool



Torch will weld, braze, metalize, or apply plastics or hard-metal surfaces

made in the general outlines of an ordinary welding torch. The torch has a special nozzle and 16 independent controls, many of them at the handle of the tool. A control box with air- and gas-pressure regulating valves, and a canister from which powdered materials are fed through the flame make up the rest of the equipment.

Known as Powder Weld, the equipment is described by the maker as "a new method of welding, brazing, or surfacing with infinite compositions of powdered materials." Super-hard metal coatings and various types of plastics are said to be quickly and easily applied with the device.

Complete control over all variables in the process—amount of flux, amount of flux-alloy mixture, flame temperature and atmosphere, processing gas temperature of projected material, and so on—makes possible a great variety of results.

Typical applications for which Powder Weld is described as being suitable are surfacing with plastics or synthetics enamels, powdered-alloy brazing, powdered-metal welding, rod welding with projected fluxes, controlled-atmosphere welding, and metal spraying.

PLASTICIZERS

Offer Advantages In Many Coatings

TWO NEW plasticizing resins for use in metal, wood, fabric, and paper coatings, and with plastics and wax compositions are known as 276-V2 and 276-V9; they are the first of a new series of styrene resins to come from research done in the Dow laboratories.

The company, describing them as water-white, non-yellowing viscous liquids which are chemically inert, said that they possess an attractive combination of properties, are soluble in all common organic solvents except the lower alcohols, and are compatible with a wide variety of film-formers and plasticizers. The workability of these new resins with waxes, and their resistance to alkali were particularly pointed out as greatly expanding their use.

Good electrical properties, ready

solubility, alcohol and chemical resistance, lack of acidity, and stability on aging will make these new plasticizing resins useful in plastics and calendering compositions, bronzing lacquers, paper lacquers, textile coatings, pressure sensitive adhesives, emulsions, and rubber compounds as well as conventional lacquers, the company said.

STABLE IRON

Used in Improved Precision Flat

A SURFACE plate of improved design is made of a specially alloyed close-grain iron to assure the utmost stability

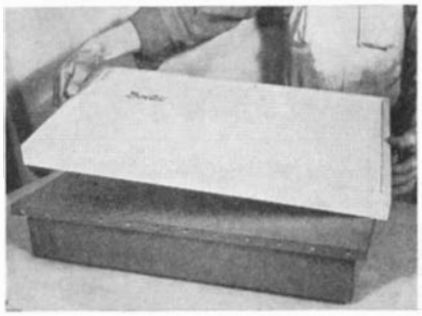


Plate edge has fixture-mounting holes

in the finished plate. Careful annealing and treatment by alternate heat and extreme cold at various stages in production is said to impart a stability formerly obtained only by long periods of natural aging outdoors.

The 14 by 24 inch DoAll surface plate is constructed with a system of ribbing to support the working surface; the number of ribs, their placement, and depth are engineered, it is reported, so as to prevent any appreciable deflection in normal use. Three feet, positioned to ensure a minimum of sagging, support the plate.

The flat surface is pin-point hand-scraped with 22 or more evenly distributed bearing spots per square inch. Maximum deviation of the bearing areas from a mean plane is .0002 inch over the entire surface. The underside of the ¾ inch overhang on the plate is machined all around. Thus, work or fixtures can be clamped to the surface plate. In addition, the edge of the working surface has been drilled and tapped on 2 inch centers all around to enable the user to mount special fixtures.

ARC WELDER

Does Versatile Job On Rural Power

AN ECONOMICAL welder for rural power lines, which simplifies welding and increases its utility for average repair and fabricating jobs features an "Arc Booster." When the electrode touches the work, the welding current is given a boost of intensity for starting the arc, and then reverts automatically to the amount set for the job. Either of the two degrees of arc boosting provided is selected by a snap switch, one for general work and the other lower amount for thin material such as automobile fenders.

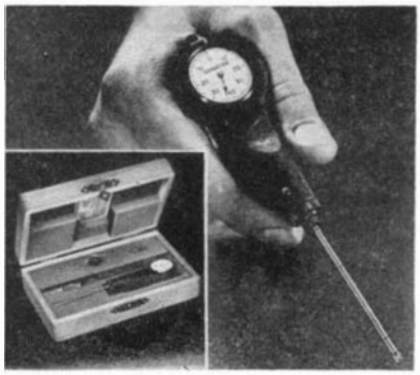
Current control for the new "Fleet-Arc Jr." is of the separate adjustable reactance type and is variable over the entire welder range of from 20 to 180 amperes by turning a hand wheel. The new unit, manufactured by The Lincoln Electric Company, is for 230-volt, single-phase power lines and meets the limited input requirements of rural utilities and REA because of high efficiency and a high power-factor. With a maximum input current of 35 amperes, the 360-pound welder can be used with the standard 3-KVA power transformer provided by the power company. Current range is from 20 amperes at 20 volts to 180 amperes at 25 volts welding duty, and electrodes may range from 1/16 inch to 5/32 inch diameter.

INSIDE DIAMETERS

Checked Visually By Small-Hole Gage

A DIAL indicator gage has recently been announced that will gage holes between .122 and .250 inch inside diameter, in depths up to 2¼ inches. Variations within the diametrical range are obtained by a set of 12 interchangeable gaging plugs.

With this new small hole gage, internal defects—taper, out-of-round, bell-mouth, and so on—are immediately visible on the indicator dial, thus giving a better visualization of the



Hardened steel ball in gage tip rides on hole walls to check contour errors

condition than is possible with a conventional plug gage. When calibrated and set for a specified inside diameter, the gage has a total range of plus or minus .004 inch in minimum graduations of .0001 inch. The dial is balanced and can be rotated.

Made by Federal Products Corporation, the new gage is said to be capable of measuring a range formerly beyond the scope of the dial indicator.

PORTABLE PLASTICS MELTER

Gives Tools "Dip" Protection Anywhere in Plant

PLASTICS protective coating of plugs, gages, carbide-tipped tools, and so on may now be accomplished at any location in a plant with a new portable melting tank of one-gallon capacity. According to the manufacturer, Aeroil

Melter uses lighting circuit power

Products Company, this tank allows the plastics compound to be brought to dipping temperature, from a cold start, in minutes instead of the hours normally required for equipment of this type.

The tank, called the Midget-6, features a one-piece inner vat of heavy, warp-proof, cast-aluminum of high heat conductivity. The special design of the unit is said to result in complete uniformity in heating the critical plastics coatings.

Other features include accurate thermostatic controls to automatically maintain heat at required temperature; removable cover with insulated plastics handles; neon pilot light; and a carrying handle for portability. The complete unit weighs 16½ pounds.

The portability of the 1000-watt equipment is aided by a two-prong plug which fits standard lighting outlets—no special fuses or wiring is necessary. The equipment can be set up anywhere in the plant, so that the processing can be brought to the parts to be coated rather than vice versa.

PATTERNED METAL

Gains In Appearance and Strength-Weight Ratio

DESIGN-ROLLING of patterns into ferrous and non-ferrous sheet and strip metal is a new process that offers the advantages of decorative textures, improved strength-weight ratios, and increased utility values. Called Rigidizing,

Resistance to mars and finger smudge adds attractiveness to metal objects

the treatment gives metals finely-textured patterns providing directional, non-directional, or three-dimensional effects for decorative interior and exterior applications such as panels and trim in architectural work, transportation equipment, appliances, and so on.

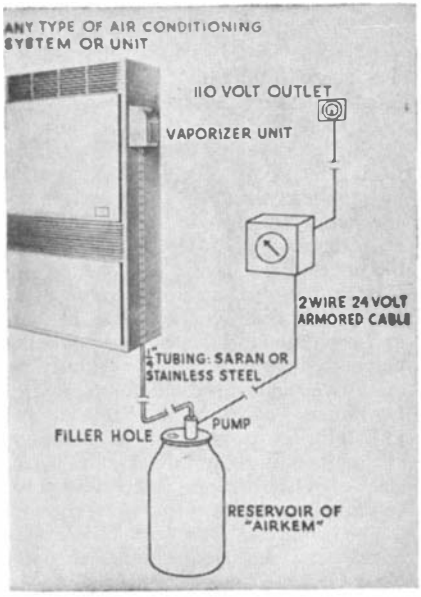
Some Rigid-Tex Corporation patterns are designed for increasing stiffness and impact strengths without materially increasing the unit weight. To date the greatest field for the use of Rigidized metals is reported to be in utility applications such as acoustics, illumination, and heat transfer.

Other uses are anticipated where attractive textures that mellow light and hide such surface imperfections as finger prints, scratch marks, and so on are important.

AIR DE-ODORANT

Dispensed Through Air-Conditioner, Portable Unit, or Wick-Bottle

FOR ODOR control and air-quality improvement in industrial plants and other enclosed spaces subjected to occupancy and industrial odors, a new system



For use with air-conditioning systems

of dispensing Airkem-chlorophyll air freshener—has been announced. First used in hospitals, this odor counteractant and air-freshener is now supplied to large motion-picture theaters, hotels, restaurants, beauty salons, schools, and so on. Airkem has also been adapted to industry where undesirable odors are likely to slow up production.

Airkem is reported to be composed of a complex group of aromatic substances from plants, plus activated chlorophyll; the dispensing devices volatilize these aromatic substances and thus bring objectionable odors under control. The activated chlorophyll gives a pleasurable outdoors effect to the air. Enclosed spaces serviced by air-conditioning units can be de-odorized by the Evapatrol system, an installation which may be fitted to existing air-conditioning or ventilating systems. Non-air-conditioned areas may utilize either the

Airkem portable Evapatrol unit or evaporation from a 15½-ounce bottle, equipped with the special wick.

When used with air-conditioners, whether of the central or the packaged self-contained type, the Evapatrol unit consists of a reservoir of Airkem, in which is a pump, a regulator, and a vaporizer. The pump forces the deodorant into a nozzle in the vaporizer from which it is sprayed out over a cartridge holding excelsior. Some of the air of the air-conditioning unit bypasses through this cartridge and evaporates and mixes the air freshener into the conditioned air. The portable type differs from the other units distributed by W. H. Wheeler, Inc., in that the supply of Airkem which is evaporated is thrown into the air by a motor-driven fan.

BINDERY GLUE

Based on Plastics Resin, Has Permanent Flexibility

BECAUSE of its resistance to extremes of temperature and climatic conditions, a liquid plastics synthetic resin is adaptable for use as a cold padding glue in print shops and binderies.

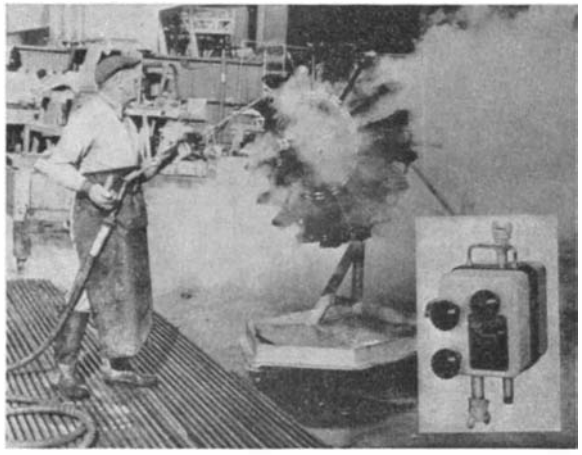
The use of plasticizing agents is said to overcome troubles due to crystallization, hardening, and brittleness, and also to impart greater covering qualities. According to the manufacturer, Paisley Products, Inc., one gallon of the glue, called Pliatab, will cover two hundred square feet of padding area. The compound, which features long storage life and permanent flexibility, can be applied by hand brushing or spray gun, and is available in red and white.

STEAM CLEANER

Combines Portability with Operating Simplicity

AN ECONOMICAL steam-cleaning unit that operates from a standard plant steam supply is said to give a powerful cleaning action through the use of heat, water, detergent, and friction. Weighing only 28 pounds, the unit is portable, and couplings permit fast connection. Steam lines maintaining 80 to 150 pounds pressure, with ¾ inch valve outlets are usable with the cleaner.

Three manual controls vary the temperature, quantity of solution, and nozzle pressure to fit the needs of the job at hand. Turco Products, Inc. describe the Hydro Steam Unit as adjustable to deliver a high-temperature, penetrating spray, or a moderately warm spray. Other features are ease of operation and the absence of moving parts, pumps, pressure tanks, motors, electrical connections, and toxic or explosive cleaning agents.

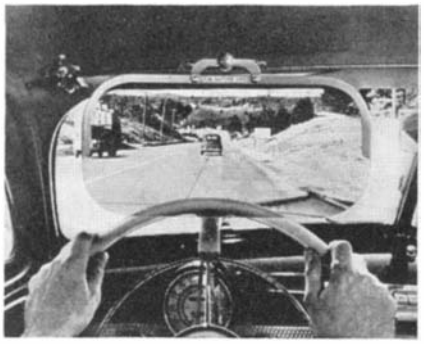


Non-explosive and non-toxic cleaning agents are used in unit that connects to shop steam lines with single valve fitting

DRIVING VISOR

Reduces Motoring Fatigue by Blocking Road Glare

REFLECTED sun glare, a common source of eye-strain and driver fatigue, is said to be efficiently screened out by a new light-polarizing automobile visor. The driving aid, called the Polaroid Day-Driving Visor, is designed to be suspended in front of the motorist's eyes. Made of a curved, polarizing-plastics sheet, the visor is supported by a lightweight steel frame which attaches the unit to the car and allows it to be swung up out of the way when not needed. It is claimed that the special properties of the Polaroid material exert a selective control over the light reaching the driver's eyes.

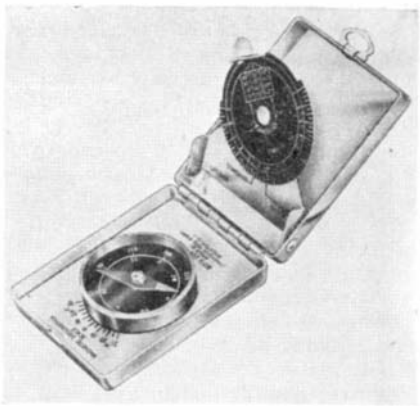


For day-time use, pushes up at night

SUN-WATCH

Has Luminous Compass Needle; Needs No Winding

A POST-WAR version of an ancient horological device is now offered to sportsmen in the form of a compass and sun-watch combination that tells both time and direction accurately. The Boyd "Sun-Time" is intended for use when fishing, hunting, sailing, camping, hiking, skiing, or motoring. No winding or setting is necessary.



Time and direction told accurately

Described as waterproof, compact, and durable, the device has a solid brass case which houses a compass with an unbreakable crystal and a luminous jewelled needle.

PICTORIAL DRAWING

Done Faster, More Accurately with Angle-Ellipse Stencils

TO SPEED production of the three-dimensional type drawings now widely used in many industries, two new sets of draftsman's pencils have recently been placed on the market. One set of stencils provides the correct axes for isometric drawings; the other set is designed for drawings with axes at dimetric angles.

Both sets incorporate edge graduations for scaling the work in hand, and each stencil has 27 ellipse openings, correctly projected and ranging from ⅛ to two inches in diameter. The larger Hi-Range Instrumaster Stencils provide ellipses of greater diameter. All ellipse openings are marked as to the size of circle represented and carry center lines for locating purposes.

The stencils, manufactured by Instrumaster Industries, are made of clear plastics stock .040 inch thick. Graduations and lettering are debossed on the lower surface.

PRECIPITATOR

Provides Clean Air for Industry or Home

AIRBORNE dust and dirt, a serious handicap to precision manufacturing, are said to be efficiently reduced with a new electrical dust eliminator. It is claimed that lower maintenance costs, higher efficiency, and greater comfort and safety may be achieved with this device, called the Raytheon Precipitator.

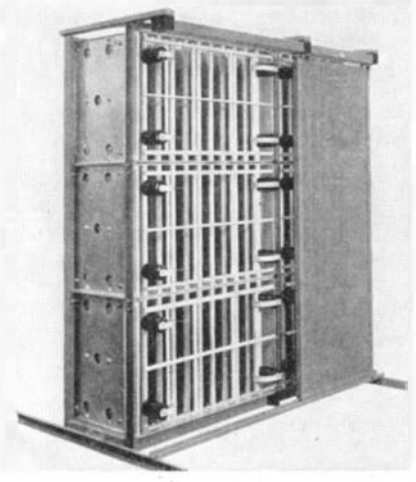
Used to remove smoke, dust, pollen, oil mist, and other contaminating particles commonly found in fresh and recirculating air systems, the unit appears adaptable to metal, textile, precision instrument, food, pharmaceutical, and other industries. Another industrial application is the cleaning of re-circulated air in forced-ventilation rotating machinery systems.

Domestic users may incorporate the Precipitator in the heating and ventilating systems wherever practicable, or small individual floor units that plug into the lighting circuit may be used.

Electrostatic dust precipitation involves passing all airborne particles through an electrostatic field and subsequently precipitating the charged particles onto oppositely charged collector plates.

The Raytheon device consists of three principal parts—the dust-collector cell, the ionizer unit, and the power supply. The ionizers are energized by the power pack with high-voltage direct current to create a strong electrostatic field. The collector plates are periodically washed down to remove the dirt although, on some units, washing equipment will be completely self-contained.

A 1200 cubic feet per minute Precipitator is said to be able to clean, by recirculation, the air in a room approximately 35 by 35 by 12 feet, and with a ¼ horsepower motor blower, is enclosed in a cabinet measuring 26 by 27 by 54 inches. Standard 115-volt, 60-cycle power is used and it is reported that power consumption is 50 watts per hour or less than that consumed by the average reading bulb. A Precipitator of this size, with the installation of suitable duct work, is described as suitable for removing oil mist from high-speed cutting tools.



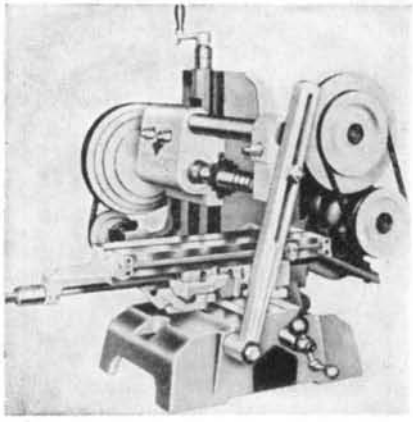
Ionizer and collector cell unit. Cell variations match capacity to air flow

BENCH MILL

Offers Big-Machine Features

ADAPTABLE to many jobs, the new Armor milling machine, is reported to accomplish accurate and high-speed production work, as well as intricate tool work, even though reduced to the size of a bench-type mill. It weighs 320 pounds, stripped.

Eliminating the use of a knee by means of a rise and fall spindle the mill has both horizontal and vertical spindles, and precision adjustable bearings. A fully automatic power feed is available which drives the table in either direction through a reversible gear box for feeds from ¼ inch per



Weighs 320 pounds, has automatic feed

minute for high-speed mill cutters through 32 steps to a 15 inch feed for carbide-tip cutters.

Eight spindle speeds provide a range from 98 to 1140 revolutions per minute through double-belted, cast-iron pulleys. The back-gear accessory provides a low spindle speed of 33 revolutions per minute. A one-horsepower motor or smaller can be used if desired.

Made by Aircraft Machinery Corporation, the mill has a travel of 12 inches longitudinal, 10 inches vertical, and 7 inches across. Two types of heavy-duty vertical attachments are offered to convert the horizontal machine into a standard vertical milling machine.

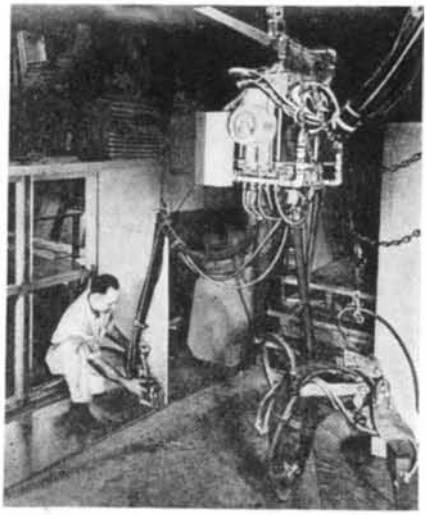
SPOT WELDER

Moves to Job via Overhead Hoist System

USE of a single portable installation for spot welding is one method which may help small plants to lower the unit cost of products to a point of economical competition with larger factories.

One such installation, used at Vering Manufacturing Company, consists of only two welding guns operating from a single transformer and with a single timer and air-hydraulic booster.

The entire assembly travels on a mono-rail chain hoist, thereby permitting the welding equipment to be moved quickly over a wide area and raised and lowered at will for welding



Small plant gets wide use from welder

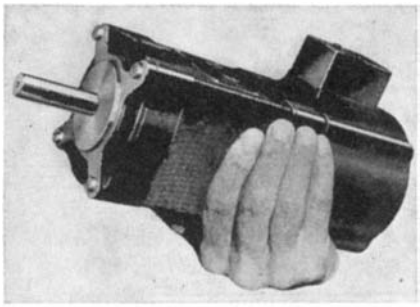
in different positions. One of the welding guns has a short throat and the other a deep throat to permit reaching all the joints of the assembly.

This portable dual welding gun unit, made by Progressive Welder Company, is said to have reduced production times and costs and also eliminated drilling, bolting, and reaming.

15-POUND MOTOR

Develops Two Horse Power for Continuous Duty

EXTRA-COMPACT and light, a two horsepower explosion-proof motor of the continuous duty type is now available for use in railroad, marine, aircraft, and special industrial applications. With an armature speed of 9000 revolutions per minute, the motor can be supplied for any output-shaft speed. An integrally built gear reducer, used where lower speeds are required, adds two pounds to the basic weight of 15 pounds. An enclosure helps to render



Features heat-resistant construction

the motor safe for use in hazardous locations.

Construction features of the motor, made by Electrical Engineering and Manufacturing Corporation, are ball-bearings, glass insulation, and high-temperature insulating varnishes. Variations in models permit operation on 28, 32, or 110 volts, D.C.

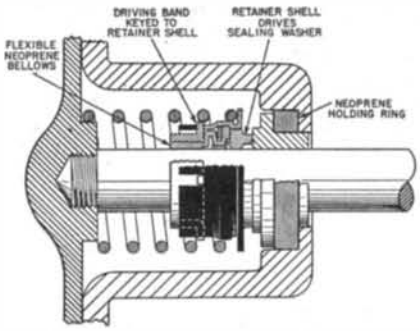
SHAFT SEAL

Compensates for Wear and Misalinement

A LONG-LIVED shaft seal employing neoprene, recently announced, is expected to reduce the expense of repeated re-packing of pumps or glands.

The seal assembly consists essentially of a low-friction sealing washer of bronze, carbon or hardened steel, and a seat of cast iron, bronze, or nitralloy as required to give best service with the sealing washer selected. The sealing washer is driven by the shaft; the seat is stationary. The two are lapped together to give an absolutely smooth surface; both are then floated on resilient neoprene supports to compensate for misalinement, wear of sealing washer, shaft vibration, and end play. A neoprene bellows is used to float the sealing washer, while a neoprene cushion ring is used for the seat. A strong spring is used to force the sealing washer against the seat.

The driving end of the resilient neoprene bellows forms a seal between the shaft and the driving band. Force



Resistant to oil and chemicals, seal material is resilient and long-lived

is also transmitted to the metal parts which turn the sealing washer, thus allowing the neoprene bellows to advance freely and maintain a seal as the sealing washer wears from contact with the seat.

Neoprene, made by E. I. du Pont de Nemours and Company, Inc., was selected for this shaft seal because it is a resilient material which retains its original properties for long periods, resisting the deterioration caused by oils, refrigerants, and most chemicals. Thus, the manufacturer can apply this shaft seal to a wide variety of uses.

SOUND-ON-FILM

Device Takes Dictation, Usable for Public Address

EQUIPPED with an electro-magnetic head, which serves the dual purpose of recording and reproducing by means of a diamond pointed stylus, a new recorder indents up to one hundred sound tracks across the width of a special film. A numbered dial automatically shows the number of the track on which a recording or playback is located. Originally developed for use as a sound supplement for silent films, the device is now offered in other models for business dictation.

Recordings are made longitudinally on the film and the period of recording on a single sound track is approximately 20 minutes. The film, light in weight, compact, and tough, can be mailed safely and economically since

Recordings are durable, may be played back repeatedly, shipped conveniently

it is not affected by humidity or changes of climate.

It is claimed that the Filmgraph has sufficient power to be played back through loud speakers if desired, and that the recording is of high fidelity and good tone quality. Manufactured by the Miles Reproducer Company, the instrument can be used as a public address system and a talk can be broadcast by public address and recorded at the same time.

SNAP SWITCH

Easily Mounted in Limited Space

COMPACT and sturdy, a new and smaller size open-blade snap switch may be vertically mounted singly or in multiples. Constructed with a heat-

Various models give wide adaptation

treated beryllium copper center blade and rolling spring, and offering unusually small dimensions—1 13/32 inches by 1 1/64 inches by 5/16 inches—the Acro switch has a standard operating pressure of 6 to 10 ounces. Single pole, normally open, normally closed, and double throw types are available with ratings of 15 amperes, 125 volts A.C. and 1/3 horsepower, 110 volts, A.C.

NYLON TUMBLERS

Resist Boiling Water; Drop Without Breaking

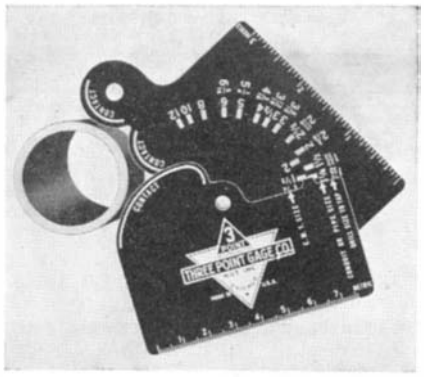
DRINKING tumblers are now being made of nylon plastics, the first use of the material for this purpose. Manufactured by Du Bois Plastic Products, Inc., the tumblers are said to be non-breakable and heat-resistant—permitting usage for hot beverages, and sterilization in boiling water.

The tumblers are graceful in shape, designed with slightly curved sides and rimmed top. They come in standard eight-ounce size and in an ivory tone.

PIPE GAGE

Takes Measurements Over Wide Range in Tight Places

FOR MEASURING all sizes of pipe from 1/8 to 12 inches, and both heavy- and thin-wall electrical conduit, a new gage operates on the "three points of contact" principle. By placing the two fixed contact points of one plate against the outer contour of the pipe or conduit and sliding the second or moveable plate until it makes a third con-



Shows diameters and drill-tap sizes

tact, the markers on the face of the gage show the size of the pipe or conduit and also the correct drill size for tapping.

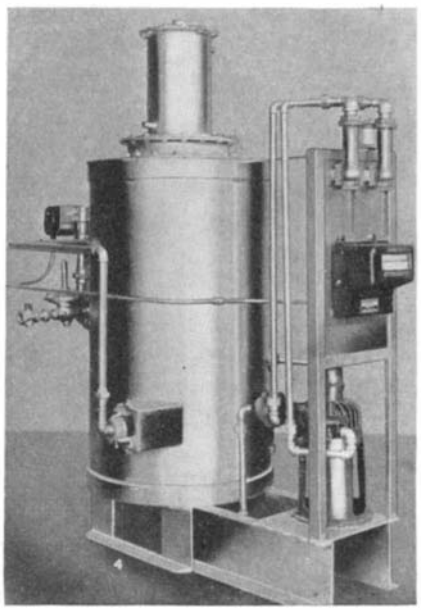
The manufacturers, the Three Point Gage Company, state that it is necessary to contact only a small section of the pipe contour and that the device will measure pipe in any position, even against a wall or in a corner. It is also possible to measure a covered pipe if there is a small opening where the gage may be slipped in between two pieces of asbestos pipe covering.

CRACKED GAS

Formed with Catalyst for Heat-Treat Atmosphere

USED in conjunction with heat-treating furnaces, a new gas cracking unit provides a protective, inert atmosphere that is effective in temperatures upwards of 2450 degrees, Fahrenheit. Natural fuel gas is employed, although manufactured gas can also be used. This gas, mixed with air in a Selas mixing machine, is fed into the cracking unit which consists of a high nickel alloy steel retort heated externally by a small furnace built around it.

Within the retort, porous refractory cubes which have previously been impregnated with a special catalyst react with the air-gas mixture under a properly adjusted temperature, to produce the controlled atmosphere. Before entering the furnace muffle, the cracked gas passes through a short cooling tower.



Natural gas input, inert gas output

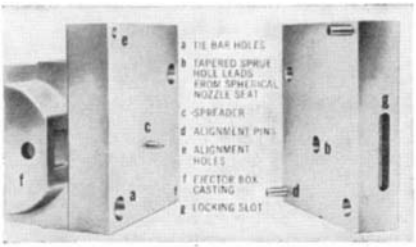
The manufacturers of the generating equipment, Bellevue Industrial Furnace Company, say the arrangement will produce good results throughout an unusually wide range of atmosphere requirements.

PRE-FABRICATED DIES

Bring Casting Facilities To Small Shops

ON-THE-SPOT die casting is now described as available at low cost with a high-speed production die-casting machine that uses pre-fabricated die sets. Blank die sets, available from machine tool dealers, permit manufacturers to make their own dies by simply machining the die cavity and grinding the gate.

The DCMT Die Caster is said to take only two to three minutes to set up. High production or low runs of die castings can be produced in the shop as required, eliminating the need for large inventories. Runs as small as 250 parts are reported as economically possible, and production speeds of 600 shots an hour are claimed.



Offers maximum economy for both long-run and intermittent die-casting

TROWELING PLASTICS

Molds to Close Tolerances; Is Adaptable To Many Uses

A PLASTICS troweling compound, which can be "tailored" to conform with individual requirements, has been announced by Duorite Plastic Industries. Called "Plastipaste," it is described as being lighter than magnesium, yet stronger than the finest grade of wood. Uses include making tools, heat and electrical insulators, relief maps, art objects, novelties, and containers for various corrosive chemicals.

A phenolic resin, Plastipaste is held to various dimensional tolerances by controling the shrinkage through regulation of the percentages of "filler" required for its mixing. The filler is a special fiber compound known as Duorite Flox Filler. A catalyst is used as an accelerating compound to cause the resin to harden.

Plastipaste is applied by troweling, and it will readily adhere to wood and other surfaces which are not coated with a wax parting agent. When rapid hardening is desired, complete curing can be effected without heat in about 30 minutes by replacing the regular catalyst with a special one.

The Editors Recommend

Best Sellers In Science

PROCEDURES IN EXPERIMENTAL PHYSICS — ***By John Strong, Ph.D.*** A wealth of useful data of a practical kind for the constructor, experimenter, and skilled craftsman. **$7.10**

HIGH FREQUENCY INDUCTION HEATING — ***By Frank W. Curtis.*** Answers many questions concerning induction heating and its utility in industrial processes. Thoroughly practical in scope. **$2.85**

TOOL MAKING — ***By C. M. Cole.*** Instructions for making and using all kinds, from personal tools to arbor presses, lathes, planers, etc., in different metals. **$3.60**

TECHNIQUE OF PLYWOOD — ***By Charles B. Norris.*** Technical information on all phases of plywood manufacture and use, compiled for engineers, designers, and users of plywood. Important to many phases of peace-time housing and manufacturing problems. **$2.50**

YOUR HAIR AND ITS CARE — ***By Oscar L. Levin, M.D., and Howard T. Behrman, M.D.*** Scientific facts about hair—how to save and beautify it, treat infections, and so on. Real facts — not a "cure-for-baldness" screed. **$2.10**

HANDBOOK OF CHEMISTRY AND PHYSICS — A classic reference book recently revised and brought up-to-date to keep pace with recent research. Includes materials on all branches of chemistry, physics, and allied sciences. Used in laboratories and by engineers throughout the country. Flexible binding. 2640 pages. **$4.10; Foreign $4.50 postpaid**

ATOMIC ENERGY FOR MILITARY PURPOSES — A General Account of its Development Under the Auspices of the United States Government, 1940-1945. The famous Smythe report, telling in relatively non-technical language of the developments in nuclear physics that lead to the manufacture of the atomic bomb. **Paper cover, $1.35; cloth $2.10**

PLASTICS — ***By J. H. Dubois.*** Third edition, again revised and enlarged, with two four-color plates. This is an important book on the whole general subject of plastics, plus much brand new material on synthetic rubber, manufacturing processes, and plastics moldings. **$4.10**

PLANNING TO BUILD — ***By Thomas H. Creighton.*** Answers many of the questions asked by prospective home builders. Planning, design, and construction are fully covered. **$2.60**

EXPERIMENTAL ELECTRONICS — ***By Ralph H. Muller, R. L. Garman, and M. E. Droz.*** A solid book of eminently practical information on the characteristics and non-communication applications of electron tubes. The text describes experiments and presents results. For students, radio engineers, communications experts, and the serious general reader. **$4.75**

THE MEANING OF RELATIVITY — ***By Albert Einstein.*** Second edition with added chapter describing advances since publication of first edition some 25 years ago. Requires knowledge of advanced mathematics and physics; not a popular exposition. ***$2.10***

A SMALL BUSINESS OF YOUR OWN — ***By Harold S. Kahm.*** Simplified, compact, paper-covered book that sets out to tell persons with capital ranging from $10 to $2000 how they can get started in the right direction. **$1.10**

A PRACTICAL COURSE IN HOROLOGY — By ***Harold C. Kelly.*** Definite, outright, practical instructions on watch making, repairs, and adjustment. **$2.85**

SLIDE RULE SIMPLIFIED — ***By C. O. Harris.*** How to use a slide rule, without any of the mystification that often surrounds this important tool of the engineer. Excellent illustrations make everything clear. **$3.60** including a slide rule; for book alone, **$2.60**

HOW TO SOLVE IT — ***By G. Polya.*** The text deals with the general method of solving problems. It will be of value to teachers but will also find wide use by those who have to solve problems requiring scientific reasoning. **$2.60**

MACHINERY'S HANDBOOK — ***12th Edition.*** "Bible of the mechanical industry." 1815 pages of latest standards, data and information required daily in shop and drafting room. **$6.10**

MACHINE TOOL GUIDE — ***By Tom C. Plumridge, Roy W. Boyd, Jr., and James McKinney, Jr.*** A convenient compilation of data on all types of machine tools, assembled in organized form for tool and mechanical engineers, millwrights and tool equipment salesmen. **$7.70**

ATOMIC ARTILLERY AND THE ATOMIC BOMB — ***By John Kellock Robertson.*** Standard best seller for years, describing electrons, protons, positrons, photons, cosmic rays and the manufacture of artificial radioactivity—now with a chapter added on the bomb and the difficulties of its production. **$2.60**

PRINCIPLES OF PHYSICS, VOL. III — OPTICS — ***By Francis Weston Sears.*** One of the most modern works on physical optics available today. At college level, it covers the subject with emphasis on physical principles rather than practical applications. **$4.10**

ELECTRONIC PHYSICS — ***By Hector, Lein and Sconton.*** A simplified text for those who desire to acquire a sound basis for following the advance of applied electronics. **$3.85**

A LABORATORY MANUAL OF PLASTICS AND SYNTHETIC RESINS — ***By C. F. D'Alelio.*** How to prepare many of the well-known resins and plastics in the laboratory. Understanding of the text requires a knowledge of organic chemistry. **$2.10**

FUNDAMENTALS OF OPTICAL ENGINEERING — ***By Donald H. Jacobs.*** This new work starts out at the very beginning, is mainly non-mathematical, and is probably the best suited of all existing books as an introduction to optical design. Author is a physicist at Bureau of Standards. **$5.10**

WITH THE WATCHMAKER AT THE BENCH — ***By Donald DeCarle.*** Simple, practical, straightforward instructions on the repair of timepieces, with direct implications to the manufacture and repair of delicate instruments of all kinds. **$3.10**

TRIGONOMETRY FOR HOME STUDY — ***By William L. Shaaf, Ph.D.*** Extensive and detailed, giving explanations as the text progresses, together with numerous practical applications of trig, such as machine shop problems, surveying, navigation, and so on. **$1.10**

THE FUNDAMENTALS OF RADIO AND HOW THEY ARE APPLIED — ***By Henry Lionel Williams.*** Good basis for understanding radio equipment. Suggested for general readers and beginning students. **$1.10**

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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.)

ELECTRONICS DIGEST, a 50-page illustrated booklet published quarterly for management men and groups, contains an explanation of the electron theory as well as specific electronic applications of basic devices. Included are articles on: Stratovision, Mot-O-Trol, fluorescent lighting, electrolytic tin plating, X-ray inspection, and electrostatic air cleaning. Request booklet B-3726. *Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.—Gratis.*

FACTS YOU SHOULD KNOW ABOUT CENTRIFUGAL PUMPS AND IMPELLERS. In 20 illustrated pages this pamphlet outlines the fundamentals of centrifugal pumps, describes the various types, and tells specifically the uses to which they are best adapted. It will assist materially in selecting pumps that will give the most reliable service with minimum maintenance. *The Deming Company, Salem, Ohio.—Gratis.*

PERFECT BALANCE is a six-page catalog of a line of soft hammers which include 14 models and 56 different numbers. Ranging in diameter of head from ¾ inch to 2½ inches and in weight from three ounces to 10½ pounds, there is a hammer listed for practically every industrial, commercial, and professional purpose. *Gregory Tool and Manufacturing Company, 5300 Tireman Avenue, Detroit 4, Michigan.—Gratis.*

HOW TO PUT OUT A MOTOR VEHICLE FIRE. Specific details on handling various types of fire extinguishers are given in this 24-page illustrated booklet. Consideration is given to all types of motor vehicle fires, both interior and exterior. *The General Detroit Corporation, 2272 East Jefferson Avenue, Detroit 7, Michigan.—Gratis.*

CAMBRIDGE SURFACE PYROMETERS. This 12-page bulletin illustrates and describes a number of portable instruments for determining temperatures in readily accessible as well as hard-to-reach locations. Temperature indicating instruments described include roll, extension, mold, and needle pyrometers. Several illustrations show the instruments in use on a variety of production operations. Request bulletin 194-SA. *Cambridge Instrument Company, Inc., 3127 Grand Central Terminal, New York 17, New York.—Gratis.*

PUBLICITY FOR THE SMALL COMPANY, by James W. Corey, is a 12-page booklet, the third in a series on public relations problems, written by leaders in the electrical manufacturing industry. In this booklet the importance of publicity is stressed and hints are given

as to how companies with small staffs can best take advantage of opportunities for obtaining publicity. *Mr. Leonard Lathrop, Manager, Electrical Manufacturers Public Information Center, 155 East 44th Street, New York 17, New York.—Gratis.*

SILVER BRAZING OF STEEL PARTS, by A. M. Setapen, a reprint from a technical journal, gives specific details on handling work of different types. Tabulations give specifications for alloys and tensile strengths of joints. *Handy and Harman, 82 Fulton Street, New York 7, New York.—Gratis.*

"SURFACE" PREPARED GAS ATMOSPHERE—THE SCIENCE OF GAS CHEMISTRY FOR HEAT TREATING is a 12-page bulletin presenting information on the preparation and application of various types of atmospheres used in heat processing of metals. Request Bulletin SC-129. *Surface Combustion Corporation, Toledo 1, Ohio.—Gratis.*

MIXING AND GRINDING. This four-page bulletin, containing photographs and facsimilie blueprints, describes briefly the applications of worm-gear speed reducers to various types of mixing and grinding equipment. *The Cleveland Worm and Gear Company, 3277 East 80th Street, Cleveland 4, Ohio.—Gratis.*

CENTRALAB SWITCH CATALOG. Containing 36 pages, this catalog covers information on selector types, tone, lever action, medium duty power, stock, and special electrical switches. *Centralab, Division of Globe-Union, Inc., 900 East Keefe Avenue, Milwaukee 1, Wisconsin.—Request bulletin 722 on your business letterhead.*

GEON POLYVINYL MATERIALS. A number of tabulations in this 16-page illustrated booklet cover not only the properties of Geon polyvinyl materials but also suggested applications. A discussion of these plastics, together with methods of compounding and the effects of various compounding practices, is especially valuable. *The B. F. Goodrich Chemical Company, Rose Building, Cleveland, Ohio.—Gratis.*

POINTERS ON INSTALLATION AND MAINTENANCE OF BARNES HYDRAULICS gives, in eight illustrated pages, details leading to the proper application of a specific type of hydraulic units to particular problems. Request Bulletin 013-G. *John S. Barnes Corporation, 301 South Water Street, Rockford, Illinois.—Gratis.*

FEED AND SPEED CALCULATOR. This new slide-rule type device is available to machinists for calculating the proper feed per tooth per revolution for all types of carbide milling cutters, and also shows the suggested rate of speed for machining many different kinds of materials to rough and finished states. On the reverse side of this calculator is shown the relation of revolutions per minute on the cutter head, and the surface speed in feet per minute, to the diameter of the work. *Wendt-Sonis Company, Hannibal, Missouri.—25 cents.*

Our Book Corner

THE BOOK DEPARTMENT of Scientific American is conducted with the cooperation 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. All remittances are to be made in U. S. funds. Prices given are subject to change without notice.

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THE AVIATION ANNUAL OF 1946

Edited by Reginald M. Cleveland and Frederick P. Graham

HERE is presented a virtual roundup of an important era in the development of aviation—the recent war years. Contributors to the book include a number of men whose names are outstanding in aviation today. The photographs, of which there are a large number, are the latest available; many of them are highly dramatic. (245 pages, 7 by 10½ inches, a directory of aviation organizations, aircraft manufacturers, producers of engines and instruments, and aviation periodicals.)—$4.10 postpaid.—*A.P.P.*

AIR CONDITIONING PRINCIPLES

By Charles Osborn Mackey

NOT INTENDED as a reference handbook on the practical *art* of air conditioning, nor as a catalog or description of equipment and controls, this book confines itself rather strictly to the fundamental principles of the *science* of air conditioning. Therefore, it is recommended only for those students, architects, or heating and ventilating engineers who have an adequate grounding in thermodynamics, heat transfer, and fluid flow. Treatment is predominately mathematical and represents a great deal of research work on air conditioning as a science. (204 pages, semi-flexible covers, 6 by 9 inches, 32 figures, and 28 tables.)—$2.10 postpaid.—*E.F.L.*

MICROBES OF MERIT

By Otto Rahn

BY NO MEANS all microbes are enemies of man, as Dr. Rahn points out, and many races of minute beings are actually our useful and industrious servants. In this book, the story of industrial bacteriology and mycology (which deals with molds) is told for the benefit of laymen. The book is significant in describing how many vital industrial operations are performed—from the ancient art of bread making to the ultra-modern manufacture of penicillin and related medicines. The author succeeds in clarifying the vital changes effected by micro-organisms in the important industrial processes of making cheese, bread, leather, and many other valuable products—yet he does it in a way to interest and instruct anyone of average intelligence. (277 pages, 6½ by 9½ inches, illustrated.)—$4.10 postpaid.—*D.H.K.*

THE NATURE OF PATENTABLE INVENTION

By John E. R. Hayes

PATENT-LAW students will find this a welcome book; it may well serve also as a "refresher" and hand manual for practicing attorneys. It gives first principles and their classic applications, as well as very recent decisions of the Supreme Court. A definition of "invention" is attempted in terms of the attributes of invention and in the light of the philosophical views of John Locke, Jan C. Smuts, and William James. Noteworthy is the complete absence of hysteria in the presence of the "flash of genius" doctrine. Unfortunately, the section on chemical patents is inadequate and there is no index. (183 pages, 6 by 9 inches, unillustrated.)—$5.10 postpaid.—*S.J.S.*

ARCHITECTURAL DRAWING AND DETAILING

By Dalzell and McKinney

AN EXCELLENT guide for the architectural student, those who wish to study the art in their spare time, or for executives needing a working knowledge of architectural representations and terminology, this book gives a reasonably complete coverage of the fundamentals. Taking first things first, the writer starts with recommendations on simple architectural-style lettering, technique, equipment, work sequence, and symbols. Later portions of the book follow through, step by step, architectural drawing jobs on structures of various types. A considerable amount

of material is devoted to rendering, and the details of landscaping have not been omitted. (211 pages, 6 by 8½ inches, more than 100 figures and plates.)—$2.60 postpaid.—*E.F.L.*

WHAT IS LIFE?

By Erwin Schrodinger

A WORLD-FAMOUS physicist here seeks answer to biology's biggest puzzle, by drawing together facts from two mutually little-acquainted sciences, physics and genetics. His brilliant hypothesis has aroused lively and mainly favorable discussion among scientists. Readers not already partly familiar with genetics must expect to work hard over this meaty exposition, which is not light reading. (93 pages, 4¾ by 7½ inches, four illustrations.)—$1.85 postpaid.—*A.G.I.*

THE FABULOUS FRONTIER

By William A. Keleher

FOR THE hundreds of thousands who are sick and tired of over-glamorized and over-colorized tales of the winning of the west, this is a book to be read with great interest and to be kept for reference. Filled with clear and dry facts, each of which is presented in the fewest possible words, and festooned with foot notes which are even dryer, the lubricant of coloration has been squeezed out until the facts virtually squeal whenever they move in relation to each other. In this way the frictions of frontier life become self apparent and their effects upon human behavior clearly logical. Any fact-minded reader will finish this book and say: "This is what I would have experienced if I had lived in the New Mexico of 1899." (317 pages, 6 by 9 inches, 11 illustrations.)—$3.10 postpaid.—*E.L.C.*

GLYCERIN — ITS INDUSTRIAL AND COMMERCIAL APPLICATIONS

By G. Leffingwell and M. A. Lesser

VAST are the number of uses for glycerin and exhaustive is their compact treatment in this well-rounded technical treatise. Chemists and other industrial workers should find many useful hints in the text that will aid them in using glycerin in their products or in the formulation of new compounds. Bibliographies are provided throughout. (259 pages, 6 by 9 inches, unillustrated.)—$5.10 postpaid.—*A.P.P.*

RIGHTS OF TRAINS

By the late Harry W. Forman; Revised by Peter Josserand

FOR ALL who are concerned with or interested in the intimate functionings of railroads, but particularly for those responsible for training railroad, traffic department, and dispatcher personnel, this book offers a comprehensive analysis of the rules governing railroad operation. The general rules applying to all roads are supplemented

by special rules employed by some of the larger rail companies. Most important, the regulations are not set forth on an arbitrary basis, but are explained both as to reasons, precedent, and exceptions. A question-and-answer treatment, used extensively, marks this book as a valuable text for either individual or directed study. (561 pages, 5 by 7 1/2 inches [pocket-size], numerous diagrams, charts, tables, and illustrations.)—$3.60 postpaid.—*E.F.L.*

METEOROLOGY

By George J. Brands

COMPACT general textbook covering the basic knowledge required of Pan American employees (the author is Chief Meteorologist of Pan American Airways System) who must complete the course without aid from an instructor. Aviation-connected readers will find this a suitably specialized text. Others probably would find more general texts—Blair or Byers, for example—better suited to their needs for learning to understand our weather. (235 pages, 5 3/4 by 8 3/4 inches, 73 illustrations.)—$2.60 postpaid.—*A.G.I.*

BASS TACKLE AND TACTICS

By Harold C. Hollis

GUARANTEED to warm the heart of any fresh-water angler, this bit of gospel comes straight from the St. Croix River section of Wisconsin. Although the reader may—as fishermen are wont to do—disagree with the author's recommendations for bass fishing with a 4 1/2-pound-test line and tournament rods and reels, he cannot help but feel an urge to try the very reasonable suggestions on fishing strategy. The action photographs are satisfying evidence that the techniques work; at least for the author. It may be that this book marks a milestone in mankind's dubious progress towards out-thinking a fish. (147 pages, 6 by 9 inches, 18 half-tones, 8 line-cuts.)—$3.10 postpaid.—*E.F.L.*

SURFACE ACTIVE AGENTS

By C. B. F. Young and K. W. Coons

IMPORTANT to a vast number of process industries is the phenomenon of surface tension and its effects on process materials. In this book the authors have compiled a tremendous amount of information on the subject as it applies in the production of emulsions, cosmetics, leather, textiles, cutting oils, and adhesives, as well as in metal cleaning, food preparation, lubrication, and soldering and welding. The theory of surface tension is presented briefly, and is complemented by a lengthy discussion of the determination of surface tension. The structure of wetting agents is carefully considered, and a long tabulation of them is presented, together with their chemical composition, their uses, and the names and addresses of manufacturers. (381 pages, 6 by 9 inches, a number of illustrations, charts, and tabulations. Well indexed.)—$6.10 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"

READERS of this department and friends of Russell Porter—those who have seen him and those who hope to—have asked many times since World War II began what he was doing. Though your scribe has exchanged letters and notes, containing innumerable enclosures of a telescoptical nature, with Porter for 20 years, entertained him at home and been entertained at his home many times, attempts to find out what he was doing in connection with the war just didn't get anywhere. He was under the same seal of secrecy as all who were doing hush-hush work.

With the war over, a campaign of teasing and wearing down was begun on Porter and has at last produced the following response, in reply to the argument that, sometimes, too much modesty is almost immodest. Porter's note:

Perhaps, at that, the A.T.M.s might be interested to know what I have been doing since Pearl Harbor when the 200" telescope had to be entirely laid aside. I had expected a comparative holiday for myself while the world was fighting but was amazed to find myself working harder than ever.

As you know, the California Institute of Technology was allocated several war projects to develop, through the Office of Scientific Research and Development, and the officials here soon found that my ability to visualize and put on paper military weapons, before they were actually built and tried out, would many times be useful to them when submitted to the Brass in Washington. I made so many of these drawings—several hundreds of them—that I was finally nicknamed in the capital "The Cutaway Drawing Man."

At first, we here on the Pacific Coast were preparing for invasion by the enemy, and many were the projects put forward to meet it. Later, as our forces moved into enemy territory, a vast number of offensive weapons were devised and many of them put into production. A major effort was the application of rockets to all kinds of purposes—planes, landing craft, and jungle warfare. "Cal Tech" has already been cited by the Government for its contribution to this effort, and more than one discharged marine has entered my office and spoken almost lovingly of those "jet busters" and how they confused and annihilated the Japs.

Figure 1: Russell W. Porter making flats by the proxy method. "I start my polishing machine in the basement," he says, "then I do this"

It is common knowledge that southern California has been and is a hotbed of proving grounds, scattered in remote areas in the desert, where all these gadgets are tested. A good example is at Inyokern, some 200 miles from here. It is a Naval Ordnance test station and is larger in area than the State of Rhode Island. I spent many days there—just drawing. Here are a few examples of the jobs they threw at me.

Go out and draw a perspective of ——— Station, taken from 20,000 feet up and looking northeast.

Draw an invasion by landing craft at Guadalcanal, showing an air view of the craft formation, the enemy emplacements and surrounding scenery. (Here, for the palm trees and the streams, I levied a good deal on photographs in *Life*, but not wholly.)

Make a cutaway drawing of the fuse in the head of ——— rocket. This device is as complicated and delicate as a watch and I was hard put to it but finally succeeded. Oh yes, and the drawing must be in tomorrow. "Oh hell," says I, "I'm an old man and the doc insists I take my siesta." "Too bad," they reply, and add, "Take it easy, Porter." Then, as an afterthought, "but the drawing must be in tomorrow." [A masterpiece of understatement through omission. That particular job put Porter in bed for a week.—*Ed.*]

Then there was that fantastic thing, the Jap paper balloon. They had to have one of Porter's drawings showing it dissected. Down in one corner I drew a tablet with four Japanese inscriptions on it. Translated, it meant roughly, "inefficient." They launched some 10,000 of 'em. A few reached our coast but little damage was done.

Then there were those wind tunnels and water tunnels—the latter being glass tanks filled with water into which they shot models of rockets.

Well, it was all pretty much fun in a way. That is to say, interesting. And there were breaks. One night Humason phoned from Mt. Wilson. "Get into your car and up here as soon as you can. Mars is high up in the heavens, and the seeing is fine. "When I got there the seeing had gone bad but it slowly improved toward dawn. I worked at the Cassegrainian focus of the 100" but found no canals to draw. I thought this might displease the astronomers, but, no, quite the opposite."

End of Porter's note and now you know that when they wrapped up the 200" telescope in mothballs for the duration while they turned to the production of war optics they didn't wrap Porter up with it. And since you now are sure to ask about the present status of that job, we have asked Porter to add a word. "The mounting," he writes, "is nearly ready to receive the mirror. The mirror is in the last stages of figuring, and lacks only a few wavelengths of a paraboloid. Mopping up the small odds and ends will take less than a year."

With his war contribution completed, Porter, at 74, is taking some well-earned rest, as shown in Figure 1, which does not, however, show a cutaway of his house. If it did you would see down cellar a neat machine he has designed and built, plugging away on some 8" flats while he reads. Porter has sent us a drawing of that machine and promises detailed data on it for a later number.

Throughout his 18 years at Pasadena, Porter has often itched to escape clean-

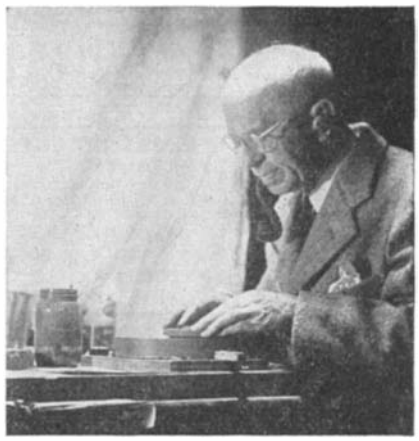

Figure 2: "But it's also a grand and glorious feelin' to get your hands into a good old job of glass pushing"

handed duties and get into the shop and push glass the same as any other amateur, and has never been so happy as when circumstances permitted his doing it (Figure 2). With all his contacts with the topflight people in science and optics he has never lost that urge. He expects to come to Stellafane for the big get-together of amateurs August 3 and 4, there he will give a talk about everything you'll think of wishing to hear about—his two years' work on the famous rockets "Tiny Tim" and "Holy Moses," also the revelations of the electron microscope at 60,000 diameters on unused and used particles of polishing abrasive.

FROM time to time new experimental research tends more and more fully to vindicate the molecular flow theory of the nature of the optical polishing phenomenon, as against the old-fashioned, microscopic scratch theory—

that is, that polishing was the same as grinding, except on a finer scale. A paper delivered by Dr. Lloyd Motz of Columbia University and The Optical and Film Supply Company, New York, published in the *Journal of the Optical Society of America*, Volume 32, pages 147-148, further bears out the validity of the molecular flow theory. This theory is sometimes called the "butter" theory and at one time was looked at as perhaps a bit wild. The following is quoted from the paper mentioned above:

"Rayleigh was one of the first to show by means of the microscope that polishing a surface is a process different from that of even the finest grinding; he concluded from his microscopic studies that polishing is a molecular phenomenon caused by the adhesive forces between the molecules of the polishing agent and those of the surface. Beilby added further to this idea by demonstrating that the polished layer resembles a film of viscous liquid and appears amorphous (in the case of polished crystalline solids) to the highest powers of the microscope. An examination of a polished surface with a microscope shows that the pits and scratches of the previous grinding are not eliminated by a wearing down of the surrounding surface but rather that these scratches are filled in by a flow of the surrounding material.

"Where one is dealing with a crystalline solid, the study of the polishing process is made easy by the fact that the polishing destroys the crystalline nature of the surface and builds up an amorphous layer. One can investigate the thickness of this layer for crystalline substances by dissolving the layer in a suitable acid until the underlying crystalline structure is reached. Thus in the case of calcite N. K. Adams reports that the completely amorphous layer was roughly 50 angstroms thick and that the flow lines produced by the fibers of the moving wash-leather were found at depths of 250-500 angstroms and some traces of the original ground surface down to 5000-10,000 angstroms.

"In the case of amorphous substances such as glass the investigation of the depth of the polished surface is difficult since there is no underlying crystalline structure upon which the polished surface rests. That the polished surface is, however, different in structure from the underlying glass can be easily demonstrated by subjecting the polished surface to the action of dilute hydrofluoric acid.

"If the polished surface is placed in dilute hydrofluoric acid for a short time, the high polish is not in general destroyed, but the surface becomes covered with innumerable scratches and pits of varying length and depth. Although many of these scratches exhibit a curvature which might be ascribed to the circular motion of the fine grinding machine, the evidence that these scratches are those originally produced in the glass by the fine or rough grinding before the polishing began is not conclusive. Another explanation which might be offered to account for these scratches is that, as the polished surface is etched off by the acid, the rearrangement of the molecules in the newly formed surface gives rise to stresses which cause the surface to crack.

"Although we may not conclude that all the scratches which appear after the acid treatment were present before the surface was polished, the following simple experiment demonstrates that scratches which are present on the surface before the surface is polished will reappear after polishing if the surface is treated with hydrofluoric acid.

"On a highly polished glass surface (hard crown glass) several faint scratches of definite shape (letters and geometrical patterns) were traced by means of a steel razor edge. The surface was then placed on the polishing machine and rouge-polished until no trace of the original scratches could be discerned even under a microscope. The surface was then placed for a few minutes in a very dilute solution of hydrofluoric acid and then carefully examined. All the marks scratched on the surface by the razor edge reappeared in a more pronounced form than they originally had.

"It is clear from this result that the process of polishing is a molecular one; the forces of adhesion between the molecules of the polishing agent and those of the glass cause the glass surface to flow and fill up the cracks, pits, and scratches. This filling up process, however, does not obliterate the scratches in the sense that no distinction exists between the polished layer and the underlying surface. The action of the acid seems to indicate that the glass which has flowed into any surface deformities as a result of the polishing is more loosely bound to the surface than the surrounding glass and is therefore more easily removed by the acid.

"These results are of some importance in considering the degeneration which polished surfaces may suffer if not sufficiently protected over long periods of time. However highly polished and free of defects a surface may appear, it will, if not well protected from acid influence, develop scratches after a sufficiently long period of time."

HOGGING out a deep curve ("soup bowl") for a Schmidt primary is an endless job if done in the orthodox way. In *The Observer*, periodical published by the Franklin Institute, Philadelphia, Web Phillips describes a short cut:

"The tool is placed on the spindle and rotated at medium speed while the mirror is held in the hands against the edge of the tool at an angle of about 30° to the horizontal. Wet abrasive is deposited on the mirror with a brush and the mirror is rotated slowly in the hands as it is held against the tool. The action is slow at first until the sharp edge of the tool is ground off, then it becomes increasingly rapid.

"Eventually the curve on both the mirror and the tool will cover sufficient area to permit curvature control by length of stroke and from this point on the mirror is ground by conventional methods."

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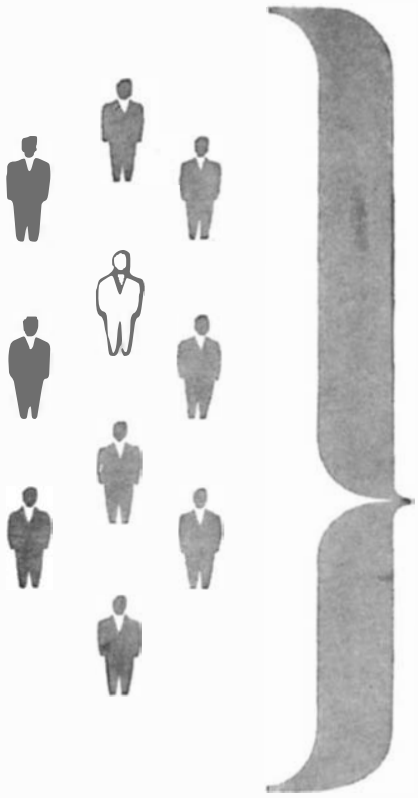

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