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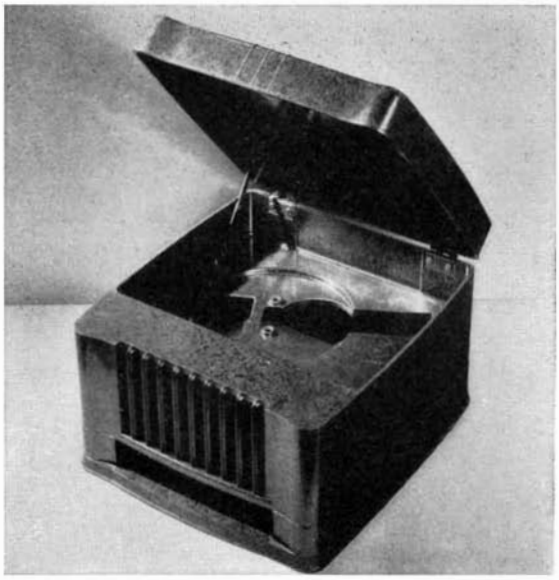
"Super" Alloys for Jet Engines . . . See page 241



INTERESTED IN LARGE PLASTIC PIECES?

Dispelling the time-worn theory that large molded plastic pieces are impractical and uneconomical, these Admiral phonograph and radio-phonograph cabinets effectively demonstrate that large products as well as small can be molded of Durez phenolic plastics.

The bigger cabinet (right) when assembled contains a five tube radio and automatic record player. The molded Durez body weighs 9½ pounds and the cover 3½ pounds. This makes a total cabinet weight of only 13 pounds.

Radio Frequency Preheat

Compression molded in a 400 ton press, the special Durez compound used in this larger unit is preheated by radio frequency. This modern method of production facilitates the molding operation considerably and results in the strong, attractive cabinet shown.

The smaller unit, Admiral's automatic record player, is also molded of Durez but in a 300-ton press.

Why Plastics?

The progressive Admiral Corporation experimented and found that for top quality cabinets of this type—having light weight and an integral, lustrous finish, plastics were better suited than any other material.

Why Phenolic Plastics?

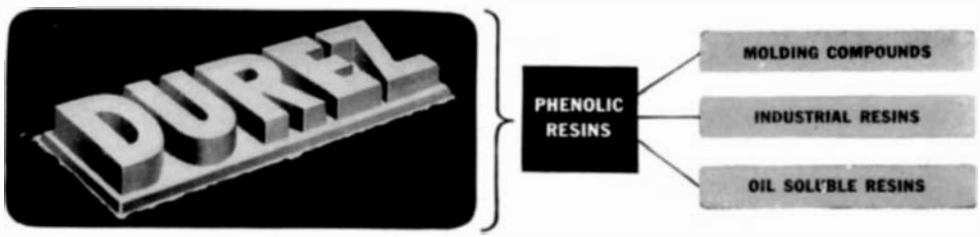
The excellent moldability, impact strength, eye-appealing finish, and the non-resonance of phenolic plastics proved the decisive factors in the choice of these most-versatile-of-all-plastics.

Why Durez Phenolic Plastics?

As specialists in the production of phenolic plastics for the past quarter century, the Durez staff have developed more than 300 multi-propertied Durez phenolic molding compounds from which to select the plastic that precisely fits the job.

Write for Free Booklet

"Machining Data on Phenolic Plastics" is an informative manual which covers all the standard machining operations encountered in the average plant. Write for your free copy. No obligation, of course. Durez Plastics & Chemicals, Inc., 112 Walck Road, North Tonawanda, New York. *Export Agents: Omni Products Corporation, 40 E. 34th Street, New York 16, N. Y.*



PLASTICS THAT FIT THE JOB

INDUSTRIAL DRAMA: Jet-engine impeller blades are made of alloys truly "super" in heat resistance but so expensive as to be limited in possible applications. See also discussion of metal-economics, page 258. Photograph courtesy Westinghouse Electric Corporation.

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50 Years Ago in . . .

SCIENTIFIC AMERICAN

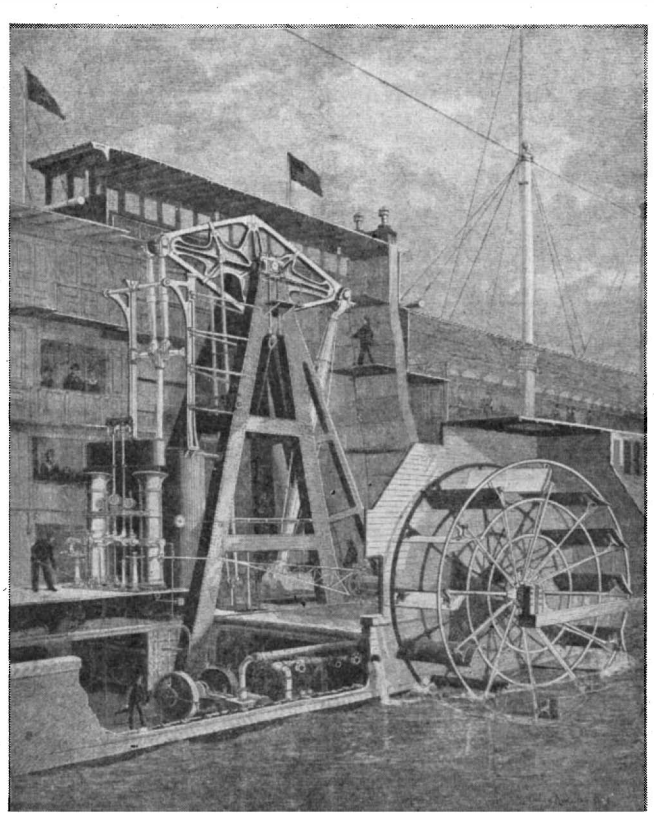
(Condensed from Issues of December, 1896)

AUTOMOBILES — "In saying that the advent of the horseless carriage, motor cycle, automobile car, or whatever it may eventually come to be named, is an event in the history of transportation second only in importance to the birth of the locomotive, the statement is made with the knowledge that it will have its special field of operation. It is certain that the perfected motor car will become a factor in the general scheme of transportation as essential in its way as the railroads themselves."

STORAGE BATTERIES — "In an electric lighting station the greatest demand for power is between the hours of six and seven P.M. and the next greatest between about the same hours in the morning. During the balance of the time the consumption is much lower, and after midnight it falls off to very nearly nothing. If steam engines alone are used, their capacity must be sufficient to meet the greatest demand, even if that only lasts for a few minutes; but, if storage batteries are added to the plant, these can be depended upon to take care of the excessive demands, and then the engine capacity can be considerably reduced."

ELECTRIFICATION — "The announcement that the New Haven Railroad is intending to make a further application of electricity to its steam roads will be taken as evidence that the present Nantasket electric line has given better results than the steam-equipped road. If this be the case, electric traction has taken another step in the direction of its application to the trunk roads of the country, and this goal for which electrical engineers are striving is brought within measurable distance."

RIVER STEAMER — "Latest addition to the famous fleet of Hudson River steamers that plies between this city and Albany, is the Adirondack. . . In order to give our readers a clear conception of a typical river steamboat beam engine, we have prepared the detailed and very handsome engraving shown. . . The reader is supposed to be looking at the boat from a position a little off from the port bow, the side of the hull and superstructure and the housing of the paddle wheel being broken away so as to show the full height of the engine, which extends through four decks. The paddle wheels are of what is known as the vertical or feathering type, in which the buckets are made to enter and leave the water in a nearly perpendicular position. . . Steam is supplied by four steel boilers of the lobster return flue type. The steam pressure is 55 pounds to the square inch."



NIAGARA — "The first use of Niagara's power was made in 1725, a primitive sawmill being operated. Nothing more was done in this line until 1842, when Augustus Porter conceived the plan of hydraulic canals, and in 1861, one was completed. The Cataract Construction Company, from whose plant power has just been delivered in Buffalo, was incorporated in 1889."

RUST — "The iron and steel of modern construction are as perishable as they are strong. The action of the elements, which sometimes prolonged the endurance of an ancient structure, commences to destroy our modern works in iron and steel from the very first moment of contact. Unless some thorough system of protection be adopted, it is certain that the life of the skeleton steel buildings, for instance, which are multiplying so fast in our cities, will never be measured by centuries."

FLIGHT — "Prof. S. P. Langley's invention, the aerodrome, again demonstrated, to the satisfaction of its inventor, its ability to fly, on December 12. . . The latest experiment was made on November 28, when the machine, launched from a specially constructed stage, flew 1,500 yards in a horizontal direction, and when its power was exhausted gracefully dropped, until it finally rested on the water."

100 Years Ago in . . .

SCIENTIFIC AMERICAN

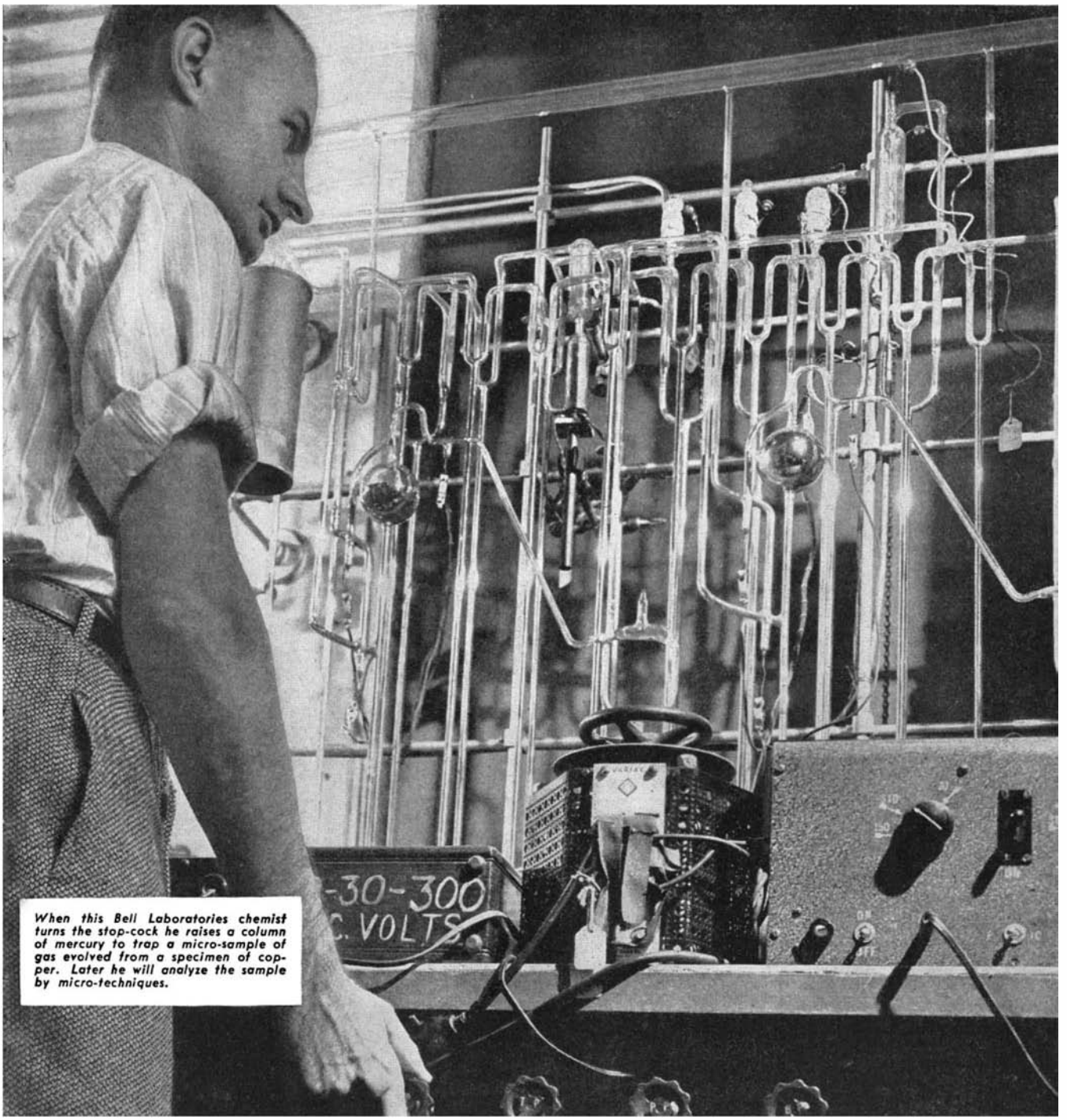
(Condensed from Issues of December, 1846)

LOCOMOTIVES—"Messrs. Stephenson & Howe have introduced in England a new and powerful engine, the improvement of which consists in the application of three steam cylinders, two of which are of the same diameter and capacity, and both are equal in capacity to the third."

STEAMSHIP — "The New York ocean steamship now building at Westervelt and Mackay's ship yard, is intended as the first in the line of ocean steamships to run between New York and Bremen via Cowes, in the employment of the Post Office department. She is called the Washington, is of 1750 tons, custom house measurement, which is equal to about 2350 tons carpenter measurement."

GUNCOTTON — "The celebrated gunpowder manufacturers, Messrs. Dupont & Co., of Delaware, have succeeded in making explosive cotton of the best quality. These gentlemen are of the opinion that in the cases where cost is of secondary importance, it may be used to advantage; but in regard to its use in fire-arms it is too costly and dangerous."

PRINTING PRESS — "Messrs. Dryden, the celebrated engineers, are now employed in the construction of a printing machine for the London Times, warranted to produce 12,000 impressions per hour, or the inconceivable number of 3 sheets per second!"



When this Bell Laboratories chemist turns the stop-cock he raises a column of mercury to trap a micro-sample of gas evolved from a specimen of copper. Later he will analyze the sample by micro-techniques.

Trapping poisons by micro-chemistry

Touch of a finger-tip—or even the dust in apparently clean air—can carry enough contamination to ruin an electron tube. Bell System scientists found this out through micro-gas analysis using new and original techniques.

They determined what could destroy the tube cathode's power to give off electrons, and how much—to the millionth of a gram. Then, with Western Electric, they developed a manufacturing technique to keep these destroyers out of the tubes. . . . Bell Telephone Laboratories scientists established the world's first industrial micro-chemical laboratory more than 16 years ago for the Bell System.

Today micro-chemistry is constantly at work, helping to raise still higher the standards of telephone service and performance.

BELL TELEPHONE LABORATORIES

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

Previews of the Industrial Horizon

By A. P. Peck

BIG BUSINESS NEEDS SMALL BUSINESS

If there should be any thought that on the horizon looms the doom of small business, gobbled up and rendered extinct by the predatory animal which those of pinkish tinge delight to label "big business," give heed to some figures pertinent to the automotive industry. Here is big business if there ever was any, yet an automobile manufacturer, essentially, is simply an assembler. He depends for his very size on a group—an extremely large group—of suppliers for most of the parts which he puts together and markets under a well-known name.

One motor company has almost 3000 suppliers who furnish a vast variety of parts and materials which go into its cars; in addition, another 3000 suppliers furnish this same company with the goods and services necessary for the operation of its business. And at least 85 percent of these 6000 firms are "small business."

Then consider the Patent Office figures which show that from 65 to 75 percent of the functional parts of automobiles are invented outside the big laboratories and are produced by smaller manufacturers.

Big business pushing the little fellow out of the picture? Quite the contrary: Big business, with rare exceptions, leans on small producers, fosters them, enabling them to grow and multiply to the benefit of all.

LOOK TO THE SKIES

While blimps can fly-out weather that grounds all airplanes, and have established a fine war-time record for dependability in service, there is still a question as to their commercial future. They are difficult to handle, require large ground crews and docking facilities, and are relatively slow. Yet there is one bright spot in their future: Aerial advertising. Thus MGM, movie producers, and Ford Motor Company have acquired two retired Navy blimps, equipped them with spectacular electric signs, and put them to work. Probably many more such aerial sign boards will dot the skies in the future, effectively carrying messages to the public. Here, at least, is one use for blimps; lessons learned in advertising may some day be translated into other lighter-than-air activities.

FROM THE FARM

Soybean uses continue to grow and multiply. Expansion programs are underway, involving such varied products as candies, cheese, milk, fabrics, adhesives, cereals, synthetic resins, and surface coatings.

KING COTTON TOTTERS, SNAPS BACK

'Tis an ill wind . . . and so on. Cotton is rapidly losing ground to rayon in tire cords, one of its most fertile fields. But now come three uses for the King of the South that promise to recoup much of the loss in tires. First is a chemically treated yarn rated at 70 percent stronger than regular yarn; second is an elastic cotton fabric made without rubber (see page 279, this issue); third is a textile resembling linen and with far higher absorbency and polishing characteristics than ordinary cotton fabric. This last material is composed of 80 percent cotton and 20 percent asbestos.

Cotton, at once the blessing and the black beast of the South, is yielding more and more of its potentialities to the searching eye of research.

SOUND ON WIRE

Almost 50 years old, the method of magnetically recording sound appears about ready to emerge as an important factor in the business and entertainment fields. Sound on wire, long hampered by technical difficulties, offers advantages of extremely high fidelity of reproduction, recordings of almost infinite length, ease of editing (in the case of metallized paper tape), permanency regardless of number of play-backs, freedom from record breakage, and small bulk of the record itself.

On the other side of the ledger, so far, is the problem of reproducing magnetic records in the quantities required to crack the popular market; overweighing this is the simplicity of recording business conferences, dictation, children's voices in the home, important radio broadcasts, and the like. Add the fact that the wire record, permanent though it is, may be instantly erased and re-used at will.

Old, yet still new, wide-spread use of magnetic sound recording now awaits only the solution of minor production problems and the availability of raw materials.

STRAWS IN THE WIND

Despite beginnings of the return of natural rubber to the market, the United States must maintain its synthetic-rubber production facilities as a safeguard in times of peace as well as of war. . . Buzz-bomb engines —pulsating jets—have possibilities in such things as blowerless industrial heaters. . . Millions of United States homes have no central heating plants, use space heaters; newly designed oil burners, quiet and clean, are aimed at this market, spell doom to pot-bellied stoves. . . Light-weight motor cars, efficient and convenient, will have tough sledding for many years to come, as in the past, largely because the American public, willy-nilly, wants to keep up with the Joneses. . . Two thirds of the wood cut from forests is wasted during manufacture and use; here is a challenge to engineers from the standpoint of conservation as well as of development possibilities.

INDUSTRY EMBRACES Weldments

Full Advantage Can be Taken of All Metal-Fabrication Methods and of Desirable Characteristics of Metals Themselves. Weldments Reduce the Need for Complicated Castings and Intricate Machining

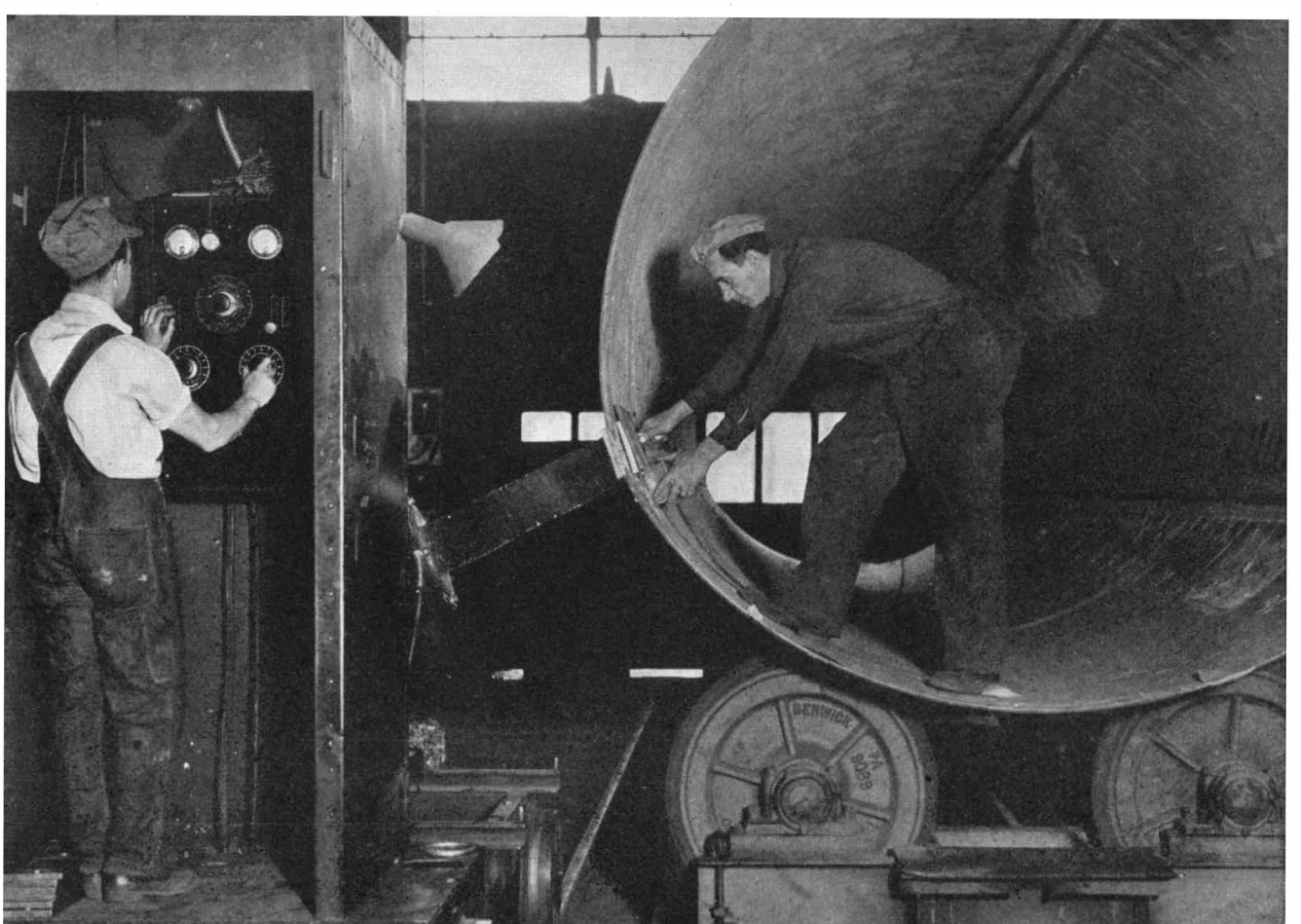
By EDWIN LAIRD CADY

IN ENGINEERING departments all over the country, draftsmen are attacking tough product-design problems and are coming up with weldments as the answers.

A weldment is any metal product which has been partially or completely assembled by welding. But when the engineer says "a weldment" he means a lot more than he used to mean when he merely said "welding." Welding is a process of joining which, even in recent days, quite often was used only when nothing else would work. A weldment is a means of taking advantage of the highest abilities of every known metal-working method and has now come to be used when plenty of other fabrication methods would work.

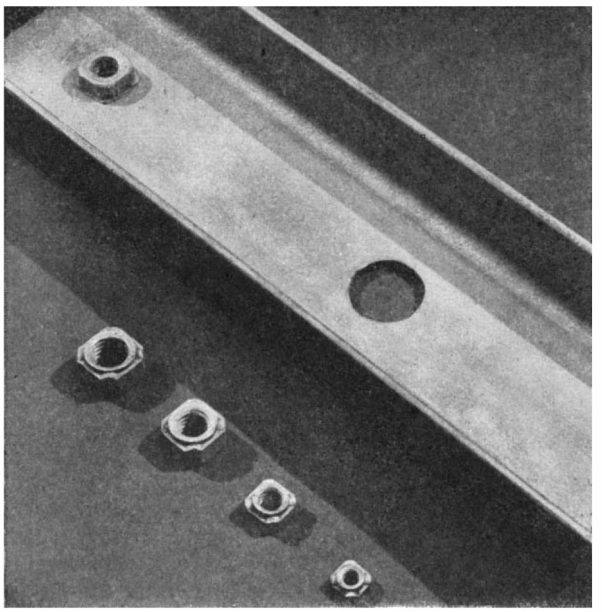
Back of the demand for more and more weldments is the constant struggle for better quality control in everything. More strength with less weight, more stiffness with less support, more resiliency with less bulk, higher or lower electrical conductivity, greater safety, less cost—in every metal product he designs, the engineer finds a demand for more and more ability to do the intended job.

The engineer can get some good points out of every fabrication method—casting, rolling, machining, extruding, forging, and the rest. But with every process he has two problems. He may need the best of two or more completely different processes in the same finished piece. Or he may need something that an in-



Courtesy The International Nickel Company Inc.

Inspecting nickel-clad steel weldment. X-ray machine moves along tracks, the weldment rotates on its supporting rollers



Projection welding of special nut to angle flange is a practical solution to the need for a substantial threaded hole in thin metal. This is just one example of potentials of weldments

• LOOKING AHEAD •

Stronger, less costly metal products . . . Fewer compromises in design. . . Simplification of forging operations through use of smaller parts, later to be joined by welding. . . Increased use of weldments as its co-operative possibilities are more fully understood.

•

dividual process can give him only at a prohibitive cost.

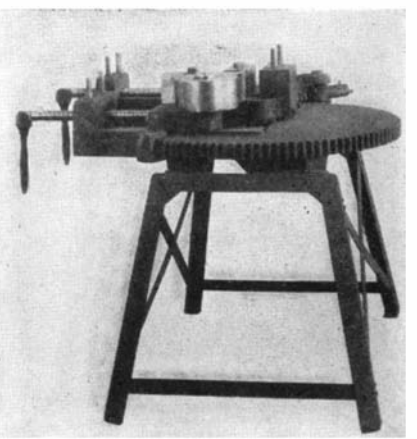
It is when he meets these two problems that the engineer can resort to weldments.

VARIETY IN CASTINGS—Compromises taken out of the design of castings is an example of what can be done with weldments. Quite often the engineer needs a part of such size and shape that it ought to be cast in the foundry. But in one thick area he may need very hard metal; in another, soft and machinable metal; in a third, high resistance to corrosion; and in a fourth, contours of such intricate shapes that they are hard to produce by casting.

Before the techniques of designing and making weldments became so well known, the engineer would have had to sacrifice some hardness in the hard area to make the soft one machinable, some intricacy of contours to be able to cast corrosion-resistant metal, and so on. Now he casts four different pieces, each of which has the properties desired for its area of the final product, and welds them all together into the finished piece. He even may do his machining on these pieces before he does the welding, and so substitute the lower cost of handling small pieces in his machine tools for the higher cost of handling a single large and heavy one, with all of its attendant difficulties.

Many of the gains from weldments come from the joining of somewhat dissimilar metals. A large casting has to have long arms or bosses which are used as shafts for the bearings of gears or pulleys. Formerly these extensions were parts of the casting itself. They were difficult to cast; if one were spoiled in the machining, then the whole bulky casting had to be discarded. And machining such areas on a large and heavy casting was by no means easy.

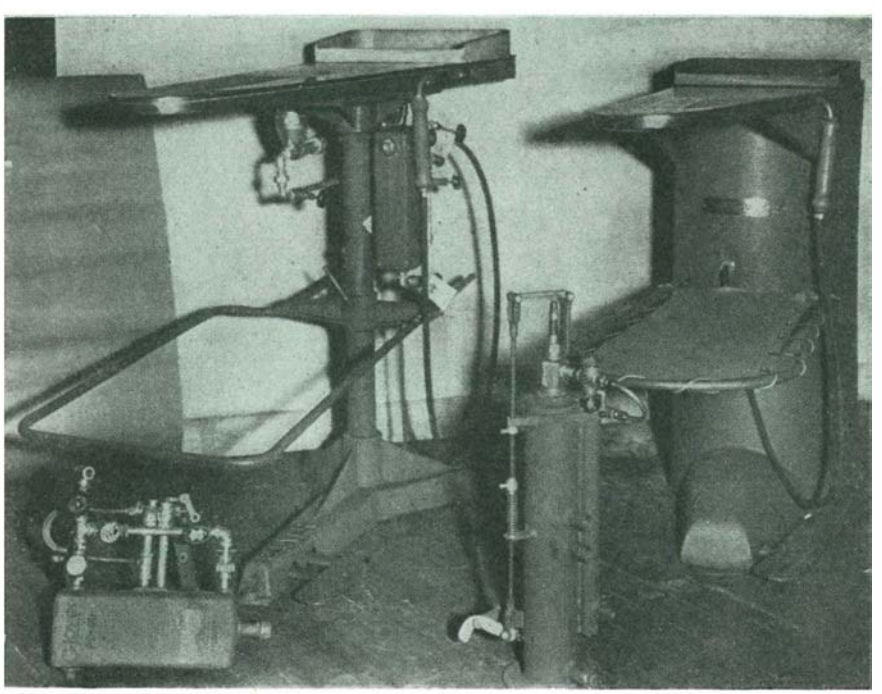
Now the casting is made without these arms. Simple pieces of cold-rolled steel are welded on. The cold-rolled steel needs no machining and is a much better bearing support than the cast iron could be. The



weldment costs far less to make, entails no risk of spoiling huge castings, and is a better product for its service.

Many large castings must be machined on several surfaces, all of which must be in close dimensional relationship to each other. There used to be a difficult problem in knowing just how to take hold of such a piece in the chuck of a lathe or on the bed of a planer so as to machine off a true control surface from which all other surfaces might be machined true and parallel. Very often the casting had to be machined on several different machines and to be mounted differently on each with many resultant opportunities for errors in the relationships of various surfaces to each other.

Now a true and round piece of steel is welded to the most con-



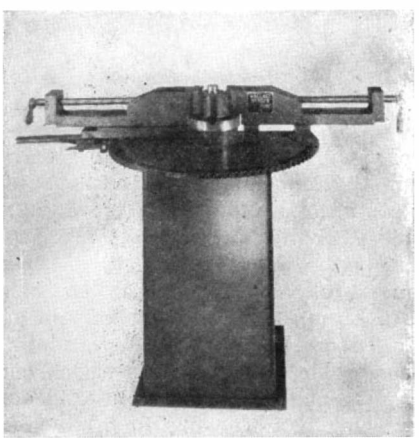
Courtesy Lincoln Electric Company

All-welded spotting machine (right) compares with older design (left). The greater freedom available to the designer of weldment construction is clear

venient area of the casting. On a large gear casting, for example, this area would be the hub.

Casting and steel piece thus become a weldment. The weldment is chucked by the steel piece which acts as a known and true control surface. If the machine tools are true and accurate, then every dimension machined from that control surface must come true and accurate to it and all dimensions will be true to each other.

LOWER MACHINING COST—The finished piece is much more accurate than was formerly the case. And since such a control area lends itself to chucking in the simplest of turret lathes and other machine tools, the machining costs are less.



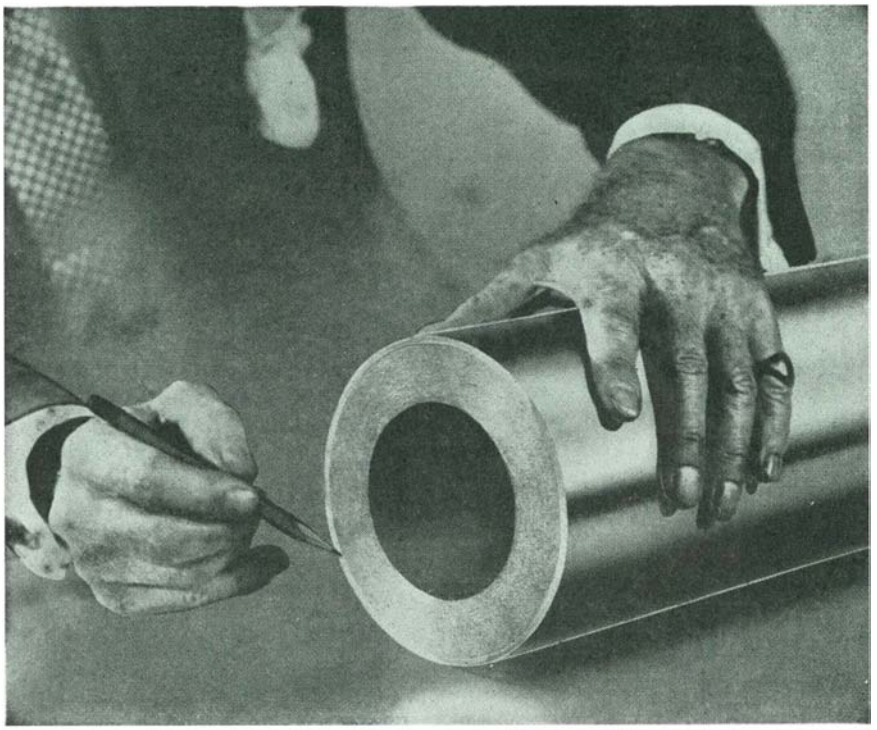
Cast bending-rack parts for machine on opposite page cost $60; assembled unit weighed 1260 pounds and required two men to operate it. Welded unit as seen above weighs 736 pounds; needs only one operator; and same parts, now weldments, cost only $32

The piece of steel which had been welded on may be cut off immediately after completion of the machining operations, or may be left in place as a holding area for cranes and other materials-handling equipment to grasp until the piece has finally been assembled into the finished machine.

Modern welds can be machined, bent, stretched, forged, subjected to any operations which the parent metals can stand. They can be heat treated, quenched, tempered, case hardened. They can be plated, painted, or otherwise finished.

From these abilities come other extensive uses of weldments.

A large, deep shell with intricate curvature on its outside diameter has to be provided with a strong threaded holding area at its bore. Former production methods called for rolling and stamping the whole piece as a unit. In order to get the necessary strength at the bore area the whole piece had to be made of a material which is very difficult to fabricate. The piece had to be pressed and drawn a little, then annealed to soften it and remove the work-hardening which forbade further pressing, then drawn a little farther and annealed again, several times. Often it would weaken or would flow incorrectly and have to be discarded after a great deal of costly work had been done on it. And when all other operations were finished the upper edge had to be flanged over by rolling or spinning, and the bore machined.



Weldments allow metals to be combined to use their best features efficiently. Here, welded-on nickel alloy will increase the life of this paper machine roller

Now a far stronger and less costly weldment, made of three sections, does the same job. Two sections comprise the main body and a third the bore or hub. The sections of the main body are stamped into semicircular pieces of the desired finished contours, including the cross curving and the flanging, but with one edge straight. This is a simple deep-stamping operation.

The second operation is to weld these two pieces together into a complete circular weldment. Next, the straight edge of this weldment is pressed and spun over so that it is at true right angles with the outside diameter and the whole weldment resembles a curved-edge round pan with a large round hole left in the center of its bottom. This spin-

Courtesy Westinghouse Electric Corporation

Welding the vanes of this blower results in assembly-time savings. In addition, warpage is less, balance and uniformity better. Closer quality control is one factor responsible for the swing to weldments

ning and pressing can be done because the metal is of a kind quite different from the tough alloy which formerly was worked (it is a metal which flows easily under the dies) and because the welds will stretch and flow at exactly the same rate as does the parent metal.

Only the hub or bore is made of the tougher alloy originally used. And this piece is a forging, much stronger than it formerly had been.

The final operation is welding the hub in place. Net result is a better product, made at lower cost.

DIRECTIONAL STRENGTH—When considering fabrication methods for highly stressed parts, designers have long been in the habit of giving the nod to forging. And when they did, the costs usually went up.

Now, forgings are broken down into the areas easiest to work under the hammers, then welded together. This method cuts thousands of dollars from die costs, eliminates rejecting of large forgings for faults occurring only in small areas. Even more, it permits taking more advantage of that prime asset of forging, control of directional strength.

Directional strength means that metals can have grains somewhat similar to the grains of wood, although not so pronounced. Whenever metals are rolled, drawn, stamped, spun, or otherwise "worked," these grains appear and run in the directions in which the metals have been caused to flow. The metals are stronger in the directions of their grains, weaker across the grains.

Weldments can be so assembled that grain strengths run in the directions in which strengths are most needed, very much as wood structures are so designed that most of the heavy loads run "with the grain." In forgings and in stampings, or other "cold forgings," the grains can be caused to follow curved paths, but not always to exactly the curvatures desired. When the engineer creates several smaller parts having the desired grain directions, and then welds these parts together in such fashion that the grain strengths support and reinforce each other, he creates a finished piece which has all the strength that grain can give it.

Grain in metals has other effects. Electrical currents like to go with the grain. Parts which must roll or slide upon each other will have longer endurance if the direction of wear is with the grain.

It is practical to take simple flat sheets of metal, roll them into cylindrical or other shapes, weld them where the ends meet, and so have finished forms for electrical equipment in which the grain is in exactly the direction in which it is desired to have the current flow.

Machine beds, slides, races for ball and roller bearings, clutch parts, brake parts, and plenty of others, can be so designed that weldments provide grains in the directions of greatest friction and abrasion. Work-hardening in service, which often is depended upon for prolonging the lives of such parts, can be most successful when the working is parallel to the previous work-hardening that provided the grain structure. And lubrication of the part also may be helped.

DESIGNS SIMPLIFIED—Weldments simplify designs in which heavy stresses are imposed over limited areas. Reinforcing pieces can be welded to such products so that they absorb some of the stresses and pass others along to the primary structure. When this is done, parts can be made lighter and stronger and can be more trustworthy for the same loadings. Designs of these kinds appear in airplanes, automobiles, railway equipment, almost everywhere that great strength and shock resistance with light weight is needed.

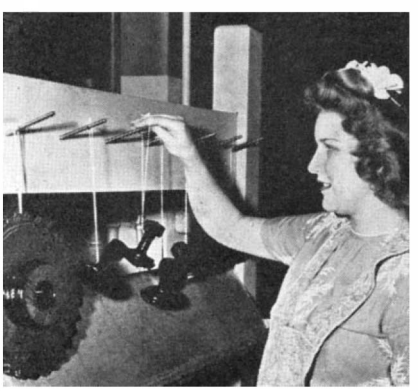
Engineers have hardly scratched the surface of the field for weldment designs. The greater the pressure to design better and stronger machines, the more will weldments be used. Weldments are the team players in the field of design, the elements which help all other fabrication means to be at their best.

FIBERGLAS USE

Expands Where Heat and Chemical Resistance Is Needed

THE ABILITY to withstand both heat and the action of some chemicals is making Fiberglas an industrial servant of many uses.

Electric motors which have given trouble in the field may be rewound with it. One such motor, which had failed several times in the field, was re-wound with Fiberglas insulation in 1939 and has operated without failure ever since.



Glass cords resist dipping solutions

Another up-and-coming use of Fiberglas is in the form of cords for dipping machine parts in protective solutions and afterwards for hanging the parts to dry.

IN-PLANT TELETYPE

Adds Flexibility to Complex Production Operations

THE CLASSIC difference between the large shop and the small one is that of flexibility. The large shop is inflexible, and once a production lot is moving through it, schedules and procedures are hard to change. The small shop can change easily.

In an effort to achieve more flexibility, many large plants are now using the teletype. With this, typed messages and forms can be sent quickly to any one department or to several departments simultaneously. Department supervisors can be warned of the receipt of goods which mean step-ups in production rates in their departments, whole manufacturing sections can be ordered to change outputs or prepare for other changes.

Such a system cuts down materially on the delays which occur when the shop telephone and the shop mail system alone are in use.

TENSILE TESTERS

Brought to Production Line for Rapid, Practical Use

WHEN an engineer is handling a familiar machine part, or when it is desired to know the true strength values of materials which have been fabricated into bar stocks or other common shapes, then tensile tests and hardness tests are the measurements which usually can reveal the most in the least time. Dozens of interpretations can be made from these two tests, and portable hardness testers capable of making hundreds of tests a day are an old story. Now, the use of portable tensile-strength testers capable of equally fast operation is growing. These machines do not have the complete adaptability of the portable hardness tester. But they are taking one more "laboratory-type" test out of the inspection room and transferring it to the production line where it has its highest value.

High Pressure Plastics

Standing On an Enviable 30-Year Record, The High-Pressure Laminates Look Forward to Continued Large Markets and Even Wider Use. Durable, Laminates Combine Technical and Decorative Advantages

By CHARLES A. BRESKIN
Editor, *Modern Plastics*

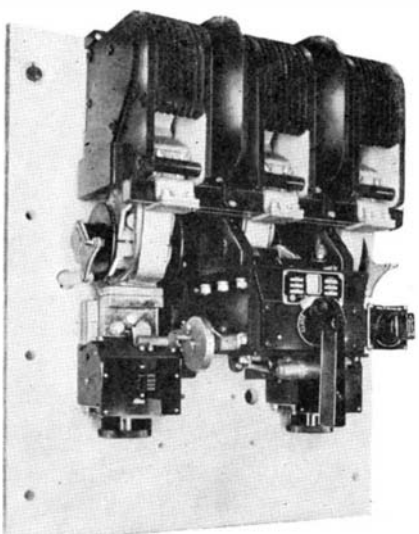
THAT THE great versatility of plastics in general and the wide range of end uses to which they are put has brought forth a proportionately diversified number of production methods is a fact well recognized by most persons interested in the industry. As is frequently the case in other fields, the latest process to be developed tends to eclipse older and often equally useful or better processes. So it has been with plastics laminates. Thus, low-pressure molding (see "Molding Unlimited," Scientific American, June 1946) has received a substantial impetus during recent years and as a result there is a danger that the full possibilities of high-pressure laminating, developed over the past three decades and still achieving new uses, will be overlooked.

High-pressure laminating, admittedly, requires molds, presses, and so on, that must be constructed to handle the pressures involved and hence are often relatively expensive. On the other hand, high-pressure laminates can be produced that have remarkable resistance to moisture, wear, and chemicals. Their record is good and, judging by the tentative plans of some industries, neither the decorative nor the industrial high-pressure laminates have yielded to any other materials one iota of their pre-war markets and new markets are coming more than half way to meet them.

HUGE MARKET—In view of the serious problems now facing the building industry in obtaining materials for new construction and for the renovation and redecorating of old structures and places of business, it is well to inquire first as to the place of high-pressure laminates in this work.

The National Housing Administration proposes to erect two million new homes during the next year. Into these will go high-pressure laminates as wall decorations, as parts of bedroom furniture, as bathroom wall surfacing, and as accessories. The kitchens of these homes, and the kitchens of the nine million presently constructed homes which equipment people expect to be called upon to re-equip, will find good use for these materials as kitchen sink work tops and as kitchen or dinette table tops.

Hotels, restaurants, bars, barber shops, offices, all types of more or less public rooms, in fact, are even more fertile fields for high-pressure laminates. The reason lies in the explanation given by the purchasing agent of a hotel chain for his installation of several thousand laminated window sills. Prior to purchase he had subjected the material to repeated kicks, butted cigarettes against it, poured liquor over it and, when finished, had carelessly wiped the surface with a damp cloth, only to find a still satisfactory surface on the sample. As unreasonable as tests of this type are, these laminates have been meeting them and, in so doing, have been marking off for themselves a big share of the hotel, restaurant, and automobile markets.



Courtesy Continental Diamond Fibre Company and I-T-E Circuit Breaker Company

Good electrical qualities make high-pressure laminates ideal for articles like the circuit breaker shown above

• LOOKING AHEAD •

Extensive use of high-pressure laminates in public and private housing. . . . Decorative effects as yet only hinted at. . . Lower costs with newly developed core materials. . . Many applications in sudden-stop-quick-start machinery. . . New laminates adapted to compound curves.

In the hotel field alone there is a tremendous immediate market. The American Hotel Association estimates that 1½ billion dollars will be required to rehabilitate, modernize, and build additions to existing hotel structures. This involves almost 13,000 hotels with over two million rooms. On furniture tops and window sills, the average hotel room would use about 24 square feet of decorative laminate. Thus, if only 10 percent of the existing two million hotel rooms are so equipped, there is an immediate market for 4,800,000 square feet of laminate. In addition, American hotels are in immediate need of a half million dollar's worth of serving trays, many of which can be high-pressure laminates; 116 million dollars worth of cocktail lounge and bar equipment; a million dollars worth of elevators, in all of which the decorative laminates will share to a considerable extent as table and bar tops, as trim, as bar front panelling, and as elevator interior walling.

DECORATIVE LAMINATES — For the most part these decorative laminates will be 1/16-inch sheets made of 11 layers of paper, the nine layers in the core being impregnated with phenolic resin and the two outside decorative sheets being impregnated with melamine. Urea is still widely used in the translucent laminates.

The high-pressure laminates are, of course, going to meet with competition from other materials in the decorative field. In table tops, for example, they will compete with enameled steel, with glass, and with wood. Enameled steel tends to chip, stain, and warp under too much heat; glass has a tendency to chip

Courtesy Caiplasti Corporation and Formica Insulation Company

Attractiveness and long life of pressure-laminated plastics are responsible for their continued popularity. Kitchen work surfaces (above) and areas that receive hard wear in taxicabs (right) are typical usages of these materials

and shatter and is cold to the touch; wood dents and stains and costs quite a bit to maintain.

In kitchen work surfaces, high-pressure laminates face competition from linoleum which must be strongly supported, pits, and does not have the same chemical resistance as the laminates. Other contenders for this market are tile, which will not stand up to too much vibration and impact; stainless steel, which is expensive and subject to stain under some circumstances; and enameled metal, which cannot take the same punishment as can the laminates.

The competition from other materials should not be so great in equipment for bars, restaurants, and hotel furnishings. In these applications ease of maintenance is an important factor.

As for the costs, it has been found that, given equal chemical and physical qualities, all table and kitchen work surface top materials have about the same final cost, with linoleum having a slight advantage. Wood, however, when treated to make it resistant to acids, alkalis, heat, and so on, becomes expensive. In general, flat high-pressure laminates without edging cost about $1.25 a square foot, with plywood or other core material included.

CORE MATERIALS—The cost of the core material used as the base for many decorative high-pressure laminate applications, and its availability, will continue to have a considerable influence on markets. Plywood, long the standard core and the most economical to date, currently is not readily available—a situation that is likely to continue for some time. At present, fabric honeycomb for cores is rather expensive—a dollar a square foot.

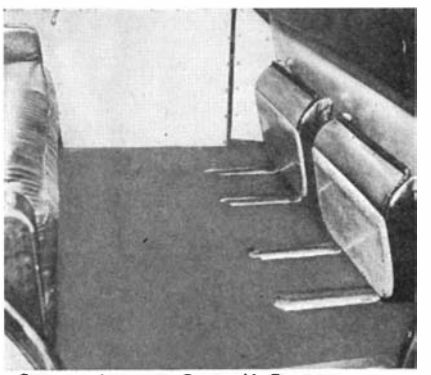
There are a number of honeycomb structures presently under development which, it is hoped, will resolve this price question. One is a new paper honeycomb whose possibilities seem clear considering that paper costs seven cents a pound against a fabric cost of about 65 cents. And there is at least one laminator who proposes to ply a laminate to 1/32-inch tempered pressed wood at about 60 cents a square foot for the total job. In Canada a paper mill is going ahead with a lignin board program to provide core material for table tops. Another company is experimenting with a self-supporting decorative laminate.

It is doubtful that high-pressure laminates will have wide use in the wall decoration field. The contact-pressure laminates, the vinyl wall-covering materials, metal, wood, fabric, and linoleum will all be offering competition. And new competition is coming up. There is, for example, striated plywood, a three-ply sheet 5/16 inch thick, bonded for internal grade with urea to sell at 13 cents a square foot and bonded for exterior grade with phenolic to sell at 20 cents a square foot. Another material consists of a thin sheet of aluminum bonded to a thin ply of textured wood—the material being applied to walls with the metal on the underside. The latter costs about 35 cents a square foot which is substantially cheaper than standard 1/16-inch decorative laminate.

The new papers which are being developed for surfacing plywood right on the press are yet another source of competition for high-pressure laminates in wall applications. Some of these resin-impregnated papers can be applied to ply for as little as three cents a square foot.

USEFUL INDUSTRIALLY — High-pressure laminates will, to all appearances, continue to serve the industries where they built their original reputations. These fields include the electrical and the related communications industries, textile manufacturing, aviation, automotive, and the maritime industry.

The old standbys in the electrical industry are the paper- and fabric-filled phenolic laminates. The war brought the glass-fabric bonded



Courtesy American Cyanamid Company

with melamine resin laminates which provided high strength, high arc resistance even when wet, and heat resistance. As for the silicone-glass laminates which are now undergoing tests, it is questionable how much the present very high prices can be reduced. Another new product is an asbestos-melamine laminate designed to give very good combined arc and heat resistance in the presence of moisture.

In the textile industry a rough estimate indicates that there are at least 18 uses for high-pressure laminates. Among these items are picker sticks, bobbins, doctor blades, carrier rolls, and loom-box linings. Research, however, is intensive in this line and the list of applications should take a spurt. The high-pressure laminates' chief advantage in this field lies in their ability to overcome the problem of static generated by friction in all textile processes.

These laminates are well adapted to jigs, fixtures, and forming tools in the aircraft industry. Here, their comparatively light weight—half that of aluminum and one fifth that of steel—means a reduced outlay for such equipment. Another important factor which accounts for the standardization of laminates as the material for pulleys, axles, ball-bearing retainers, bearings, cams, and other items is the strength-weight ratio of these materials. This factor is

growing in importance because modern machinery must travel at very high speeds, yet must be able to start and stop frequently and easily.

The factors that account for the use of high-pressure laminates in the electrical, textile, and mechanical fields are also all important to the automotive manufacturer. A typical and promising application in this industry is the use of the laminates as inside paneling and as the kick-plates of jump seats in taxis.

In the marine industry an interesting use of a cotton-fabric laminate is found in the marine-bearing housings of stern-tube shafts for underwater use. Success here has lead to the manufacture of bearings for similar application in other industries—steel rolling mills, to give one example.

WHAT'S COMING UP—There are many developments being worked upon that promise interesting things in high-pressure laminates. A few such items include papers such as Patapreg, developed by the Forest Products Laboratories, which are formable in compound curves; and knit fabrics for the same purpose. There are laminates with nylon-fabric filler and melamine or phenolic resins which are applicable to electrical, communication, and radar work.

There are a dozen new laminating resins; and combinations of glass, fabric, paper, fiber, rubber, wood, and other materials in single sheets, rods, and tubes of laminates designed either to improve the qualities of the product or bring down the costs, or both. Also new is engraving stock, white inside and black outside, for use in instrument faces, dials, instruction signs, and so on.

Currently, many new products are in the development stage, some ready for the market. What is missing is enough material—paper, fabric, resin, core material—the same complaint of almost every industry today.

RAILCOACH REJUVENATED

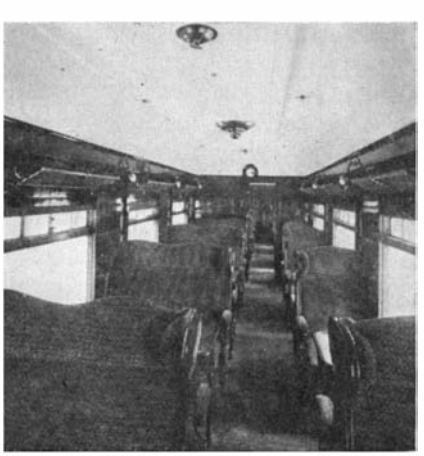
With Plastics Panels in Modern Colors

THE ancient railcars which were thrown back into service during the war because of the extra heavy traffic and the inability of railroads to get more than a trickle of new cars, may have yet another lease on life. In England, an outmoded, plush-seated, dark-panelled coach has been modernized by the use of plastics laminates and a variety of molded plastics parts.

In redesigning the old coach, everything was removed, down to the outer shell. Then a wooden framework was built which outlined the old walls and acted as a support for the laminated panels selected for the walls of the new car. Not only the walls, but the bar and table tops as well are surfaced with Wareite laminated in a color scheme of pink, grey, and cream. The laminated plastics, used in 5/32 inch thickness, weighs less than half as much as aluminum and has a high impact value. Equally important is its resistance to hard and careless treatment such as the spilling of hot liquids, juices, and alcohol.

The walls, which follow a continuous swooping curve from floor to ceiling, comprise alternate panels of pink and grey, a color scheme that is echoed in the upholstery material. The same asbestos fabric that covers the chairs, stools, and wall benches is used to surface the wall laminate. Balancing the curve of the walls is the contour of the bar front which has a reverse curve. This was done to insure ample leg room for standing passengers, but was found to have the added advantage of being pleasing to the eye.

Other plastics applications in this renovated railroad coach are molded acrylic lighting shields and plastics display cases and curtains. The plastics used are a product of Bakelite, Ltd. of Great Britain.



Interior of old railcoach (left) was stripped out and panels of plastics laminate installed. Result (above) is a surprisingly modernized appearance

PLASTICS FABRICS

Meet Needs of Automotive Use

UPHOLSTERY, in convertibles and station wagons, is expected to afford a very practical application for the new synthetic fabrics. Appearance, durability, and resistance to dirt and stain is of paramount importance in these coverings and the plastics fabrics are said to fill the bill. One such fabric is Duran, a film made from Geon by Masland Duraleather Company.

Seat material resists wear and stains

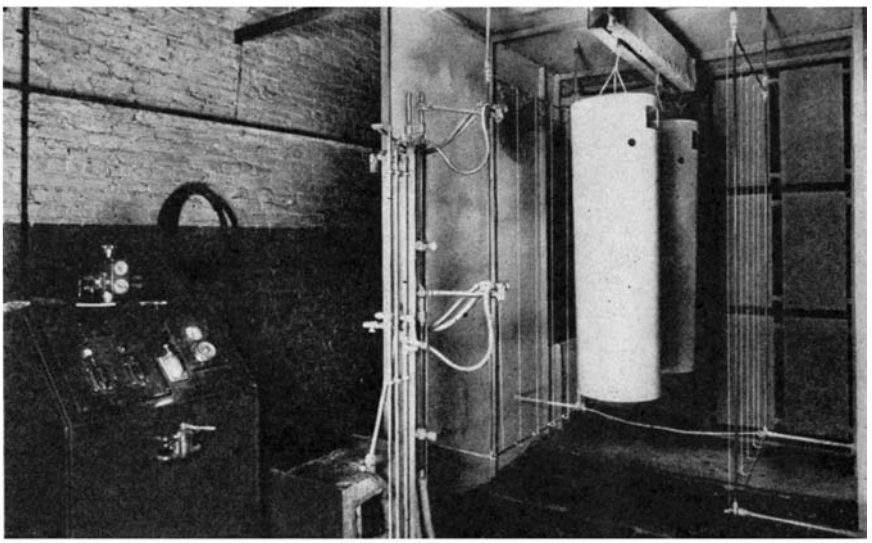
COLORFUL LAMINATE

Combines Features of Two Plastics in One

FOR industries requiring a material with the optical and light transmission qualities of acrylic and the vigorous color characteristics of nitrocellulose, there has been developed a new laminate called Kolor-Plex. Celluloid sheets in iridescent pearl tones, in "bread pudding" effects, and in translucent colors are laminated to thicker sheets of Plexiglas and delivered to fabricators who use the laminates in making powder boxes, cigarette cases, hand-mirror backs, bathroom accessories, and a wide range of other items.

The makers of this laminate, Willson Plastics Division, Willson Magazine Camera Company, state that exhaustive tests indicate that the adhesion is sufficiently strong for all purposes to which the material would be put, and that in fabrication, tools normally used on the acrylics are quite satisfactory for this new material as well.

By VIN ZELUFF
Associate Editor, *Electronics*



Paint particles, sprayed towards water-heater casings, are directed to their target by a static field created by the electrically-charged vertical rods

ELECTROSTATIC Painting

Overspray Waste and Blisters or "Tears" have Long Remained Bugaboos in Industrial Finishing. Electronic Equipment that Sets Up Charges To Draw Paint to Article Now Minimizes Overspray; Similar Devices, Working in Reverse, Remove Excess Paint and Prevent Unsightly Tears

A SHORT time ago a boiler manufacturer was employing three men to hand-spray one coat of synthetic baking enamel on water-heater casings. One gallon of enamel covered 10 to 15 casings. Today that same manufacturer is covering twice that number of casings with one gallon of the same enamel. But now the operation is automatic to the point of requiring only one man to check and set the controls of the equipment. And the finish is more consistently uniform.

The answer to the "enamel stretching" process described above is packed into one word—electrostatics. A glass rod charged with static electricity by rubbing it with a silk cloth will attract or repel small particles of paper or lint, depending on the polarity of their charges. Similarly, charges of commercial magnitude, generated and controlled by electronic equipment, are being used in industry far and near to do a multitude of jobs. In the example cited above, the casings and the paint bore opposite charges. Hence, the particles of paint leaving the spray gun were snatched from the air to the casing instead of drifting hit or miss in the general direction of the painting surface. Essentially, the paint was drawn to the casings like paper particles to the charged glass rod, and overspray waste was reduced to a minimum.

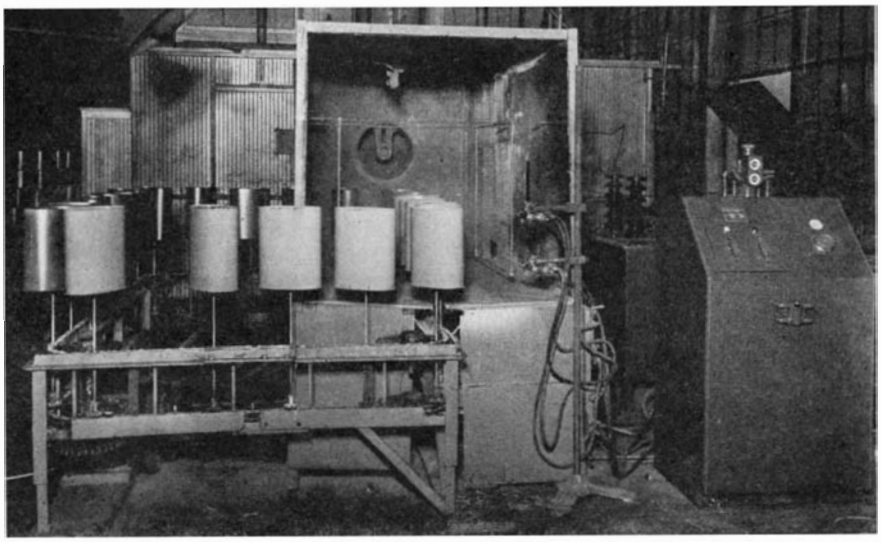
Another example: In a conventional automatic-spraying set-up for painting the outside of metal wastebaskets, each basket was inverted over a perpendicular holder. This rotated the basket as the conveyor moved it along through a booth in which three stationary spray guns forced the paint directly onto the containers. Now, with electrostatic spraying, the same equipment and the same materials are used. But the difference is that within the spray booth are arranged suitable metal electrodes which, when charged from a special high-voltage electronic power-pack, produce an electrostatic field within and around the spray painting zone. The number of guns is reduced to two and these are directed approximately parallel to the conveyors so as to atomize their material into the electrical field. For electrostatic spraying, the spray guns are adjusted to atomize the paint properly at an air pressure as low as 15 or 20 pounds per square inch. The solvent balance of the paint is adjusted so that the paint particles will stay wet a little longer.

In operation, the paint leaves the spray guns and breaks into finely atomized particles that form a suspended paint fog. As each particle encounters the electrostatic field, it is charged with static electricity of opposite polarity to the metal wastebaskets moving along on the conveyor and instantly the electrically charged paint particles are attracted to the metal wastebaskets within the electrostatic spraying zone. The paint film is deposited smoothly and uniformly over the oppositely-charged surface. Paint particles which otherwise would miss the product being painted become electrically charged, changing their course and flying to the metal surface that attracts them.

The relatively low-pressure air stream carrying the wet paint particles makes it possible for the power of electrical attraction to draw to the product being painted most of the paint which otherwise would be spent as wasteful overspray. The small amount of paint that does escape this electrostatic attraction, and the evaporating solvent fumes, are exhausted through the regular spray-booth exhaust system.

VERSATILE METHOD — A wide variety of products can be electrostatically sprayed. Whether or not the object is rotated during the process is determined by its size and general character. Such items as metal wastebaskets, radio tubes, water-heater jackets, lamp shades and bases, and cylindrical containers of all types, are rotated because their external symmetry readily permits such handling and increases the efficiency of paint application.

Flat stock, corrugated panels, small-diameter pipe, Venetian blind slats, and structural steel members can be coated either overall or on one side only, without rotation. They present to the electrostatic field and spray guns a flat extended surface which appears continuous



A complete electrostatic spraying set-up, such as this one for painting waste-baskets, includes electronic generator and controls at right, insulated leads to spray booth, and charged rods in booth. Gains in efficiency may be high

• LOOKING AHEAD •

More extensive finishing of irregular shaped articles. . . Reduced basic finishing costs. . . Further savings because fewer jobs are rejected at inspection. . . Cleaner, safer paint booths. . . Wider application of automatic spray equipment.

as the separate parts move along a conveyor.

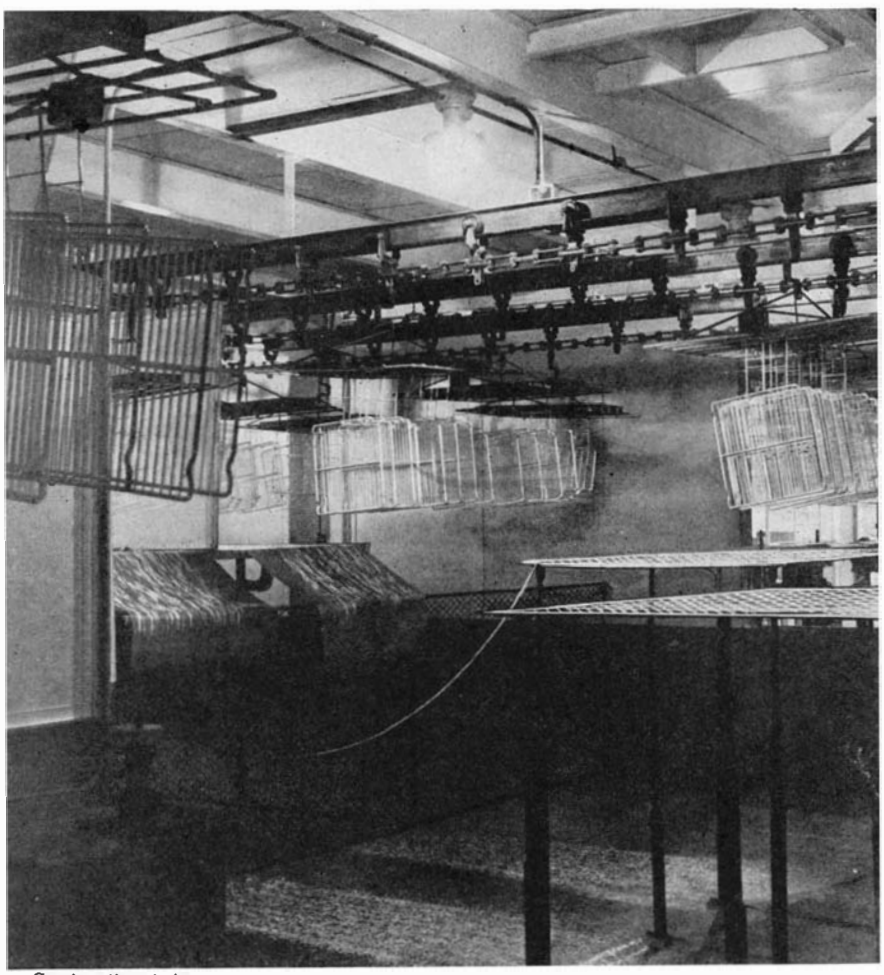
Irregularly shaped articles that are not normally possibilities for automatic spraying can be coated by the electrostatic method, because of the extended area over which coating matrial is attracted to the items. Such things as automobile jacks, air cleaners, steering wheels, mouldings, mufflers, washing machine parts, and metal furniture are typical examples.

EQUIPMENT USED—The electronic voltage source which maintains the necessary electrostatic field is a rectifying unit capable of converting the normal 220-volt, 60-cycle alternating current into rectified voltage of approximately 100,000 volts. The regulation of this voltage source is arranged so that the current delivered at this high voltage cannot exceed 0.01 ampere, a value considered safe for human beings. When the output of the unit is shorted through a low resistance, such as that of a person having wet hands and feet, the current does not exceed this value. Under normal operation the power consumption of the electrostatic rectifier is comparable to a 1000-watt lamp. Constructed without moving parts, the unit requires little maintenance. Only occasional replacement of tubes is required.

Any material can be applied by this method, so long as it can be atomized at the lower atomizing pressures used and can be adjusted in solvent balance so that a satisfactory wet film can be precipitated. Synthetic enamels, cellulose lacquers, aqueous suspensions, wrinkle and splatter finishes, oils, and some chlorinated-rubber type adhesives have been successfully applied.

The process is directly applicable to article made of electrically conducting material; with non-conducting material, arrangements must be made for the part to become effectively a collecting electrode for the sprayed material. Flower pots, for example, can be inverted over a conical metallic fixture; flat sheets of acoustical tile or other insulating material can be laid upon a conducting metal-mesh belt in order to form the necessary precipitating field over the surface to be coated.

On flat surfaces, and items that can be rotated, the paint film is practically uniform in thickness. On other items, the uniformity of coating that can be obtained depends largely upon the contour of the part. Since the electrostatic field is responsible for the precipitation, the coating is light where the electrical field is weak, and normal where the field is strong. Thus, protruding sections receive more paint than recessed surfaces, whereas the internal coating of comparatively closed



Courtesy Servel, Inc.

De-tearing electrodes remove "last drop" of paint from dipped wire shelving

openings is practically impossible. On some objects the shielded or recessed sections can be satisfactorily coated by directing the spray guns so that such sections will be mechanically covered by direct spray, while the overspray from such guns reaches other parts of the object by the precipitating action of the electrostatic field.

ECONOMICS—The saving in material and labor that results from electrostatic spraying depends upon several factors. The replaced method may or or may not have been efficient. On small parts, where ordinarily there is considerable overspray, great savings can usually be expected. On large flat sheets or similar areas where the usual hand or automatic spraying is somewhat more efficient, the savings are correspondingly less. In general, the adoption of electrostatic spraying may result in a saving of 40 to 60 percent of the material used in conventional high-pressure spraying.

An exceptional case was encountered in the spray painting of bazooka barrels. Here 75 percent of the paint used in former spray operations was saved. Painting Navy powder containers by the electrostatic method, although not exceptional in paint saving, did make it necessary to clean the spray booth only once every six weeks instead of twice daily as was formerly done.

"REVERSE" PAINTING — Another household product that has benefited from electrostatic processing is the refrigerator. In one 1946 model, the manufacturer wanted the finish on the wire food shelves to be as smooth as the gleaming interior of the box. A high-quality baking enamel was found to have an excellent appearance but spray painting the grid-like shelves was not practical for economic reasons. An automatic dipping process was found ideal but had the disadvantage that the enamel formed drops, or tears, and these became unsightly blisters after baking.

Now these drops of paint are pulled off electrostatically. The shelves are hung on the conveyor, dipped in the usual manner, then carried over a drainboard which returns the major part of the excess paint to the tank. On the way to the drying oven, when all but the last tears have drained off, the shelves pass over electrostatically-charged de-tearing electrodes. The electrodes exert an attraction of sufficient force to pull free these last drops or tears of paint while they are still in a fluid state. As a result, glossy white shelves of many sizes and shapes continuously come to the inspectors and packers uniformly coated and free of excess material.

The electrodes used with this process are designed for the particular set-up involved, due consideration being given to conveyor speed and the type of article to be treated. Each "drain-off" point from which excess material is to be removed must be exposed to the electrode. If any drain-off portion of the coated article is electrically shielded from the electrostatic field by some other part of the article, it will be less effectively "de-teared" in proportion to the degree to which it is shielded.

The distance between the electrode and the article being de-teared is generally held fairly constant at eight inches. The conveyor speed, the distance between dip tank and de-tearing electrode, and the length of the electrode are arranged so that the freshly coated parts continue to pass over the electrode until all excess coating material is removed.

Parts and products made of a wide variety of materials can be treated. Items made of metallic or electrical-conducting materials can be handled if their shape is such as to make dipping possible. Pottery, wood, and plastics items can be de-teared if a field of static electricity can be established at the de-tearing point.

There are only two limitations to electrostatic de-tearing. One is encountered when the coating material is sufficiently thermoplastic to cause a harmful reflow during the baking process, after the object has left the de-tearing grid. The other limitation is encountered on those objects wherein the drain-off points are surfaces of relatively large radius. The excess material is only partially removed from such surfaces. The maximum benefit is derived when the article is hung in such a manner that the drain-off material accumulates on edges or corners which are sharp or which do not exceed ¼ inch in radius.

SLIDE-FASTENER RELIABILITY

Improved by Electronic Control In Manufacturing Process

FLASHING neon lamps and synchronized control circuits in a dual predetermined electronic counter are helping slide-fastener manufacturers to achieve exact length and precise spacing in their products. The counter, made by Potter Instrument Company, is set for the desired number of elements in a length of fastener, and the electronically-controlled machine does the rest. Greater accuracy and uniformity of product is attained, minimizing the possibilities of fasteners jamming.

MINIATURE RECTIFIER

Takes Little Space, Has Extended Service Life

IF THE newly available midget selenium rectifiers are accepted by radio receiver designers and are not overruled by those who base the price and value of a set on the number of tubes it contains, there will be one less tube to burn out in the portable radio set of the future. The new rectifiers are about the size of a walnut and can therefore be mounted in places too small for a conventional rectifier tube and socket.

Only two soldering operations and a single mounting bracket are needed, since no filament connections or sockets are required. It is reported that the rectifiers will not break when dropped, and on continuous test have proved their ability to outlast several of the conventional 117-volt rectifier tubes.

Starting is instantaneous, reducing greatly the usual warm-up period before a radio set starts playing. Currently, the rectifiers are made by General Electric Company in a size suitable for radios where voltages up to 125 volts are rectified, but larger units may come later.

FIRE DETECTOR

Responds to Match Struck 60 Feet Away

SUNLIGHT and electric light contain very little energy below a wavelength of about 3000 Angstroms. Although the tungsten filament in a lamp may be hot enough to radiate in the far ultra-violet region below this point, the glass envelope is an effective filter. Flames and sparks, however, radiate in this region and advantage is taken of this fact in a newly developed fire detector that is extremely sensitive to minute sources of flame, sparks, and arcs. Detectors of this type can be installed in factory buildings and rooms to control a central indicating system for warning of an outbreak of fire. Some manufacturing processes that utilize flames and arcs might also use the unit.

The instrument consists of a specially designed Geiger-Mueller tube with a window that permits penetration by radiation below 3000 Angstroms. Its sensitivity is so great that it responds within one tenth of a second to the striking of a match at a distance of 60 feet.

MUST FLYING be a "Racket"?

Aviation, Now Finding Itself a Noisy and Unwanted Neighbor in Many Communities, is Starting a Search for Ways and Means to Silence the Roar and Clamor That, Continued, Might Cost the Industry Heavily

By ALEXANDER KLEMIN
Aeronautical Consultant; Research Associate
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A STORM of indignation against noise and hazard from the air is sweeping the country. T. P. Wright, the Civil Aeronautics Administrator, himself, leads the chorus of protests. Congress has voted to build hundreds of airports, but when an attempt is made to locate one, nearby residents howl vigorously. Because of airplanes roaring overhead, they tell the Administrator, babies can't sleep, conversations are interrupted, and dishes rattle in the cupboard. Genial Ted Wright, as he is known to thousands of people in aviation, has his own personal grudge against noisy flying. "I am an old music lover," said he. "When Washington's National Symphony Orchestra moves outdoors and its music is drowned out by planes from the National Airport. . ."

Mr. Wright believes, however, that the airplane can and will be silenced. To suit actions to words, he has called for immediate research and engineering effort by all concerned. The public, unable of itself to take such long-range action, continues to suffer, but not silently.

A report typical of the pressing problem comes from Roy E. Carey, County Superintendent of Public Buildings, Union County, New Jersey. Here, low-flying planes often interrupt proceedings in the Elizabeth court house. "I shudder," says Mr. Carey, "when I see how close planes fly to the 320-foot building."

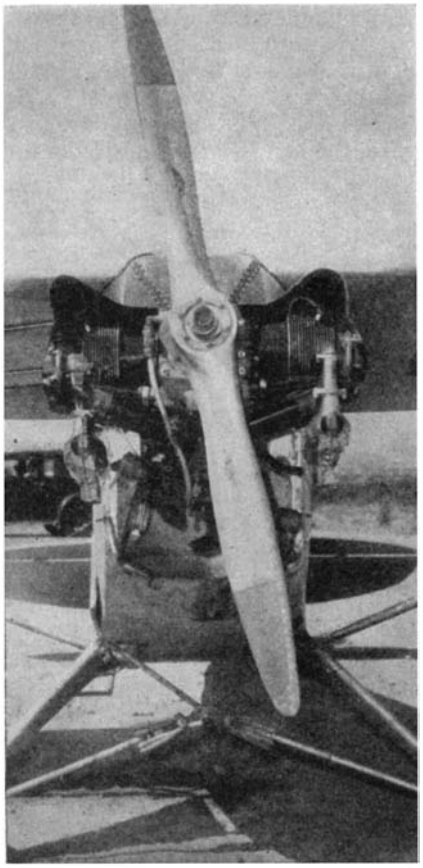
But courts and business activities are generally limited to daylight hours; it is in the quiet residential areas where aviation's noise problem literally strikes home with greatest force. Ben Stern, Assistant CAA Administrator, advises that residents of Alexandria, Virginia, near Washington National Airport, suffer keenly from the noise of transport planes. At peak traffic periods, airliners with engines at full throttle go over some of the houses at the rate of about sixty an hour, one a minute. The homes are located on hills and the planes pass very close to them during the early part of the climb; under such conditions, the invasion of residential privacy is almost absolute. Other areas report that chickens refuse to lay eggs because of the aerial disturbance . . . and new complaints are heard almost daily.

Grover Loening, nationally known aeronautical engineer and pioneer in aviation, summarized the situation in a recent speech before the Institute of Aeronautical Sciences: "I can venture a prediction. If we do not do something drastic, and right now, we are going to so limit the future of aircraft development that it will be just too bad for all of us. . . Just so long as the noise is going to militate against the establishment of local airports and shove aviation out to the outskirts as an undesirable citizen, just so long will we remain in the stunt transportation class and not in a universal mode of travel."

From this it is clear that both the professionals and the public agree that the airplane is a noise nuisance and to some degree a public hazard. Which of the two evils is the greater is a subject worthy of examination.

• LOOKING AHEAD •

Eventually a law requiring exhaust mufflers on all private airplanes. . . Better propeller design to reduce noise at source. . . Increasing familiarity will make the public less sensitive to overhead noise. . . Stricter enforcement of existing regulations by authorities. . . New noise problems when supersonic speeds are attained.



Exhaust mufflers, one on each side of this light-plane engine, reduce noise considerably. Slight power loss gains added comfort for pilots and public

DANGER FROM ABOVE?—Statistics make it apparent that the hazards—crashes involving injuries or damage to persons and property on the ground—are largely the responsibility of private flying. Commercial aviation accidents seldom occur in crowded areas but private aviation accidents are apt to concentrate on airports and their environs. Pilots show off, "buzz" houses, indulge in aerobatics too near the ground. Ben Stern states that one third of the fatal accidents in private aviation result from diving and zooming—showing off. Countering the colorful tales of such happenings, however, are facts to indicate that their very novelty and news value tend to exaggerate the danger to an extent unwarranted by their numerical frequency. Also, the accurate estima-

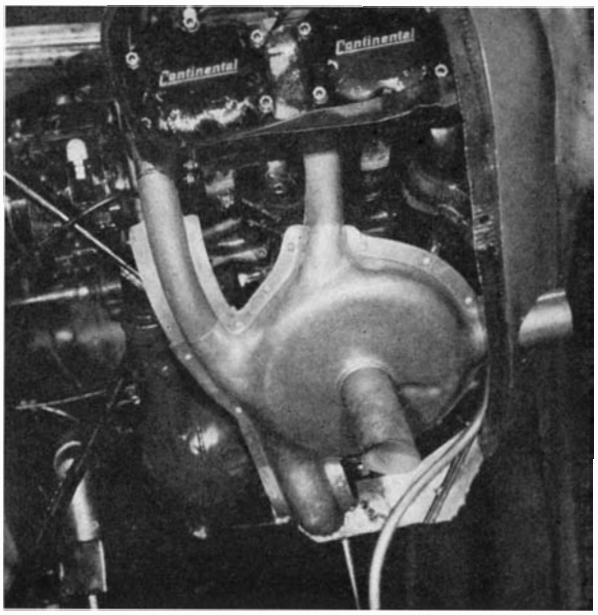
tion of a plane's altitude, while fairly easy for an experienced observer when the plane is directly overhead, is practically impossible when the plane is seen from an angle. Hence, the stories of planes flying at tree-top height sometimes mean only that the complaining citizen saw the plane through the trees—a different matter entirely.

For these and other reasons, it is now generally agreed that it is the noise and not the physical hazard which arouses the public, and it is here that the complaints find greatest justification.

NOISE INESCAPABLE — The noise level of a light airplane flying at minimum legal height over a community may be less than that of a truck in the streets or about the same as that of an automobile. The protests arise from the fact that airplane noise is overhead; it stands out in the heavens and fails to merge with the street noise. Consequently it intrudes itself in every home in range. Expert analysis and testimony to the effect that the airplane is not, after all, such a great offender as compared with street traffic is met, and correctly, with the reply that the public is not complaining about planes above crowded city streets but rather is concerned with otherwise peaceful neighborhoods located close to busy airports. Comparative figures along these lines, shown in the accompanying table, were gathered by the Aircraft Owners' and Pilots' Association from tests made by the CAA at a Pennsylvania airport. The planes used were the 200-horsepower Fairchild and the familiar 65-horsepower Piper Cub.

Since airplane noise is not a natural occurrence but an act of man, it might logically follow that someone in aviation is to blame for allowing the present conditions to arise. Actually, no particular group or agency deserves full condemnation and most have the fairly valid excuse that the importance of other things has eclipsed research on noise prevention. The airplane, engine, and accessory manufacturers have been busy seeking the highest possible performance and do not wish to do anything that will decrease speed, lessen payload, or increase cost. Silencing the airplane might do one or all of these things to some extent.

Airline operators, engrossed with the task of meeting a rush of patrons and harassed by a shortage of equipment, have not been able to devote a substantial amount of attention to noise. Airport managers, although appearing rather insensitive to complaints, have been partly at the mercy of their customers. And CAA, state, and police officials have, it would seem, been overly forgiving towards transgressors.



Two views (left and on opposite page) of one muffler arrangement recently devised show stacks which lead exhaust into central expansion chamber. Inlets at cowl front are passages to heat exchangers that provide warm air for cabin and carburetor heating

Courtesy Ryan Aeronautical Company

SOMETHING BEING DONE — Despite Ted Wright's forthright statement, and the public feeling which has been brought to bear, the noise problem has not yet improved physically. But those concerned have begun to work. The Aircraft Industries Association has responded heartily and has appointed a committee to investigate the reduction of noise at its source. The Air Transport Association, equally concerned and willing to help, has an engineering committee at work. The National Advisory Committee for Aeronautics is marshalling its unrivaled resources. Some manufacturers are already at work and civil authorities and airport managers are at least starting to keep closer tabs on activities under their jurisdiction. A beginning has been made.

The heart of the noise problem is three-fold; it lies in the propeller, engine, and exhaust. The so-called clatter of the working parts of the engine, as well as the aerodynamic noise of the plane rushing through the air, may be dismissed from the discussion as relatively weak and unimportant. It is from the propeller and engine exhaust that the genuinely loud and offensive noises arise. And even here it is estimated by the National Aeronautics Association that about 60 percent of the total noise originates with the whirling propeller which approximates the action of a fire siren.

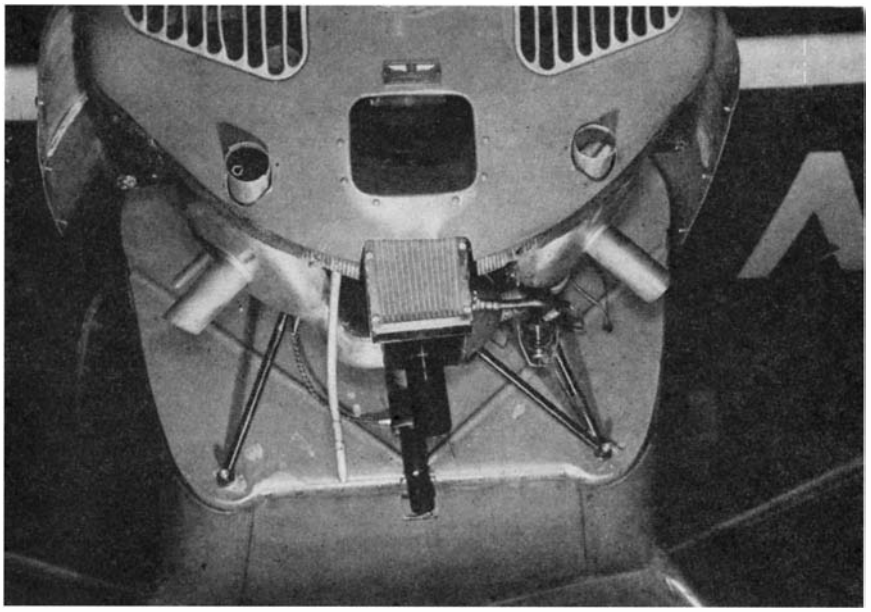
Since the propeller absorbs power from the engine and translates it into thrust, it follows that the greater the power and thrust the louder the noise. Power, the very essence of flight, is not subject to reduction. Therefore it is necessary to look in another direction; namely, the reduction of propeller speed, for any effective method of reducing noise from this source. Propeller-tip speed is the foremost consideration in this respect and when the thin blade tips approach the speed of sound—some 700 miles per hour—the noise becomes almost intolerable. In addition to the sustained air-pressure waves that batter the eardrums at such speeds there arises another tearing, swishing sound resulting from the vortices at the rear edges of the blades. This latter noise, less overwhelming than the tip roar, can be reduced by using thin but wide blade sections placed at a small angle to the airstream which strikes them.

From the standpoint of noise reduction, one golden rule may be drawn from the foregoing facts—keep the tip speed down by gearing

NOISE MEASURED	NOISE LEVEL
Directly below plane take-off path	88-89 decibels
Aircraft circling overhead near airport as for landing approach	70-85 decibels
Normal peak noise level, plane passing within half-mile of field	65-80 decibels
Truck noise, at point 230 feet from road; passenger car noise 10-15 decibels less in most cases observed	80-90 decibels
Transport airway traffic in the general airport area	74-81 decibels

Peak sound levels were generally of three to five seconds duration

Matching of truck and airplane noise shows little difference technically. General public is not impressed with such figures because airplane noise is overhead and invades a wider area



the propeller and by increasing either the number or diameter of the blades.

PRACTICAL PROBLEMS—Presented in this fashion, solutions to the propeller-noise problem appear relatively simple. It is only when an attempt is made to apply the solutions that the practical factors make it difficult. Dr. Theodore Theodorsen of the N.A.C.A. Langley Field laboratory suggested, for example, a revolution in propeller design that would involve a fan-like, eight-bladed arrangement turning at 500 to 600 revolutions per minute. The wide, thin blades of such a propeller would produce so slight a sound as to be inaudible at a distance of 50 feet away.

Airplane manufacturers, on the other hand, resist such devices because the gearing would be heavy, costly, and inefficient, and so would the propeller. Moreover, a variable-pitch propeller with its inherent complications would be necessary even on a small plane, and an appreciable penalty would be imposed on private flying. Clearly, some sort of a compromise must be found.

EXHAUST MUFFLERS — Approximately the same situation occurs in the exhaust muffler field. Opponents of these devices, so long used and required by law on motor cars, submit that the back pressure of the muffler reduces engine efficiency, that mufflers weigh too much, heat up, cause fire hazards, make the engine overheat, and reduce plane performance because of increased drag and lower power.

The National Aeronautic Association is of a different mind and voices its opinion: "An aircraft engine muffler involves some loss in performance, but there is no more reason for an airplane to go blasting around unmuffled than there is for an automobile to do so, especially in view of the fact that a plane spreads its noise over a wider area. . ."

Nevertheless there are but few people working on aircraft mufflers and the information regarding them is scanty. The general principle surrounding the mufflers is a simple one of reducing the velocity of the hot exhaust gases before they reach the open air. Momentary cooling in an expansion chamber accomplishes this and so does a series of baffles forming a tortuous route to slow down the noisy gases. The latter system, however, is open to some criticism in terms of lost efficiency and so on. Other exhaust silencing attempts by means of sound absorbing materials and acoustic filters to take out the more irritating frequencies have been discarded as too heavy or impractical.

In the case of larger aircraft, it is possible to put a portion of the exhaust energy to a useful purpose by using it to turn turbine superchargers. When this is done, a noticeable reduction in noise occurs.

Some of the light-plane manufacturers are now installing mufflers but for the most part their objective is greater passenger comfort rather than less noise for the general public. Ryan Aeronautical Corporation, for example, has produced a muffler for the 65-horsepower Taylorcraft which works on the general principle of expansion and fills two secondary functions in addition to reducing exhaust noise. By using the exhaust heat, this device warms the cabin and raises the carburetor air temperature as is desired by the pilot. The complete unit, built of stainless steel, weighs only eight pounds. In use, it reduces engine noise appreciably and lowers engine power only about 2 percent.

Solar Aircraft Corporation, a well-known manufacturer of exhaust manifolds, has developed a similar three-in-one muffler which lowers the noise level at 25 feet distance by at least 3.5 decibels. Engine speed is reduced only 25 revolutions per minute and some 7000 British Thermal Units are available from the heat exchanger. When installed, two such mufflers weighing a total of 10 pounds are placed on each side of the engine. A short manifold connects each cylinder to a fairly long expansion chamber which is formed to facilitate heat exchange. The heater muffs are in two parts, demountable to expedite inspection and prevent cabin air contamination. A long tail pipe helps in the silencing process and reduces any possible fire hazard.

Both of the above mufflers are for light airplanes. Silencing a small engine of 65 to 100 horsepower does not appear overly difficult, but silencing 2000-horsepower and larger engines promises to be a much tougher nut to crack.

PILOTS CAN HELP—It is because of the tremendous engine power involved in air transport operations that the airlines are often considered the worst noise offender. Since technical solutions to the noise of high-powered engines do not seem readily available, other methods requiring the attention of pilots and traffic-control authorities are mandatory. The Air Transport Association Engineering Committee in one pronouncement says in part: "With propeller noise causing most trouble, the airlines should stress to their pilots the importance of reducing propeller revolutions as soon as possible consistent with safety after take off. They should stress altitude. They should channelize aircraft where possible in the interest of safety to keep them away from the more congested areas."

At least one terminal airport manager has recognized the signs of the times. Archer Armstrong of Newark Airport has presented the airlines with a five-point program that includes all of the foregoing recommendations with strong emphasis on the direction of flight after take off.

All in all, the problem of noise from the skies is a complex one that will require the co-operation of many agencies for solution. About the best that can be said at the present time is that a beginning has been made and that the public tone appears such as to demand that the good work be continued.

COMING CHANGES IN

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

DURING a war economics bows to logistics; then the cost of a metal, for example, may become secondary to its performance, availability, speed of manufacture, and so on. But in peace-time (or even the current reasonable facsimile thereof) the question "how much?" quickly resumes its all-powerful position.

Cost factors have always been decisive in engineering. In the metals field the price and supply of each material profoundly influence the extent of its general use as well as its suitability for a given application. Thus, other materials may be individually stronger or more machinable or more corrosion-resistant, but plain carbon steel remains the basic raw material for manufactured products because it is simultaneously the most abundant and the cheapest engineering metal.

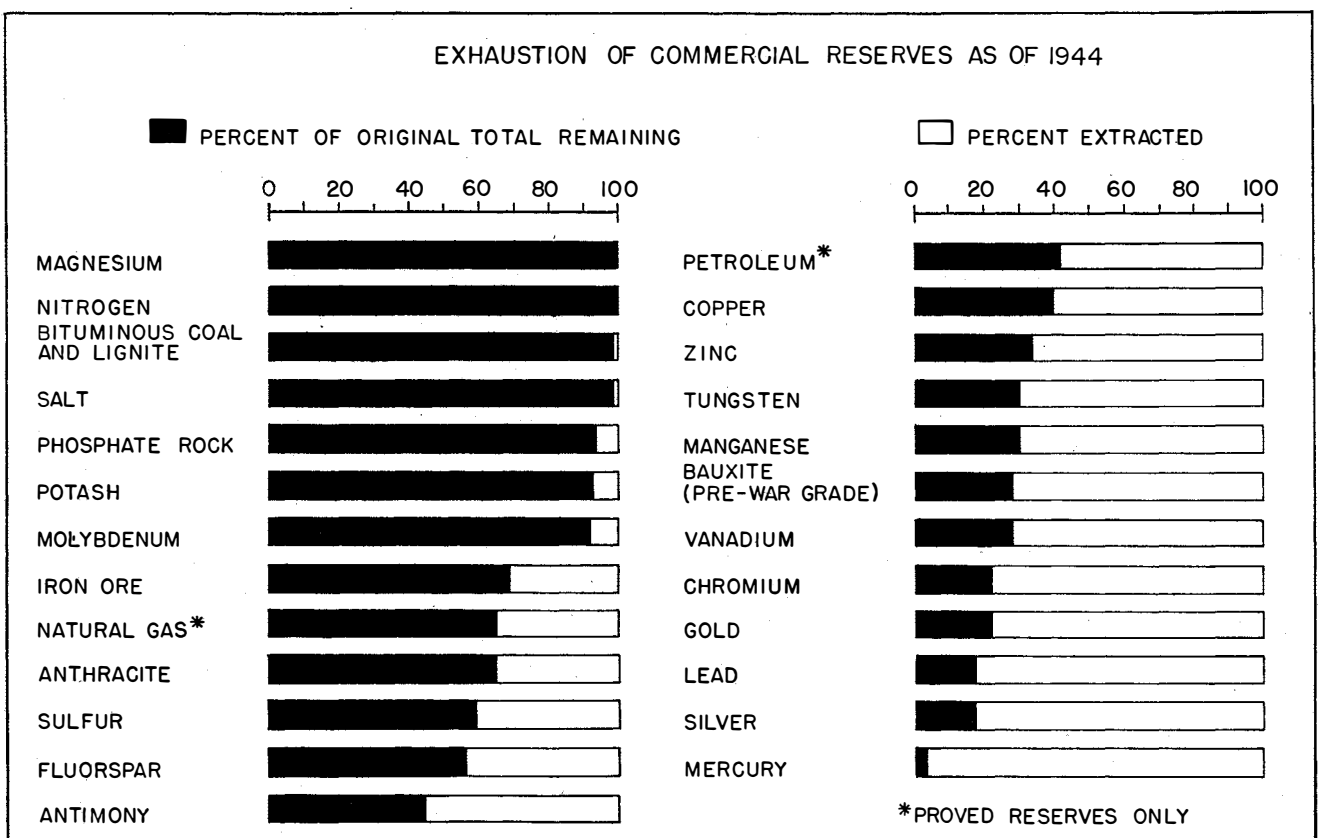
Today manufacturers everywhere are closely watching and studying present trends and impending shifts in total mineral supplies, production volumes, production costs, and demand factors of individual metals, for clues as to what the relative supply and cost factors may be two, five, and ten years hence. Only with such knowledge can products now in the dream or rough-idea stage be most effectively planned from both the functional and lowest-cost standpoints.

TREMENDOUS INFLUENCE—Some of these trends are startling even to expert materials engineers and will certainly exert a tremendous influence on the character of the automobiles, electrical appliances, household goods, hardware and small tools, airplanes, radio and television sets, homes and other buildings, furniture, and the like that will be produced a few years from now.

The trend toward lightness and mobility is certain to find the light metals in a better competitive cost position in 1955 than they are today. Copper, zinc, and lead will likely be more expensive a few years hence than they are now. Steel will be less attractive economically than at present, although certain currently high-priced grades—that is, stainless steels—will be increasingly competitive on a cost basis and the development of lower cost mass-production finishes will aid our present Number 1 material to maintain that position.

The simple depletion—and in some cases the near-exhaustion—of certain mineral supplies is a leading factor in many of these forthcoming fundamental changes. Those that were heavily depleted by the war, such as copper, lead, and zinc, are certain to rise in price.

There are also many metals that will remain doubtful as to availability and price in this country, even when labor and general industrial conditions return to normal. Thus,



Alarming state of depletion of some once-common resources may be vizualized from this graph—the implications to industry are clear

METAL-ECONOMICS

Survey of Trends in the Metals Field Indicates Wholesale Design Changes and a Complete Readjustment of the Thinking Which has Recently Dominated Procurement and Application of Industrial Metals

• LOOKING AHEAD •

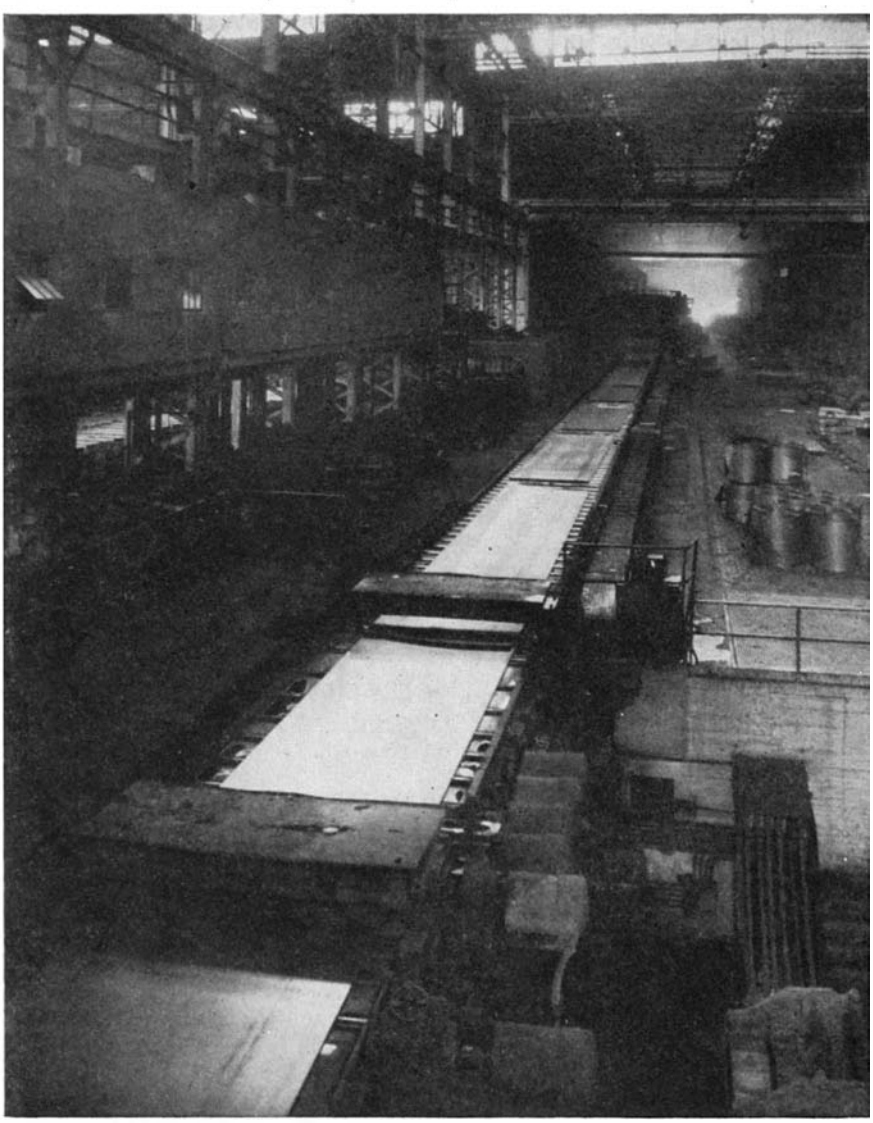
Lowered reserves will throttle certain metals. . . Many costs will climb, but advantages of some higher-priced metals will intrench them firmly. . . Stainless steel, for example . . . Better knowledge of metal-working will influence material choice. . . Steel will remain dominant, but will yield somewhat, in some fields, to the light metals.

for mercury, the United States has only 3 percent of its original resources left; for silver and lead but 16 percent; for gold, 19 percent; for chromium, 20 percent; vanadium, 25 percent; for aluminum, only 25 percent of our pre-war grades of bauxite; manganese, tungsten, and copper are now at 30 percent; zinc at 33 percent. Our iron ore reserves, the most important of all, are at 68 percent. Of molybdenum, potent alloying element in steels, we still have 92 percent of our basic reserves. Only for magnesium has no dent been made in the level of our mineral resources, the magnesium figure still standing at 100 percent by virtue of the inexhaustible supply of magnesium minerals in the ocean.

Tin and nickel are completely imported, the former over long distances and sometimes under the control of countries that may not always be friendly. Although virtually our entire nickel supply originates in Canada, the history and probable future of our relations with that country presage no difficulty whatever with our nickel supply.

But tin has doubtless become a metal which must henceforth and permanently be regarded as "not plentiful" and which may be at an economic disadvantage in this country in the future. This will affect the applicability of tinplate, tin-bronzes, high-tin solders, tin-base bearing metals, and other once-plentiful combinations. Already tinplate is facing intense competition from aluminum and aluminum-coated steel, glass, and other container materials; aluminum, beryllium, silicon, and manganese bronzes are making inroads on the tin-bronze markets; the high-tin solders have failed to regain all the ground they lost during the war; and the tin-base babbitts—still technically supreme—have been permanently replaced in many applications by lead-base babbitts, silver-lead coated bearings, and aluminum-bearing alloys. All of this is chiefly because of the supply or cost position of tin.

PRICE AND VOLUME — Today's price *per pound* of raw material, the traditional basis for economical selection of metals for specific applications, will be less influential as time goes on. The present base prices, for example, of aluminum and copper are close—aluminum around 15 cents per pound and copper 14.5 cents. But many metals are chosen and applied on a *volume* rather than a weight basis. A cubic foot of copper weighs about four times as much as the same volume of aluminum; obviously for products where the material is required to fill a given space, to make up a



Courtesy Republic Steel Corporation

Plain carbon steel from mills like this is still the leading basic metal. In time, its price advantage reduced, lighter metals may challenge steel's throne

specified section-thickness, to provide a covering, and so on, aluminum will be much more economical.

One materials engineer has reduced four common engineering materials to a basis of cost-per-cubic-foot of semi-fabricated material, as follows: aluminum $25; copper $106; magnesium $22; plastics $30 to $35. The strong position of the light metals in this lineup is at once clear, and when the powerful and increasing tendency to make everything light is considered, doubt ceases as to the rosiness of the ultimate future —the coming higher production volume and lower prices—of aluminum and magnesium.

On the other hand, the engineering properties of a high-priced material such as stainless steel are often so desirable as to make it economically more attractive than lower-priced metals. Although stainless steel costs 12 times as much as ordinary steel, it is occasionally found to be a "cheaper" material (say, for railway cars) because its much greater strength and corrosion resistance permit the use of sections only a fraction of the size of conventional steel sections and because the resulting lighter-weight cars cost less to haul and thus save money in power or fuel.

STAINLESS IS DIFFERENT—Again, the workability of a metal has a direct bearing on the economics of its use. Stainless steel is now considered a costly material to process, but actually it is not nearly so hard to handle as many people think and as it once was. As time goes on and better methods are developed, along with the education of the industrial public to the fact that working with stainless is *different,* not difficult, the consumption of stainless will increase and its price will decrease. "Material: Stainless Steel" will be a more common legend on the blueprints of 1956 than it is on those of today.

With labor costs skyrocketing and likely to remain in the upper realms, manufacturers from now on will consider the workability of a metal as one of the most important cost factors in its selection. The major production operation performed on metals is of course machining, so the machinability of a material, especially when translated into power required to cut it, is another important measure of its economic appeal. According to one set of widely accepted figures the power required to machine several common metals is in these proportions: magnesium 1.0; aluminum alloys 1.8; yellow brass 2.3; cast iron 3.5; mild steel 6.3; nickel alloys 10.0. Note again, the favorable positions of the light metals in this procession.

In trying to estimate the probable metal-price trends of the next 10 years, it is also helpful to examine the nature and extent of price fluctuations in recent years. Here again it is found that copper, lead, and zinc have shown a rising tendency, which is expected to continue; the prices of aluminum and magnesium have been falling gradually, with a specific prediction for the latter of a 25 percent decrease within the next five years; and steel of all types as well as cast iron have maintained a surprisingly even price record.

The case of steel is particularly interesting in this respect. Even after the $5 per ton rise early this year, the prices of steel were only 5 percent higher than the 1937 level. (Over the same period hourly wages rose 70 percent in the industry.) The steel industry is so large that its response to broad economic changes is sluggish; if steel prices had been brought into line with other prices, the recent rise would have been $19 per ton instead of $5.

It may therefore be expected that the increase in price of iron and steel products in general over the next 10 years will be smaller in proportion than the increases that may come in some of the other "older" materials. Don't forget, too, that the economics philosophy in the steel industry is much like that in the automotive field, involving the largest possible volume of sales at a small profit per unit, and also that steel will fight hard to maintain its position as the leading basic industrial raw material—all of which will tend to hold down steel prices.

DESIGN CHANGES—When the current international, political, and labor uncertainties are removed from the industrial scene, many materials will return to reasonably abundant supply and their prices will find their proper levels. Look then for wholesale changes in the design of many familiar products, for costs and prices will again become the dominant factors in metal-selection —and the costs and prices of the common engineering metals are likely to be quite different in the future than they have been in the past.

TANTALUM

Found in North America, Will be Available for More Uses

DISCOVERIES of new sources of tantalum near Ross Lake in Northwest Canada now promise more widespread use of this metal which has proved indispensable in electronics, medical, and chemical fields. Tantalum is a hard, ductile metal with high melting point that is resistant to most acids and inert corrosion. It is expected to find favor in high-temperature applications such as jet engines.

Heretofore tantalum has been obtained from Australia, Central Africa, and South America.

CERAMIC-COATED STEEL

Resists Corrosion at Elevated Temperatures

TO PROTECT steel exhaust stacks and similar equipment from corrosion, new ceramic coatings, the key material of which is calcined aluminum oxide, are being applied to both surfaces of the steel. Applied in very thin coats, not over 0.002 to 0.003 inch and at 1600 degrees, Fahrenheit, the ceramic has a dull finish, such as is found in conventional porcelain enamels.

Even when the metal itself bulges slightly from the heat, no damage to the coating accrues. Also, these coatings resist failure under repeated thermal shock, protect against oxidation at 1250 degrees, Fahrenheit, resist cracking and blistering, and produce no glare.

A few of the applications will be automobile exhausts, stove parts such as inner liners of oil space heaters, burners on gas ranges, coatings for heating furnace tools, and pipe in natural gas fields that must resist hydrogen sulfide.

HEAT TRANSFER UNITS

Achieve High Efficiency With Light, Compact Structure

NEW METHODS of fabricating heat-transfer equipment, originally developed for airplane use, now make it possible to produce units that are not only very efficient but are also extremely compact and light in weight.

The production process employs wafer-thin sheets of aluminum, stamped to form a series of half tubes on their faces. When two such sheets are fastened together by a special brazing process, a complete tube arrangement results. Sheet pairs are then assembled in groups so that a series of many tubes are formed into an air-tight unit arranged so that air passes through the tubes and over them as well.

The original use as an aircraft radiator is expected to lead to many applications in heating, air-conditioning, and related equipment.

Atomic-Bomb By-Products

Nuclear Knowledge, Even In Its Present Stage, Embraces a Wealth of Practical, Usable Material. Industry Will Benefit—Of This There Is No Doubt. Decentralization, Based on Atomic Power Plants Where Ordinary Power Plants Cannot Go, May be One Important Ramification

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

• LOOKING AHEAD •

A host of new synthetics when isotopes show "how" as well as "what" happens in reactions. . . Future city sanitation plants operating on atomic power. . . Power for industry where coal, oil, and cooling water are not available. . . Greater use of "micro" research techniques to lower experimental costs. . . New instruments and devices borrowed from nuclear laboratories.

FIRST fruits of atomic "peacefare" are already being harvested. Using the same techniques that produced the bomb, Clinton Laboratories at Oak Ridge, operated by the Monsanto Chemical Company, are now turning out radio-active isotopes to the number of almost a hundred.

When chemical substances are subjected to the bombardment of neutrons escaping from disintegrating uranium 235, they absorb some of these neutrons and form unstable atoms. Such atoms behave chemically just like the stable normal atoms, entering into the same reactions and forming the same compounds. But, and this is the important difference, they can always be detected by virtue of their own slow but continuous disintegration during which they emit particles and high-energy rays. Minute quantities of radio-active isotopes have been made for years by the cyclotron, a very complicated and expensive piece of apparatus, but the uranium pile now produces quantities sufficient for extensive research.

Much has been written about the use of radio-active materials for medical research and therapy. Vitamins, amino acids, and other essential fuels for the human machinery can be traced through the system by incorporating radio-active atoms in their molecules. The question of what happens to the sulfur in the eggs we eat can be answered by tracing a synthetic sulfur-containing amino acid made with radio-active sulfur through the body. Similar studies in nutrition, metabolism, drug action, and the like can be made with radio-active carbon, phosphorous, iodine, and other elements. Eventually these radio-active materials may be used to treat diseased tissues just as radium is used to treat cancer, but initially, at least, they will yield their greatest benefits as tools for finding the causes of disease.

INDUSTRIAL VALUES—The medical aspect of isotope usage has been so stressed that benefits to industry have virtually been overlooked. Many of the chemical products that are taken for granted—plastics, synthetic rubber, high-octane gasoline, to name a few—are formed by chemical processes which are relatively mysterious. The isotopes, because they are atom-sized "observers," can help to clear up the mysteries. Entering into a molecule to be swept into the reaction zone, they can "sit" on a molecule of catalyst for a moment and emerge again in a totally different type of molecule, thus telling continually where they are by means of their constant, detectable radiation. It is easy enough to find out what happens when certain chemicals are brought together; it is far more difficult, usually, to tell how it happens. With the new knowledge that radio-active isotopes can provide, industry shall undoubtedly be able to design better equipment, discover more favorable operating conditions, and thereby direct the course of reactions into the most useful channels.

Other industrial benefits of radiation chemistry were described to the recent American Chemical Society meeting by Dr. Milton Burton, of the University of Notre Dame. He envisioned the city of the future operating its entire sanitation system as part of an atomic-energy plant—sterilizing its water supply, cleaning its waste, and producing new products from the by-product radio-isotopes.

Also, Dr. Burton thinks that the new materials may lead to new chemical processes, including the production of new polymers, both organic and inorganic; low-temperature cracking of petroleum oils; and more effective chemical use of some of our inefficiently employed natural resources. One possible wide application is the industrial use of "cold

RADIO-ACTIVE ISOTOPES NOW AVAILABLE

Accredited institutions for fundamental scientific, clinical, and technical research can now obtain useful quantities of C, Na, P, S, I, and other less common radio-active isotopes from Isotopes Branch, Research Division, Manhattan District, Oak Ridge, Tennessee.

Requests must be made through a recognized institution and the results of research must be published. Further details will be found in the accompanying article.

light"—the kind that lights up luminous watch dials—instead of incandescent light. A biological possibility is the production of animal and plant mutations. Thus the geneticist might accomplish in one generation what would otherwise take generation after generation of patient breeding.

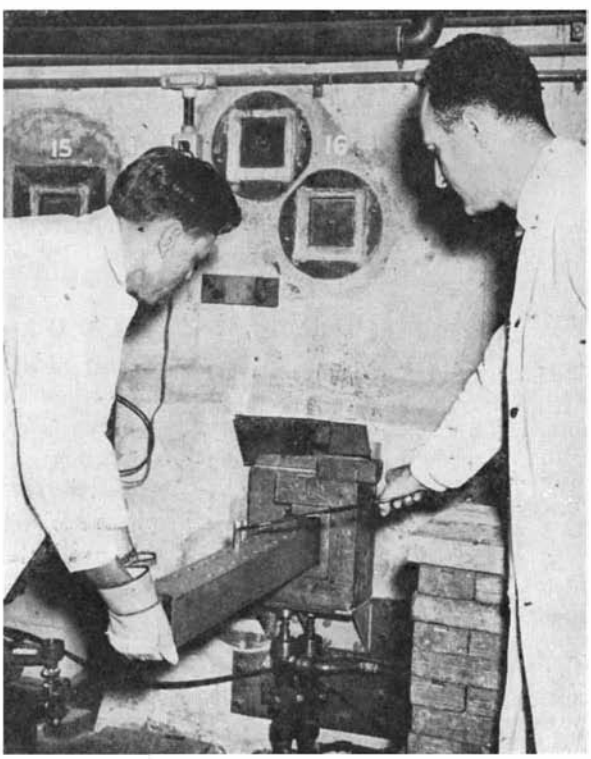
New chemical reactions are a definite possibility, Dr. Burton asserted, because nuclear radiation is essentially of the same type as ultra-violet light or X-rays. Just as the latter agents promote certain chemical reactions, so might the more powerful and penetrating nuclear radiation.

ISOTOPES AVAILABLE—Not all of the hundred or so isotopes are equally available; their availability depends upon to what extent they are produced in the pile reactions; how well they can be isolated from other reaction products; and how stable they are. Fortunately, among the more easily obtainable are the particularly useful isotopes of sodium, carbon, phosphorous, iodine, and sulfur. These are being sold at "out-of-pocket" cost to qualified institutions with the stipulation that results of research using the materials must be published. Fundamental research and human applications have first priority, followed by educational uses and applied research in that order.

The paucity of isotopes from the earlier cyclotron processes limited the scope of the research done and the number of persons who could use radio-isotopes. Nevertheless, many important results, particularly in biology and medicine, came from their use. Now, with the prospect of radio-active isotopes being made available on a large scale, even more important advances in all sciences can be expected.

No phase of atomic energy except the bomb itself has fired the public's imagination more than the attractive possibility of cheap, ubiquitous, and omnipotent atomic power. Scientists are becoming a little weary of all the glowing prophecies—automobiles with a fist-sized atomic engine, traveling from New York to Hollywood on a lump of uranium the size of a pea; rockets sizzling to Mars on a blast of nuclear disintegration.

ATOMIC ECONOMICS—Such fantastic seeds of prophecy may bear fruit someday, but even now atomic power, as a present reality, is a force to be reckoned with. Dr. Charles A. Thomas, vice president of Monsanto Chemical Company and project director of this firm's Clinton Laboratories, told an American Chemical Society meeting recently that "a 75,000-kilowatt atomic energy plant could be built in the eastern United States for about $25,000,000. On the assumption that the plant would operate at 100 percent capacity and that interest charges on the investment would be 3 percent, the plant could produce power at approximately 0.8 cents per kilowatt hour. This figure has been computed by different groups of engineers working independently.

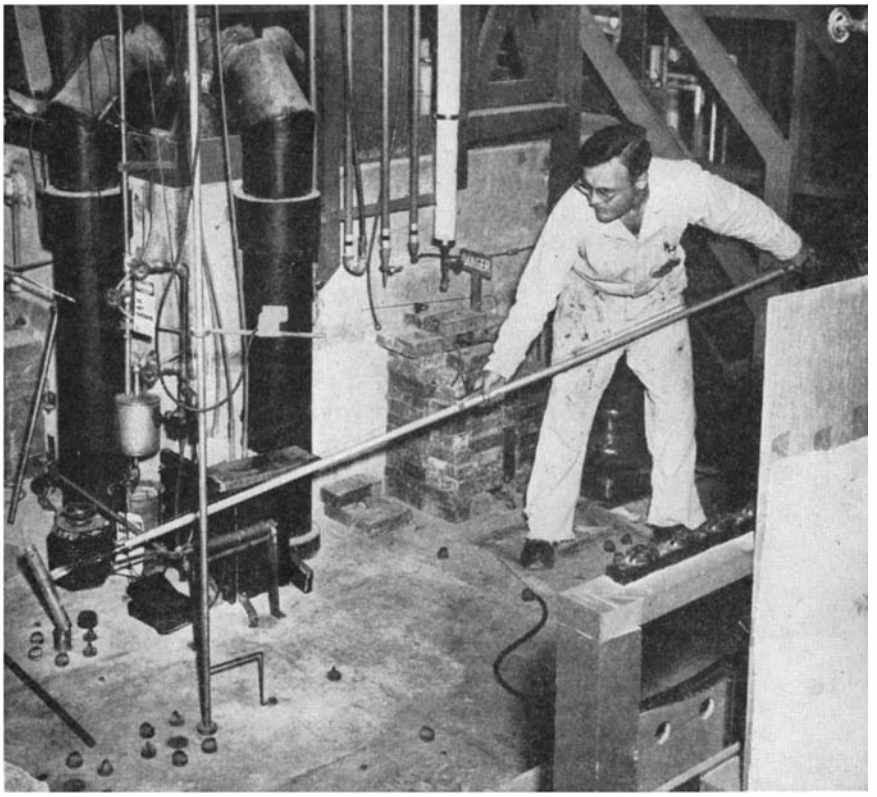


At start of neutron bombardment (right) sample of the material to be made radio-active is inserted in graphite carrier block to be pushed into center of the uranium "pile." To remove material (below)—now radio-active—carrier block is pulled into lead shield to protect workers. Girl at right checks on radiation of sample. In both cases pile is inoperative while hole through shield is open

All illustrations Official United States Army Photographs

"A coal plant of the same output would cost $10,000,000. Assuming capacity operation and the same interest charge on the investment, power would cost 0.65 cents per kilowatt hour with bituminous coal delivered at seven dollars per ton."

For those who question the value of such a project if atomic power cannot compete in cost with conventional sources, a logical answer is available. Coal accounts for about 60 percent of the operating cost of a power plant, and the cost of coal and fuel oil has increased greatly since the war and shows signs of continuing upward. If coal cost should reach $10 dollars per ton, the costs of coal



Highly-active isotopes must be processed in special "hot" laboratories. Here, operator quickly drops sample through the roof of a heavily-walled concrete room where further treatment can be accomplished safely by remote controls

power and atomic power would be equal. Atomic power, on the other hand, is in an initial stage of development. Lower costs are dependent on successful solutions of numerous technical, operating, maintenance, and labor problems; but it seems reasonable that further exploration of the field will result in the standardization of design and construction, and a material reduction in investment and operating costs.

But atomic power should not be considered merely as a competitor of existing power sources, Dr. Thomas pointed out. "It is not altogether a case of nuclear power versus coal, gas, oil, or water power because the nuclear power plant has advantages and fields of application not open to other types of power-producing plants. Atomic power will not supplant but supplement our conventional power production."

It is predicted that the first atomic power plant will resemble an ordinary steam power unit. The turbines, electrical generators, and transmission lines will be of conventional design, but the furnace or boiler will be replaced by a chain-reacting pile, which must be heavily shielded to protect the operators from lethal radiation. A cooling fluid—possibly liquid bismuth—will flow through the pile to pick up the heat produced therein. Since this fluid will be highly radio-active, it will undoubtedly be awkward to use it directly for electric power generation or as a heating medium. Accordingly, a heat exchanger will be used to transfer the heat to water or gas. If water is used, it will be converted to high-temperature steam which can be used without danger in conventional turbines.

ATOMIC POWER PLANTS—Three broad applications for atomic power were outlined by Dr. Thomas: "Nuclear power plants would make feasible a greater decentralization of industry, a desirable factor in the world economy. Only a trivial amount of fuel need be brought in, and the need for a large cooling-water supply might be obviated by the development of gas turbines. Because nuclear plants lend themselves to decentralization, more economical industrial combinations should develop.

"The nuclear power plant," Dr. Thomas continued, "will aid in the industrial development of isolated parts of the world where the cost of oil, gas, or coal is prohibitive and where a supply of water is unavailable. This is possible, for a nuclear power plant, if combined with a modern gas turbine, will make unnecessary a supply of any such fuels or cooling water.

As for the third field: "The nuclear power plant, in connection with the modern gas turbine, might be desirable as an operating or standby plant, to existing large utilities. Unlike hydro-electric power plants, nuclear power plants are able to supply process and heating steam directly in addition to power."

Such plants, it was pointed out, might be integrated strategically with present utility systems to reduce the cost of power transmission and insure partial operation of the system in the event that the standard power stations were inoperative. The problems in the construction of an atomic power plant appear difficult, Dr. Thomas ceded, but not insurmountable.

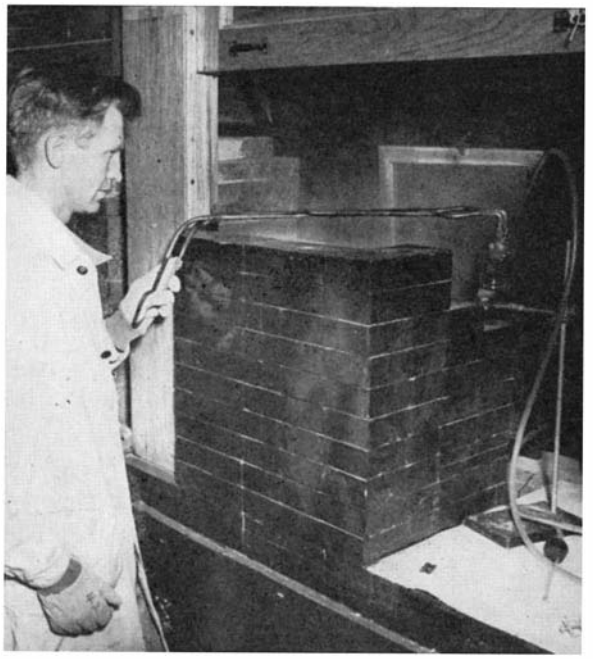
INDIRECT BENEFITS—So far the direct benefits of nuclear fission, radio-active isotopes and atomic power, have been considered. In the near future it may also be possible to enjoy some of the indirect profits of the Manhattan District work.

Among these profits are the new techniques and new equipment which had to be devised to solve the unprecedented problems with which the atomic scientists were confronted. In order to weigh accurately the infinitesimal amounts of some of the radio-active materials available, for example, an ultra-microbalance was developed which may be useful in micro-chemistry. Also, the great amount of work with uranium hexafluoride gave impetus to the rapidly expanding field of fluorine chemistry, leading to the commercial production of the gas and many of its useful compounds. In the process of declassification are new chemical products and new equipment designed to facilitate production of fissile materials. Many of these will undoubtedly find use in non-atomic chemical engineering.

Perhaps one of the more unusual contributions of the Manhattan District will be to the philosophy of chemical engineering itself. The atomic scientists designed and built a full-scale atomic plant on the basis of data obtained from micro test-tube experiments. It might be most uneconomical for industrial chemical companies in general similarly to abandon pilot plant procedures, but the same ingenuity that made possible the remarkable feats at Oak Ridge and Hanford may alter the conventional conception of pilot plants and lead to more intelligent engineering.

Some of the peace-time benefits of atomic energy described are already available; others will take years of patient work by men who know what they are doing.

In order to provide such men, Monsanto Chemical Company has started a one-year training course for a selected group of 35 scientists



Radio-isotope sample, too small to be seen in beaker, is dryed in this "semi-hot" laboratory where materials not excessively radio-active can be processed safely in well-shielded and well-ventilated hoods. Mirror allows operator to view sample; long tongs, gloves, and smock are necessary for protection

and engineers. Representing both industrial research institutions and leading universities, the group will participate in the research and development program of Clinton Laboratories as well as study nuclear physics and radiation chemistry. The program will be continued if the first course is successful.

As a result of their studies these men should be prepared to carry on atomic research in their own laboratories, delving into the mysteries of this comparatively infant science and bringing to fruition the incalculable benefits that now lie latent, waiting only for discovery.

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FLUORINE

Marketed for First Time—In Pressure Cylinders

MOST chemically active element known, flourine has now been put on the market for the first time. The gas is available in steel, pressure cylinders on a limited commercial basis for experimental use by manufacturers and researchers.

Hundreds of uses for fluorine may become possible with the availability of it in its elemental form. One of these uses is as a non-flammable, non-toxic liquid with a high enough boiling point and specific gravity to replace mercury in the present mercury-vapor boiler, thus making the efficient vapor engine practical and safe. Another use is for a gas, already developed but requiring elemental fluorine to manufacture, which is a nearly perfect insulator for the high voltages used in X-ray and nuclear physics. Also possible is the development of a lubricating oil so stable that it will not oxidize or break down under any present engine or mechanical operating conditions and which will make possible gears and engines heretofore only dreamed of by designers.

Other uses for fluorine compounds now definitely within the realm of possibility include heat-transfer and dielectric media, more effective insecticides, fungicides, fumigants, germicides, stable solvents, anesthetics, fire extinguishers and fireproofing materials, resins and plastics, and weed killers.

The rapidity with which fluorine combines with almost all other elements—it will burn both glass and water—has been the greatest stumbling block to its isolation and research on its use. But the great stability of most of its known compounds is perhaps their chief value. Freons, widely used as refrigerants since 1930 and as the propellant for insecticides in the "bug bombs" used by the thousands during the war, demonstrated this. Dyes made from fluorine compounds have unusual brilliance and color fastness.

The biggest problem in the project of making fluorine commercially available was packaging the gas after it was manufactured. The fact that steel and copper will resist fluorine corrosion well at normal temperatures was a great help, but detailed research was necessary to develop gaskets to make the present containers leak-proof and safe. A comparatively small amount of the gas is packed in each cylinder at present — one-half pound at 400 pounds pressure.

The gas is produced by the Pennsylvania Salt Manufacturing Company in an especially designed electrolytic cell containing potassium fluoride and hydrogen fluoride at about 100 degrees, Centigrade. The products of this electrolysis are hydrogen and fluorine. A special diaphragm extending into the electrolyte is necessary to prevent these two gases from combining explosively. Another problem in manufacture is the complete elimination of water from the cell, since in its presence the process gives off oxygen instead of fluorine.

WILD GINGER GERMICIDES

Said to Compare With Penicillin, Compositions Unknown

AT LEAST two substances shown to be highly germicidal have recently been extracted from wild ginger, which grows over most of the northeastern section of this continent from New Brunswick to North Carolina and as far west as Manitoba, Missouri, and Kansas. Research workers C. J. Cavallito and J. H. Bailey, of the Winthrop Chemical Company, have found two substances, present in this plant to the extent of about 20 parts per million, which have been shown on preliminary tests to have powerful bactericidal effects on pus-forming organisms. The substances apparently do not harm the common intestinal organisms.

The discoverers state that the effectiveness of the new compounds, whose natures and compositions are not yet known, is of at least the order of magnitude of penicillin, if not actually greater.

COAL MINES

May Become Power Plants With Fires Underground

INSTEAD of being removed from the mine, coal may be burned at the source to produce power in the future, according to Professor Roger Adams, head of the Chemistry Department, University of Illinois. "Just as sulfur is melted in the ground and pumped out in liquid form, it is not too fantastic to believe that with cheap oxygen, such as has been discovered in the Soviet Union, coal may be burned in the mine," states Professor Adams.

"The heat generated in the gases and the subsequent burning of the carbon monoxide would provide the power for a utility plant near by," he explains. "The carbon monoxide might also be reduced to petroleum. With the present conditions in the coal industry, investigations of this kind may be stimulated which, by past experience, generally result in inventions or discoveries for replacement of labor by mechanized processes."

Emblematic of the wet-strength paper's toughness are these bags to be stored in a damp mine, then packed with moist sand as a backing for explosive charges

Paper Gets Webbed Feet

Paper's Renowned Weaknesses When Wet have Long Prevented Its Use In Many Packaging Applications. Now, the Addition of Resins to Pulps Permits the Manufacture of Bags that Can Go Swimming if Necessary

By WARREN L. BASSETT

To THOSE persons who have had a wet milk bottle soak its way through the bottom of a paper bag, news of paper with high wet-strength will be welcome. It will be even more welcome to the manufacturer who must pack a water-damageable product with the full knowledge that somewhere along the line carelessness or necessity will probably result in his containers being exposed to the elements. Backing this news are records proving that such substances as sugar, flour, and other perishable products in bags made of this remarkable paper have been stacked in the open by the tons—without damage from rain, snow, or steaming tropical humidity. In some areas where standard ship unloadings are impossible, it has even proved practical to dump the paper-bagged merchandise bodily into the ocean. The bags hold together without difficulty and eventually the cargo drifts ashore.

RESIN BINDERS—The secret behind these extraordinary performances of paper lies in synthetic resins, plus perfection of multi-wall bag construction.

Urea-formaldehyde or melamine resins, when added to paper pulp while it is still suspended in water, adheres to the paper fibers, subsequently binding them tightly together. The resultant sheet, even when soaked with water, retains a high percentage of its dry strength, and does not break. Moreover, it regains its full strength when dry. Its tensile and bursting strength are increased, as is also its folding endurance; it develops a high resistance to scuffing, or rubbing, whereas ordinary paper, when wet, breaks or rubs through readily.

The first application of resins to the paper industry took place just before the war, with the result that when the supply of wood, metal, textiles, and glass for packaging became scarce, this new type of tough, strong paper was available. The Army and Navy requisitioned nearly 100 percent of production, and it was used in many combinations with other types of paper to produce containers which were not only water-proof, but also grease-proof and corrosion-proof.

Called "wet-strength" paper by the industry, this product today is causing a revolution in many industrial and retail packaging methods, and has opened up scores of new fields for paper and paper products. It is, for example, being extended to such ordinary paper articles as toweling, tissues, diapers, blueprint paper, shelf and wall papers, and many others.

Paper toweling treated with resin is much stronger, and does not disintegrate in the hands. Thus it takes less paper to do a hand- or face-drying job. But it is in the fields of industry and merchandising that wet-strength paper, in the form of multi-wall shipping sacks and various bags for retail use, is making its greatest strides. The jobs this paper

• LOOKING AHEAD •

High-flavor foods bag-packaged without loss of volatile essences. . . Better brand identification for produce now sold in bulk. . . Longer wear for bank notes, business papers, and roughly handled blueprints. . . Reduced shipping losses through water damage. . . Less freight car and warehouse contamination from leaking bags.

is doing are not glamorous, but they are of tremendous importance to the industries involved, representing advances in speed, efficiency, and economy over previous practices. As a result, paper bags are replacing rigid containers in many industries.

MULTI-WALL BAGS — Packaging experts estimate that today more than 300 commodities are being shipped from plant to consumer in heavy-duty, wet-strength multi-wall shipping sacks constructed of as many as six plies of paper, often bound together with asphalt laminations. These commodities cover a broad field of "loose solids," such as flours, sugars, salts, powdered chemicals, fertilizers, cement, and so on, which are required to be handled out of doors under all types of weather conditions.

Multi-wall bags are custom-made for each product after careful study of its properties, the type of protection it needs, and the conditions under which it is shipped and used. Exhaustive laboratory and shipping tests are made until the right bag is found. Such experiments are necessary because of the many functions a multi-wall bag can be made to perform. In addition to protection of the contents from absorption of atmospheric vapor, and vice versa from loss of essential moisture, such bags can offer protection from damage by water for as long as 24 hours of immersion, and for much longer periods when subjected to spraying by water.

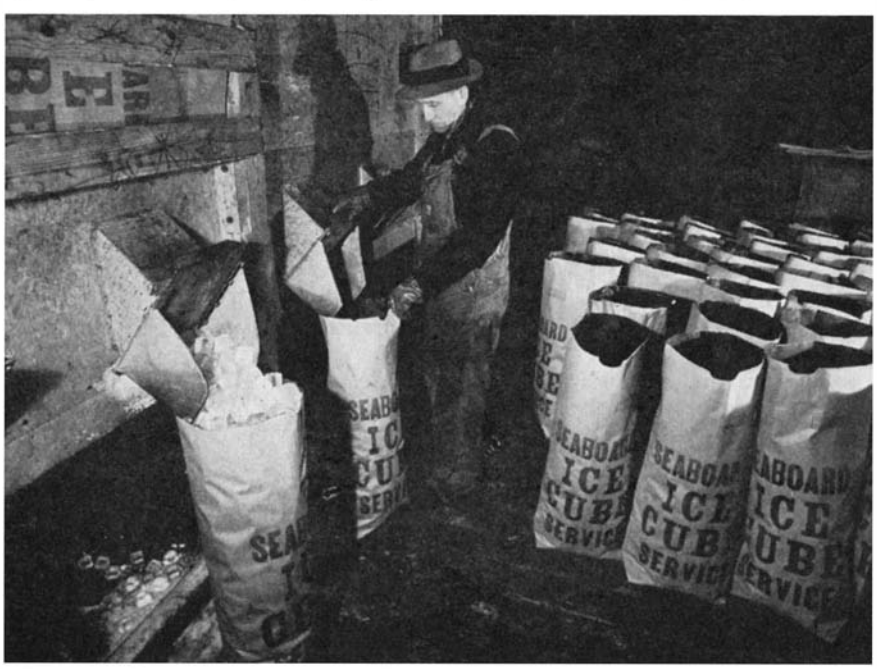
Equally vital may be avoidance of loss of flavor or essential oils, as well as contamination from other matter outside the package. Frequently, bacterial contamination and insect infestation are included in the latter. Some products require prevention of seepage or penetration because they are put into the bags in liquid form, and sifting which might occur with finely powdered products—of particular importance when the powder is toxic—must be eliminated.

Other important factors include resistance to abrasion and scuffing from the outside, and undue wear from contents when they are sharp, gritty, or coarse. In some cases, provision for easy stripping of the bag from the contents, such as asphalt, synthetic rubber, and so on, which are put in the bags in liquid form and later harden, must be made. And almost always the quality of being easy to stack neatly to any practicable height is a requisite.

So rapidly has the use of multi-wall bags spread in industry that they are being produced at a rate of better than one billion a year by the paper industry. And new uses are constantly being found. Only recently large meat packing plants started to ship meat trimmings—for conversion into ground meat and other products—in multi-wall bags of wet-strength paper provided with special liners for protection of the product from contamination.

RETAIL REVOLUTION—Just as interesting are the important changes being brought about in the retail field by wet-strength bags. The newest trend here is toward pre-packaging, which means delivering to the merchant a commodity in a package of retail size which he can sell without further weighing or handling. This has been found to reduce both costs and waste, and in many instances to increase sales, because the products can be easily and quickly picked up by the customer.

Paper containers that don't weaken when wet are ideally suited to packaging frozen foods or ice cream (right). Wet-strength bags (below) were responsible for a new business since ice cubes could be stored in them indefinitely for delivery to the customers whenever they are needed



In the food field, for example, a newly developed wet-strength bag, made by Union Bag and Paper Corporation, is altering the merchandising of fresh fruits and vegetables because it permits them to be prepackaged in take-home quantities while they are still wet from washing or refrigeration. This bag is fitted with a window of cellophane through which the contents can be seen by the purchaser. Pre-packaging of some staples such as oranges, dried peas, walnuts, and so on, is not new, but heretofore it has never been possible with fresh produce because of exterior wetness or mois-

ture content. Another big obstacle was the fact that ordinary bags completely enclose their contents, making the purchaser feel he is getting a "pig in a poke." Through the windows of the new bags, however, shoppers can see the quality of the products they are buying.

The bags reduce waste because 100 pounds of produce, pre-packaged and priced at so much per bag, bring the full price for 100 pounds, whereas 100 pounds of the same produce, sold by clerks from open counters or bins, suffer a large loss through overweight selling, shrinkage, and spoilage. Bruising through pinching and handling by customers is also eliminated. Prompt packaging while the produce is still fresh is also a large factor in the reduction of waste, since over-ripe specimens are eliminated before they can contaminate others.

The new bags speed up sales because they remove fruits and vegetables from the slow, individual, clerk-sold category to the quick shelf, or self-service field. Application of color printing to the bags, often including an attractive replica of the product they contain, enhances eye-appeal, and permits store and brand identification to be placed where they will convey their messages most effectively.

Another wet-strength bag, minus the cellophane window and resembling the ordinary kraft grocery bag, has solved an old and annoying shopping problem. It is being widely used by retail stores to package cold milk, beer, and other beverage bottles which "sweat" their way through a regular bag. It is also being used for cartons of ice cream, frozen-food packages, and many other wet or damp objects.

PAPER MATCHES PRODUCT — Other types of wet-strength bags made, in many cases, to the user's specifications, are now packaging a wide variety of products, including potatoes, onions, ice cubes, coal, charcoal, charcoal briquets, greenhouse plants, dog food, and many others which have a high moisture content, which are packaged, shipped, or stored under conditions of rain or high humidity, or which are wet or moist when packaged.

This year millions of pounds of potatoes are going to market after being cleaned, graded, and prepackaged at the shipping point in wet-strength bags of 10-, 15-, and 50-pound capacity—the popular quantities—which supermarkets and other stores can offer directly to the public without further handling. The bags absorb and dissipate—without breaking—the moisture from bruised or broken potatoes and, what is more important, the condensate moisture which drips from the roof and walls of cars due to the sharp humidity changes which often occur between shipping points and the terminals.

In the ice industry a new and profitable service is being built on wet-strength paper bags—the sale of cracked or cubed ice, in various weights up to 50 pounds. A number of companies are now offering this service to restaurants, hotels, bars, and large group entertainments which find themselves short. Deliveries are made on recepit of a telephone call, and the filled bags are stored in bins until needed.

Coal and other shaft mines have also discovered the wet-strength bag and are using it in large quantities in the shape of tamping bags, made up in sizes varying from 1¼ inches by 12 inches to 2 inches by 18 inches, according to the size of drill. They are filled with sand and tightly tamped in behind dynamite charges so that but little of the force of the explosion is lost through the drill hole. The bags withstand both the filling process with damp sand, which takes place in the depths of the mine, and storage in the damp, humid atmosphere there.

In pondering the uses of wet-strength paper, an industry expert recently drew up a list containing

115 possibilities. Not all of these have been fully explored, but some of the more interesting include advertising posters, bank note papers, bed sheets, pillow cases, Bible papers, chart paper, cigarette paper, decalcomania paper, diploma parchment, innersole board, lithographic paper, leatherboard, music manuscript and music roll paper, photographic papers, seed-germinating paper, obstetrical sheet, shopping bags, tea-bag paper, and tree-wrap paper.

Because paper is still in short supply, and likely to continue so throughout 1947, the industry champs at the bit when it considers the possibilities of wet-strength paper. Already faced with a demand it cannot supply, it knows that present applications have barely scratched the surface. But research goes on; new and unusual applications of this product can be expected in the future.

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RADIANT MURALS

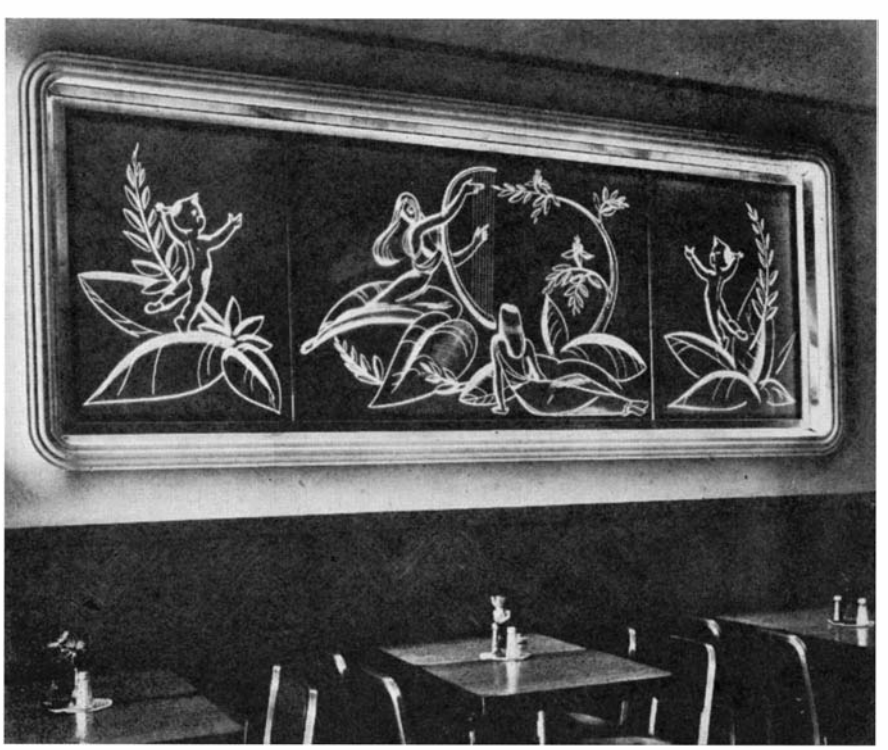
Use Plastics "Light-Piping" Ability to Achieve Effects

A NEW decorating medium, "painting in light"—the use of luminous walls, murals, and pictures—provides both illumination and decoration without the use of conventional lighting fixtures. Designed for homes, hotels, restaurants, and theaters, the new wall decoration is based on the "light-piping" property of Plexiglas. Light, introduced at the edge of a Plexiglas sheet, will travel indefinitely within the sheet until it reaches an engraved or painted design, which releases the light to the surface and hence into the room. Thus, designs scribed, etched, or painted on a plastics sheet become luminous and glowing, offering decorators, architects, and muralists a new decorative material with infinite possibilities.

The murals used in one such installation range in size from 30 by 40 inches to 36 by 48 inches. Each mural is individually mounted in a shadow box, and illumination is furnished by fluorescent tubes mounted within the boxes. The murals act not only as decorations, but as light sources to supplement ordinary room lighting.

Another possibility, three-dimensional murals, have been found especially effective in large rooms. They are produced by engraving parts of the design on two or more sheets of Plexiglas which, when assembled, produce an entire scene. The edge of each sheet is colored as desired, and when edge-lighted the complete scene appears in light and color as well as in three dimensions.

Almost endless variations for this process have been demonstrated. If desired, some of the engraving can be placed on front and back of all but the front sheet. The back surface of each sheet reflects more light but the reduced brilliance of front-surface reflection may be useful in certain designs. Paint and engraving may be combined for still further modification of the result. The distance between the sheets may be varied or each of the sheets may be of different thicknesses. In some cases, according to the Rohm and Haas Company, the designer may find it desirable to cut out sections from one or more of the sheets. If color is added to the edge thus formed, light of pleasing tint may be thrown on some other part of the design.

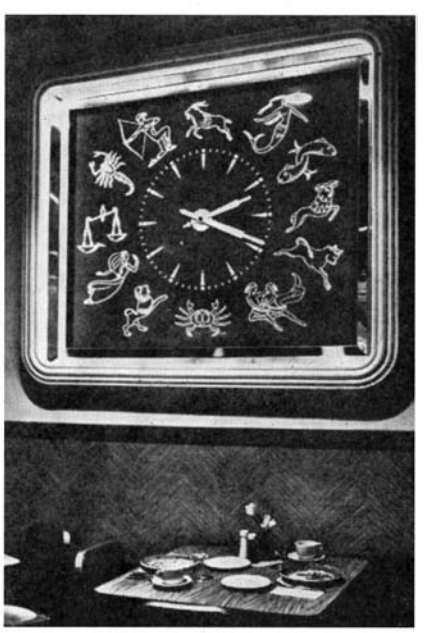


Glowing uniformly against an opaque background, engraved designs in these acrylic plastics panels are lighted from concealed sources at their edges

COLOR CHANGE

Reveals Temperatures In Gas Turbines

THE GAS turbine, which has thus far literally refused to have its temperature taken, has now been forced to take its own temperature through use of a special metal alloy. The alloy shows a marked color change for every 25 degree change in temperature from 500 to 700 degrees, Centigrade, then reverts back to its original color and begins the color scale over again in a higher



range of from 725 to 900 degrees, Centigrade.

Believed to be the highest temperature ever recorded accurately inside a gas turbine, such intense heat would amount to 1652 degrees above zero on an ordinary Fahrenheit thermometer, were it able to record that high.

The temperature-taking alloy, according to General Electric engineers, turned the tables on the gas turbine after practically all types of complicated temperature measuring devices had failed to record faithfully the intense and varied

heat created by the turbine wheel, which whirls more than 1000 miles per hour.

By making turbine parts of the alloy, the turbine has no alternative but to take its own temperature. Following operation, the turbine has to "show its colors," and by doing so also has to show the temperatures that were reached by its parts during operation.

A chrome cobalt composition, the alloy changes color like most metals when being oxidized under heat. Unlike other metals, however, this alloy oxidizes so slowly at higher temperatures that each color change occurs regularly at 25 degree intervals, thus permitting actual graduated color scale according to temperature. At 500 degrees, Centigrade, it turns a light straw color, at 525 a straw color, at 550 a bronze color, at 575 purple, at 600 dark blue, and so on. At 700 degrees, Centigrade, it turns light blue and according to all precedent, it next should turn grey, indicating the end of the color scale.

Instead of turning grey, however, the alloy at 725 degrees, Centigrade, reverts back to a light straw color and begins the progression of colors over again.

WOMEN CHEMISTS

Cited for Good Work, Discrimination Held Shortsighted

REPORTS of discrimination against women in the chemical profession are now being heard, according to the American Chemical Society. "Now that the war is over certain organizations are replacing women chemists with men," says *Chemical and Engineering News*, a publication of the Society. "Further, some concerns are discriminating against women in recruiting new professional personnel. This is both an unfair and a very shortsighted policy." The journal continues: "It is our considered opinion that the entrance of relatively large numbers of women into the chemical profession has had a most beneficial effect. The country is and will continue to be short of competent chemists. Old-fashioned prejudices should be cast aside and applicants judged solely on their training and competence."

ICAROSCOPE

Uses Phosphor Screen to Show Planes Against Sun

A DEVICE which enabled pilots to spot enemy airplanes speeding toward them directly in line with the sun was recently revealed under the name "Icaroscope," when Dr. Brian O'Brien, professor of optics and physics at the University of Rochester, described the telescope-like instrument before a meeting of the Optical Society of America. Named after the Greek mythological Icarus who flew too close to the sun, the Icaroscope takes advantage of what is known as afterglow in a phosphor screen which stores up energy when excited by radiation of short wavelengths or high energy particles. In the Icaroscope as used by Navy pilots it soaked up sunlight.

The image, such as an enemy plane in bright sunlight, is formed on a transparent phosphor screen while the screen is hidden from the eye. A double rotating shutter then closes off outside light and the pilot sees the image 1/100 second later. By this time the brilliance of the sunlight on the phosphor screen is only 20 to 50 times that of the surrounding sky as compared with the sun's real brightness which is 10,000 to 100,000 times that of the surrounding sky. The result is that a plane can be seen on the screen silhouetted against either the sun's disk or the brilliantly illuminated surrounding sky.

The disks are rotated by an electric motor at about 100 cycles per second so that the viewing appears to

be continuous as in a high-speed motion picture camera. The instrument was used extensively in observing and photographing the Bikini atom bomb tests.

AIRPORT RUN-ABOUT

Carries Freight or Passengers Quickly and Economically

A NEW motorcycle and trailer combination is now being used for quick pick-up and delivery of freight, as an "errand boy" around the field, for transport of personnel, and for other airport jobs. Equipped with vacuum brakes, the trailer has a capacity of 180 cubic feet, weighs 900 pounds, and will carry a load up to one ton. The rails of the trailer pull down, forming seats to accommodate 10 people. With an ordinary load, the Indian motorcycle averages about 50 miles to the gallon. The combination is used by Air Freight, Inc.

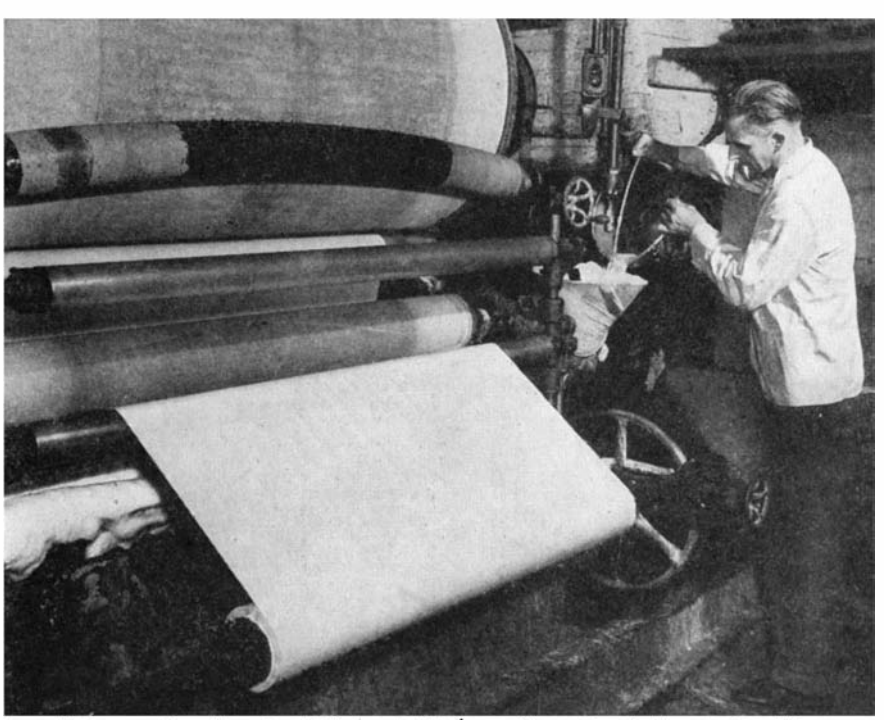
Shown here as freight carrier, trailer is quickly changed for passenger use

NEW FABRICS

Created from Older Materials By Addition of Chemicals

TEXTILE chemicals which will now improve the quality, durability, appearance, and comfort features of all fabrics, are described as capable of adding chemical sinews to both natural and synthetic fibers. As a result, rayons, cottons, and woolens of the future will have a variety of virtues they have never had before, with benefaction to the consumer.

This family of textile chemicals includes Resloom, a melamine resin which creates rayon, cotton, and woolen fabrics with marked washable, non-shrink, muss-resistant, and long-life qualities; another resin which makes cotton, wool, and rayon water-repellent; Syton, a colloidal silica, which anchors the threads of nylons and rayons to prevent runs and slippage; a new impregnated thread of unprecedented tensile strength for sewing of linings, preventing seam-splitting; a mildew-resistant agent; an organic amide insuring full protection against moths; a soluble resin developed as a sizing agent; and a synthetic colloid as a sudsless soap detergent. There is also a fire inhibitor nearing perfection but not quite ready for the market, with which textiles can be rendered so nearly flame-proof that a drape or dress treated with it will never be a fire hazard.



Rayon, passing through wrinkle- and shrink-proofing resin solution at the mill

Resloom, one of the chemicals, is a soluble resin and the cloth is immersed in solutions running as high as 20 percent. After the excess moisture has been removed the fabric is subjected to a temperature up to 350 degrees, Fahrenheit, which cures the Resloom deposits into a hard but pliable plastics to which the fibers cling. Because of its toughness, Resloom shrinks very little, hence the fibers which cling to it are also prevented from shrinking.

Another quality which is often described as plastics "memory" causes the Resloom to resume the position it held when cured, no matter how badly wrinkled. Thus, when the flat surface of clothing is creased by sitting or crossing the knees, it later becomes flat again because of this "memory." As explained by the Monsanto Chemical Company, there are additional advantages because rayon containing 10 percent Resloom, for example, is cheaper than an equal weight of untreated fabric since the cost of the resin is less than the cost of the fine yarn it displaces.

PLASTICS "MAGIC" KIT

Interestingly Demonstrates Unusual Properties of New Materials

DESIGNED to occupy the same place in the plastics field that chemical sets do in the chemical field, a new kit of "magic" tricks and experiments, in the form of a large illustrated book, contains quantities of plastics materials necessary to perform various experiments.

Called Plasto-Magic, the set was designed for hobbyists from eight years old up, and for those who want to become familiar with the properties of plastics in common use today. It contains 28 color pages, directions, and a wide variety of solid

plastics mounted on the pages, together with bottles of liquid plastics and accessories held in cushion pockets conveniently placed in the back of the book.

According to the designers, Plastomic Products Company, Inc., the experiments involve bending light around corners; making shining letters with edge lighting; creating three-dimensional scenes; permanently reproducing remembrance pin and ring insignia; making phantom designs; and writing with invisible ink letters that turn to frost. The materials also permit making luminous shade and light pulls, building an unsinkable life raft, and taking advantage of the other peculiar properties of plastics in many novel experiments.

Working materials mounted in the book include polystyrene, polyvinyl alcohol, lucite, polyethylene, neoprene, nylon, acetate, Tenite, vinyl, vinyon, thermosetting plastics, and others. Brief descriptions of each plastics are given, together with instructions for making useful and ornamental personal and household articles.

A list of materials in large quantities is supplied with each set for those who desire to go further into an investigation of the possibilities of plastics.

BUS TRANSPORTATION

Promises Many Comforts On the Highway

MOTOR BUSES of the future will possess, among other attributes: pressurized, air-conditioned passenger compartments; individual radio sets; circulating ice water; retiring rooms; inside destination signs operated by push-button; Polariod windows; turbine-electric drive; and speeds of 100 miles per hour on suitable highways.

This vehicle of the future is pictured by L. H. Smith, engineering vice president of General American Aerocoach Company, as an engineering possibility. He suggests that atomic energy ultimately might be used for propulsion, but for the immediate future directs attention to turbine-electric drive combinations operating on two fluids mixed in transit to comprise a safe and powerful fuel.

He proposes such additional features for tomorrow's motor coach as: power steering, hydraulically operated doors, electric defrosting of windows, individual draft control, public address system, and built-in automatic fire extinguishing system.

Mr. Smith estimates that fares would be on the order of one and one-half cents a mile.

New Products and Processes

SILICONE OIL

Speeds Molding of Mica Electrical Parts

FASTER and improved production of molded mica parts has been reported by the utilization of a silicone oil as a mold release agent. The silicone oil is being used as a lubricant in molding both shellac and Glyptal-bonded mica and it is reported that the application results in a freedom from carbon and other decomposition products which adversely affect the electrical properties of the mica.

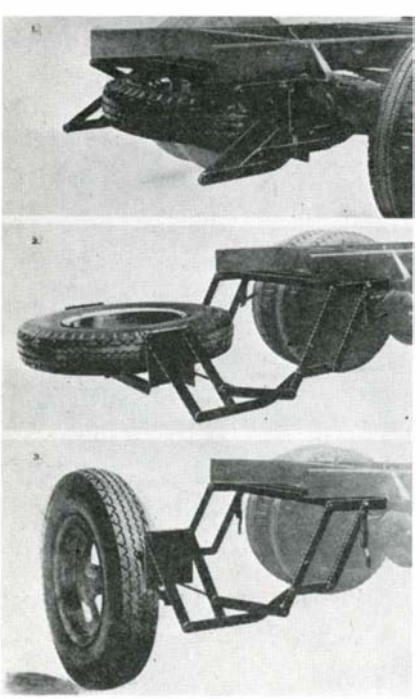
Also, a marked reduction was gained in rejected pieces caused when parts were broken in being removed from the mold. This feature of the silicone oil, plus the fact that its use saves time formerly spent in cleaning gummy decomposition products from the mold, has resulted in greater production, according to General Electric Company.

In addition, the high-temperature stability of silicone oil together with its low surface tension enables the mold operator to apply it readily to all sections of the mold while still heated.

HEAVY TIRES

Easily Handled on Road With Jointed Carrier Rack

CHANGING of heavy truck tires and wheels is said to be reduced to a one man job with a new tire carrier that requires no straining or lifting to remove the spare and replace the flat. Even tilting to upright position for rolling is done without lifting.



Three steps in moving tire from rack show why heavy lifting is unnecessary

To change a tire, the holding clamps are released and the cradle portion of the carrier which holds the tire and wheel is pulled out and away from truck body to a position where the tire is clear and can be tilted upright while it is still attached to the carrier. The tire then rests on the ground and when detached from carrier by removal of the holding clamp, it may be rolled to wheel requiring replacement. Returning the flat to the carrier is essentially a reversal of this procedure.

The device, called the Ted Tire Carrier, is bolted to the chassis frame of truck, trailer, or bus either at the rear or side and is constructed to withstand a load stress equal to four times the load it carries under normal use.

COIN-CHANGER

Supplies Vending Machine Patrons with Nickels

A FULLY automatic coin-changer, which collects five cents for merchandise and makes change for dimes and quarters, promises to be a new convenience for customers of vending machines who find they do not have a nickel handy.

In use, the customer may deposit a dime and get the desired merchandise and a nickel in change or, if a quarter is deposited, the merchandise and four nickels in change are returned. The coin-changer also accepts nickels to deliver merchandise alone.

In addition to its use in machines vending merchandise such as candy, chewing gum, carbonated beverages and milk, it is believed that the coin-changer has possibilities for adaptation to amusement games; bus and train station lockers; streetcar, bus, and subway turnstiles; and token dispensers. The device is manufactured by Bell Aircraft Corporation.

APPLIANCE CORD

Moulded in Elastic Coils of Synthetic Rubber

TO OVERCOME tangling of cords for heating irons and other electrical appliances, a new type of coiled cord has been made available that not only prevents kinks but cuts down repairs. By covering the wire with neoprene, it was possible to mold the spirals without depending on springs or other mechanical devices.

Tough and resilient, the synthetic-rubber coating stretches freely and comes back as the coils are elongated and retracted—the cord will stretch six times its coiled-up length. In compact position, the cord is about a foot long. Lasting service is claimed for the card because neoprene, made by Du Pont, resists abrasion and tearing and will withstand heat if the cord happens to touch the iron momentarily. Other domestic uses are foreseen on toasters, hot plates, portable washers, vacuum cleaners, and room heaters.

The Koiled Kord, as it is called, is manufactured by Kellogg Switchboard and Supply Company.

PORTABLE HEATER

Uses Forced-Air System; Doubles as Cooling Fan

FOR USE in factories, shops, warehouses, and garages, and claimed to be more efficient and economical than the ordinary, convection-type electric portable heater, a new heater operates on the forced-air principle in which the heat is drawn off the circular heating coils by a quiet-operating, four-bladed fan and forced out and down through a horizontal grille. With the heating element switched off, the fan may be operated individually to circulate cooling air in summer.

Does not depend upon air convection

Called the Master Duty Heat Fan, the unit weighs 19½ pounds, and is 19¼ inches high, 14¼ inches wide, and 8⅛ inches deep. It is available with thermostatic control or with rotary-range type, four-position switch. Other specifications include a 230-volt polarity-type plug; four-pole, induction-type motor; available in 3000-, 4000-, or 5000-watts capacity; and a thermostat on each heating unit that automatically breaks the circuit if an object prevents delivery of air to heater. The heater is made by the Thermador Electrical Manufacturing Corporation.

PHOTO DRYER

Is Compact in Size, Fast in Operation

FOR PHOTOSTATS, copy prints, and blueprints, a new dryer is reported to dry as many as 120 photostats per hour.

High-speed print dryer, electrically operated, cannot scorch the prints

The dryer occupies a bench space 18 inches square and is 15 inches high. Its heating system, inside the drum, consumes 300 watts and, as described by Fedco Products Company, is controlled to such an extent that prints cannot be scorched. A newly developed device enables the electric current to reach the heating element without the use of slip-rings. The Drum Dryer operates on 115 volts, either A.C. or D.C.

BRASS CLEANER

Has Long Active Life, No Tarnishing Action

STATED to have high detergent ability and, in addition, having no tarnishing action on active metals including copper, brass, bronze, nickel-silver, tin, and lead, a new alkali brass cleaner can be used as a general plating room cleaner for cleaning of steel and the metals listed. The material's qualities make it suitable for soak or electrolytic cleaning. It can also be used for scrub cleaning because it does not contain strong alkalis.

A feature of the cleaner is long life during operation due to stable surface-active materials and buffered alkali balance.

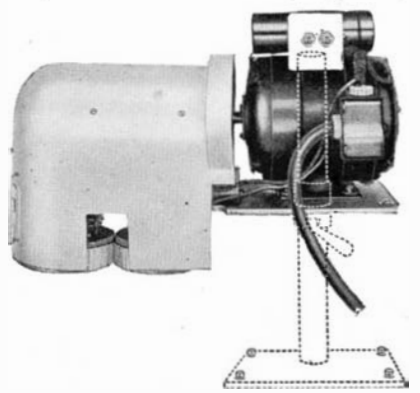
BAG SEALER

Reduces Pulling and Distortion, Handles Many Types of Jobs

A DOUBLE-DRIVE, low-priced, rotary heat sealer for bags, pouches, and so on, is thermostatically controlled to seal a wide range of heat sealing materials, can be operated horizontally, vertically, or at an angle, and can seal any length bag, pouch, or carrier. "Double-Drive"—the driving of both sealing roller shafts, thus eliminating pulling or distortion of the bags as they travel through the sealing rollers—is one of the principal features of the sealer, called Fast-Tite.

According to the manufacturer, Pack-Rite Machines, speed is another feature —up to 300 or more lineal inches per minute, depending on material being sealer, called Fast-Tite.
are used; wiring is directly to the stationary-ring heating units under transite plates covering both sealing rollers. A tension adjustment is provided for pressure on the sealing rollers. Choice of sealing krimps—vertical, horizontal, or checkered—or flat seal is also available.

Intended for long use, the Fast-Tite is described as light weight and compact.



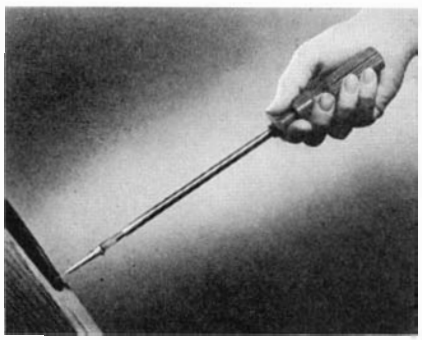
Over 300 lineal inches per minute; both of the roller shafts are driven

WEDGE-ACTION SCREW DRIVER

Grips Screw Slot Firmly, Releases Quickly

LIGHTWEIGHT, practically unbreakable handles of Tenite plastics are used on new screw-holding screw drivers, designed for speedy setting and driving and for use in hard-to-get-at places.

The double blade of this tool is encased in a steel tube which, when pushed forward by means of a plastics push button, separates the blades to hold the screw securely and keep the tool from slipping off as the screw is driven. When the tube is pulled back, the blades come together so that the tool slides out of the screw slot. The pentagonal shape of the molded push button prevents rolling of the tool when it is carelessly set down.



Speeds work in inaccessible places

Called Quick Wedge, the screw drivers have fluted handles, giving a good grip; for work on electric lines, the high dielectric strength of Tenite affords insulation against shock.

LUMINOUS DOTS

Adhere to Any Surface, Glow as Guides in Dark

FINDING a light switch, keyhole, lamp, or alarm clock in the dark may now be simplified by a product that gives off a bright glow in the dark and never fades out. Made with "polonium," a recently discovered material, the devices, called Atomic Dots, contain no radium and can be used safely.

It is pointed out that the dots need not be exposed to frequent light as do

ordinary phosphorescent and "luminous" products, yet retain their continuous glow for hundreds of hours in complete darkness. Atomic Dots are made on an adhesive base that sticks to wood, glass, metal, plastics, or any smooth, non-porous surface; they may be peeled off and placed elsewhere if desired.

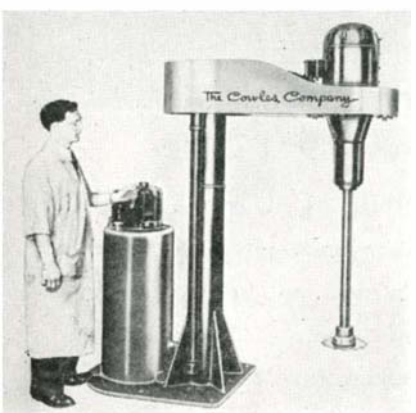
DISSOLVING MACHINE

Handles High Viscosity Materials at High Speed

OPERATING on a high-speed principle that is said to introduce components of laminar flow and inter-face shear, a new dissolver is described as 2 to 20 times faster on standard dissolving and dispersing operations.

The machine exposes broad areas of contact between the solvent and solute, subjecting the particles of the material being treated to molecular tension and scrubbing action, thus increasing dissolving and dispersing speed.

High viscosities are reported to improve the shearing effect, resulting in faster dissolving or more homogeneous mixtures. Anti-friction bearings, low



Features explosion-proof design

maintenance cost, and explosion proofing are other features of the design.

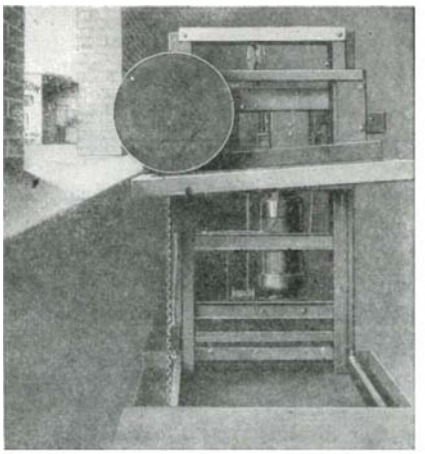
Two types are currently in production. One model has the tank permanently incorporated in the unit with capacities of 100 to 500 gallons. The second model has an elevating head, designed for use with user-furnished portable tanks.

The design of the impeller, size of motor, and tank material are specified for each job by The Cowles Company, manufacturers of the device.

BARREL LOADER

Features Safety, Precision Drive, Automatic Control

A COMBINATION elevating and unloading machine for barrels is said to save considerable time and labor and to have safety features that make accidents almost impossible. A standard motor-hoist unit is used, consisting of herringbone and worm gears, motor, and magnetic brake in one sealed unit with all shafts running in oil on ball and tapered roller bearings. The outboard end of the shaft is carried on self-alining precision ball bearings.



Barrels cannot roll off when lifted

The Revolvator high-speed barrel loader is countersunk in position so that the top of the platform when lowered is flush with the floor. Barrels are rolled on to this platform by hand. The operator then throws a switch and the platform rises to the correct height for unloading where it is tilted so that barrel automatically rolls off on to the upper level. The platform then automatically returns to the lowered position for another loading.

Barrels cannot roll off the inclined platform on the way up because of a raised stop which drops down at the proper height allowing barrel to roll off. The machine can be made portable by equipping the frame with wheels if this is desired. The manufacturer, the Revolvator Company, advises that the elevator design may be adapted for raising various size barrels, drums, or hogsheads to any reasonable height

HIGH-FREQUENCY HEATER

Interchanges Oscillators for Induction or Dielectric Use

A DUAL-PURPOSE single unit, suitable for both induction (metal) and dielectric (non-metal) heating operations, is designed for use in experimental laboratories, testing depots, and development research departments. Called the Ther-Monic M-285C, this combination heating generator is provided with two separate, interchangeable oscillator sections, one for induction and the other for dielectric heating. Changeover from one oscillator section to the other is said to be a simple job.

The unit is a high-frequency generator, operating on 205-245 volts, 60-cycle, single-phase power supply, and having a full-load input of 12 KVA, at 90 percent power factor. Its full-load output is 285 B.T.U. per minute or approximately five kilowatts at nominal frequencies of 375,000 cycles per second for induction heating and 20,000,000 cycles per second for dielectric heating operation. The tube complement comprises two mercury-vapor rectifiers and one water-cooled oscillator.

Developed to meet the need of laboratories for a rapid and dependable source of heat for a wide variety of heating applications, the heater is suitable, when operating as an induction heating unit, for thin case-hardening, heat treating, through hardening for metallurgical processing, brazing, forging, melting, and soft soldering.

When operating as a dielectric-heating unit, it efficiently heats non-conducting materials. Textile processing, wood gluing and laminating, dehydration of foods, pre-heating and polymerizing of plastics, sterilization and de-infestation of packaged foods, rubber curing, and foundry core baking are included in the applications.

Also, petroleum laboratories will find this unit useful in removing water from oil-water emulsions without raising the temperature of the oil excessively. In chemical laboratories, dielectric heating will evaporate liquids, such as drugs, chemical solutions, and fruit juices. Rapid and uniform heat for producing desired chemical reactions can also be provided. Other applications are the treating, drying, and processing of leather, paper, tobacco, drugs, cork, ink, and ceramics.

This Induction Heating Corporation's generator weighs 1400 pounds, is 36 inches wide, 28 inches deep, and 62⅛ inches high.

RE-REFINING

Fits Used Lubricating Oil for Further Use

CAPABLE of restoring used lubricating oil to the quality of new oil, a new oil refiner especially adaptable to Diesel locomotive drainage is said to remove not only solid suspended impurities, but dissolved contaminants, acids, and fuel dilution as well. It is also claimed to impart anti-varnish and anti-ring-sticking qualities to the oil.

According to the Youngstown Miller Company, the manufacturer, many harmful impurities, such as moisture, solvents, asphaltines, and so on do not yield to extraction by ordinary methods of reclaiming. The new unit, however, is said to accomplish this end by contact filtration—simulating the process used in the refining of crude oil.

In this process, the dirty oil is pumped to a heating chamber under automatic float control and adsorbent earth is added in suitable proportion. The two are then thoroughly mixed by means of an agitator and are heated electrically. The removal of volatiles is hastened by the evaporative effects of

Oil reclaimer removes both solid and dissolved impurities by contact filtration in a two-stage process. Controls are automatic thermostats

Editorial purpose of Scientific American is to provide its readers with thought-provoking feature articles and shorter items on all phases of industrial technology. In every case the material is drawn directly from industry itself. The Editor will be glad to refer interest readers to original sources and, when available, to additional literature giving further details of a more specialized nature.

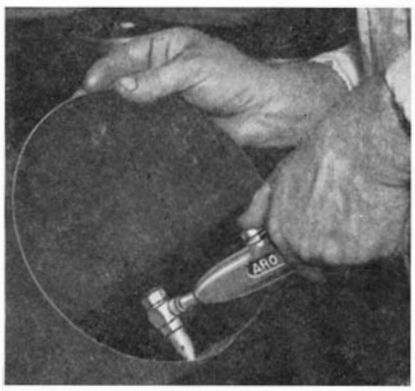
a continuous stream of fresh air which is passed across the oil surface, permitting lower operating temperatures than would otherwise be possible. Heaters are under automatic thermostatic control.

When the unit signals that the proper temperature has been reached, the oil and earth mixture is dropped to a transfer tank from which it is forced into a two-stage filter press by air pressure. Here all solids, including the adsorbent materials, are removed.

DESCALING HAMMER

Is Air-Driven, Also Peens Metal, Sets Rivets

AIR-POWERED, a new peening and scaling hammer is described as filling a long-felt need in the industrial field for a hammer-type tool for removing



5000 blows per minute

scale and rust on welded parts. It can also be used for removing sand on small castings and peening tubular rivets and other small parts.

This Aro Equipment Corporation tool delivers 5000 blows per minute, but is said not to distort light sheet metal when removing scale. Piston and cylinder are of alloy steel, precision ground. Overall length of the hammer head is 2½ inches and the tool is 7 inches in length. Small enough to get in tight places, the tool has a connection between the hammer head and body that can be any desired length. The body of the tool is cast aluminum with an automatic throttle valve.

TRANSPARENT CONDUCTOR

Coats Glass to Carry Electrical Current

A METHOD of eliminating aircraft windshield icing and interior fogging involves the use of a permanent transparent coating for glass that successfully conducts electrical current over the glass panel. Called Nesa, the coating on the glass makes it possible to heat the entire area of the panel uniformly.

Neither distortion of vision through Nesa treated glass nor any material reduction in the intensity of light transmission through the coating is apparent, according to the Pittsburgh Plate Glass Company. In addition to the de-icing and de-fogging characteristics, another advantage of Nesa-treated glass for aircraft windshields is that it actually strengthens them against impact at low atmospheric temperatures. This is because the vinyl-plastic interlayer of laminated plate glass should range from 80 to 120 degrees, Fahrenheit, for the most efficient protection. Thus, when the Nesa-treated glass is subject to low temperatures, the electrical current passing over the glass coating will maintain the plastic interlayer within this range thus increasing its resistance to collision with birds.

Electrical contact to the transparent coating is made by applying metallic bus bars to the edges of the glass area. The treatment can be effected on plate glass, laminated safety glass, and multiple-glazed units designed for both civilian and military aircraft.

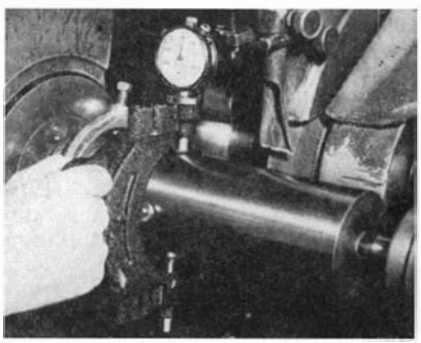
Development of Nesa-treated glass is attributed to the extensive research for a satisfactory glass for use on radar equipment and for covers for various types of electronic instruments and dials. When untreated glass was used for these purposes, static electricity would collect on the surface and cause deflection of the registering mechanisms of the instruments. Hence, a transparent conductive coating was needed to "drain off" the static.

DIAL SNAP GAGE

Adjusts Over Wide Range, Has Carbide Contact Faces

A SINGLE pair of heads and four extension spacers of different lengths cover the unusually long range of four inches with substantial saving in cost on a new dial snap gage.

Using a popular sized indicator, these instruments show highly consistent repeatability, are free from whip and waver of the hand, and are easily set to a master. Both of the gaging pins are surfaced with cemented carbide to reduce wear. The lower, adjustable pin is flat while the upper one, which actuates the indicator, presents a spheri-



Amount of variation read from dial

cal surface. The gage is operated by passing it over the work piece and noting the greatest deflection of the hand as the reading.

Using any extension spacer, the Decimatic Dial Snap Gage, made by Standard Gage Company, is adjustable over a range of one inch. Sets comprising a complete gage and three extra spacers are available and cover either the range of zero to four inches or four to eight inches.

SEAL NUT

Prevents Entrance of Foreign Matter to Equipment

To prevent dirt, water, or gas from entering equipment panels around switch and control shafts, a new mounting and sealing nut has been developed. In use, an elastic sleeve tightly grips the protruding shaft or switch handle. The base of the nut is

Elastic sleeve grips switch handle; rubber ring seals nut to panel face

sealed to the panel by an internal rubber ring which permits metal-to-metal contact between nut and panel to ensure solid mounting.

Applications of the Sealnut include pressurized and moisture-proof equipment, whether operating submerged, at high altitudes, or exposed to the elements. Another use, according to the makers, Radio Frequency Laboratories, is protecting equipment used in the presence of dusts and corrosive fumes. As described, the nut may be substituted for the standard mounting nut on components of equipment now in service without further alterations.

SMALL THERMOSTAT

Carries Heavy Current, Suits Many Applications

A compact thermostat for general application at 120-240 volts a.c. is only 1-9/16 inches in diameter and 1-7/32 inches in depth. The manufacturer claims that this unit, called a Type A Cam-Stat, has many features formerly found only in thermostats of larger proportions. These include a high current carrying capacity without the necessity of a condenser, differentials as low as two degrees, Fahrenheit, a selection of temperature ranges from minus 50 to 350 degrees, Fahrenheit, resistance to vibration, switching arrangements of single-pole, single-throw—break or make on temperature rise—and single-pole, double throw and independent circuit double throw.

It is pointed out that these features make the Type A Cam-Stat suited for such applications as water heaters, furnace fans, furnace limit controls, room thermostats, or wherever the use of a general purpose thermostat is indicated. Ruggedly constructed of aluminum and plastics, it is claimed that the Cam-Stat will give long, trouble-free service.

HARD METAL ROUNDS

Come "As-Extruded" or Centerless Ground

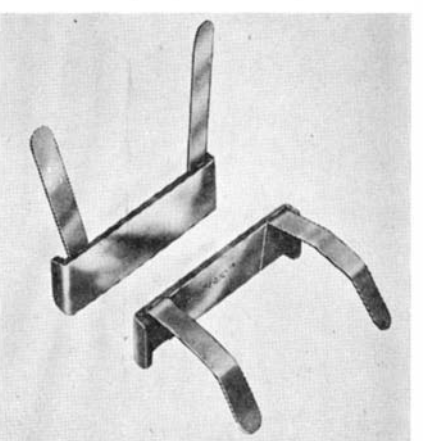
Available in two straight tungsten carbide grades, KE5 and KE7, with a Rockwell hardness of 89.0 and 91.0, respectively, a new line of extruded rounds has been developed primarily for use as wear-resistant elements, and are suitable for such applications as guides, feeding fingers for automatic machines, rollers, guide rails, laps, scribers, points for engraving tools, thread checking wires, and so on.

These extrusions, according to Kennametal Inc., are obtainable either rough extruded or centerless ground, in diameters ranging from 1/32 to ¼-inch in 1/32-inch steps, and in standard lengths in even inches from 1 to 10 inches. Intermediate diameters can be furnished.

VISE CAPS

Produced in Soft Metals and Plastics

Called Softfaces, and made in seven different sizes ranging from three to six inches, a new line of vise-jaw caps protect surfaces with copper, brass, or plastics. The metal caps are made from



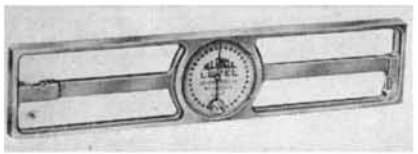
Work held without damage

mill bars which provide smooth, soft surfaces, without hard spots, to grip most classes of finely finished work. Plastics caps are suggested for finely finished, soft-metal surfaces.

DIAL INDICATOR

Provides 360-Degree Range for Spirit Level

Of interest to industries employing carpenters, shipbuilders, construction men, surveyors, inspectors, or jig makers is a new aluminum spirit level with a dial indicator in the center. Known as the All-Angle Level, the heat-treated tool weighs less than one pound, is rustproof, and may be used



Accurate within one-half degree

in any position. The dial indicator—described as accurate to within one half degree—is protected by an unbreakable-type crystal and is calibrated through a 360 degree range for accuracy.

Two air-bubble tubes, one for horizontal use and one for plumb testing, are incorporated, one on each end. A little over 14 inches long, with a width of three inches, the level is manufactured by the Brand Tool Company.

CASTING FLAWS

Detected Before Machining By Air-Water Testing

POSSIBILITIES of oil or water leaks occurring in Ford cylinder blocks or heads are now said to be virtually nonexistent due to adoption of specially-designed air-test equipment. All production cylinder blocks and heads now are thoroughly air-tested; this replaces the costlier and less accurate water-test method formerly employed.

The testing machines simultaneously seal all orifices, pump 300 pounds of air pressure into the block or head, then immerse and rotate the casting slowly for several seconds in a tank of water. The slightest leak reveals a tell-tale bubble.

Rusting is averted by the addition of a rust inhibitor and it is reported that the technique virtually eliminates all defective blocks before extensive and costly machining and build-up operations are accomplished. The new machines are also faster, cycle time being 60 per hour compared with 40 for the water-test machines.

FUSE TOOL

Pulls Safely, Checks Circuit by Neon Light

A TRANSPARENT plastics housing on an electrical tool—a fuse puller at one end and fuse tester at the other—affords insulation against shock and permits handling without the use of bulky gloves. In addition, since the Tenite plastics is low in heat conductivity, the housing remains comfortable to bare hands in heat or cold.

Used safely without protective gloves

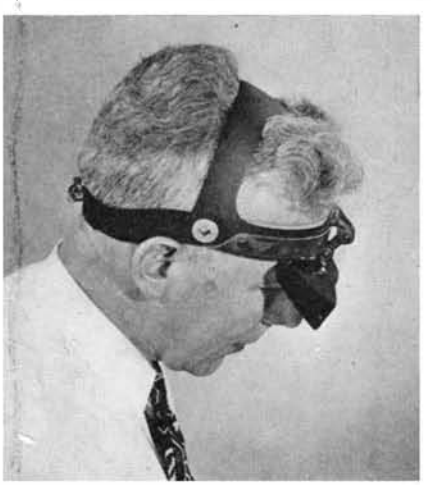
Inside one of the handles of this tool is a small neon light, the glow of which is visible through the plastics when a proper connection is tested.

MAGNIFYING LOUPE

Fits Over Head, Adjusts to Convenient Positions

SUPPLIED with a lens system in either of two powers, a new head loupe supplements portable and stand models of Super Sight loupes. Worn with or without glasses, it is supplied with a bracket permitting the lens system to be set in any position.

The flexibility of the mounting allows the lens holder to be moved in or out, up or down, as an aid in projecting an object in the inspection position. Also, it may be pushed up out of vision when not needed.



Aids both depth perception and vision

It is explained that this feature of a completely adjustable bracket is important to those having occasion to use this type of equipment in industries where depth perception together with good magnification are vital. Both hands are free for work.

The back headband, of fiber formed to fit the lower head, is adjusted by a knurled nut with a right and left-hand thread to provide a floating suspension that can be worn over long periods of time without fatigue. The lens holder also acts as an eye shade. Loupes are available, according to The Boyer Campbell Company, in 1¾ diopeters, 13 inch focal length; and 2½ diopeters, 9 inch focal length.

SUDSLESS SOAP

Does Not Form Curd, Industrial Uses Seen

PRIMARILY developed for use in automatic home-laundry machines, a detergent that does not form suds, will cleanse clothes as easily in hard as in soft water, and will not allow the formation of objectionable curds is now

available under the name Sterox. Overflows resulting from foaming of conventional laundry soaps and powders when excessive amounts were used are said to be eliminated by the sudsless synthetic soap.

Sterox, now being made by Monsanto Chemical Company's Phosphate Division, is termed a non-ionic, or non-curd forming, detergent. Hence, it will not combine with metallic substances found in tapwater to form insoluble curds which normally cause the familiar greasy washtub ring, leave grayish deposits on rinsed clothes, and frequently lead to clogged drains.

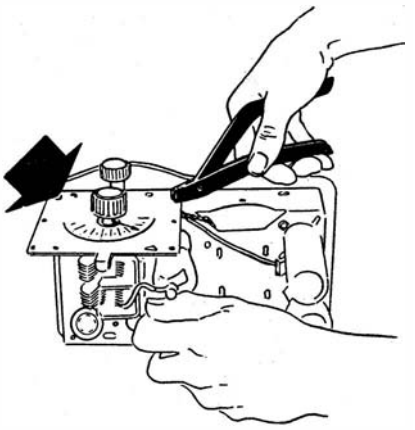
The developers also forecast industrial uses of Sterox in textile, metal cleaning, commercial laundry, and other industries in which quick, thorough, non-injurious cleansing operations are important to production.

HOLLOW RIVETS

For Small Jobs, Set With One-Hand Tool

AN INEXPENSIVE, light-duty, blind rivet "gun" has been added to the Cherry line of blind-riveting tools.

The Junior Riveter, a one-hand, plier-like tool that installs the rivet



Installs hollow "pull-through" rivets

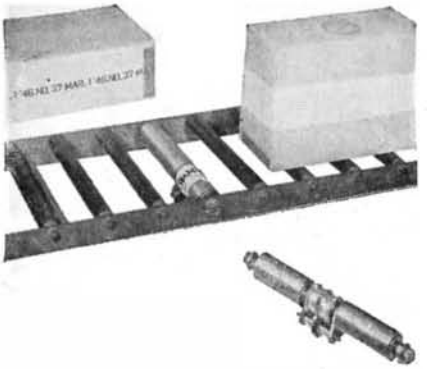
with a simple "pull," is made especially for the many small fastening jobs common to any shop. It installs a new 3/32 inch-diameter blind rivet, provided in three grip lengths. The rivet is the pull-through, hollow type.

CASE MARKER

Fits Roller Conveyor, Inks Type Automatically

A MARKING attachment for placing a continuous impression on the bottom of a case or crate as it travels along on a roller conveyor is now offered as an automatic self-inking assembly. This assembly, known as Rolacoder 50, is installed in a roller conveyor in place of one of the standard rollers. The type cylinder carries a channel or slot into which the interchangeable rubber type is inserted. Inking is by two felt ink rollers in contact with the type.

The device will imprint a code or mark repeating approximately every six inches. Thus, one full imprint, at least, appears on cases as short as six



Rubber type is interchangeable

inches. For cases of length less than six inches, however, the information may be inserted twice in the die wheel. Type sizes may be 3/8 or 5/8 inch, and inks are of the quick-drying, permanent variety.

The Rolacoder 50 is made with two-inch diameter rolls. For those roller conveyors which require smaller diameters, the unit is mounted below the center line of the rest of rollers so that the top surfaces are in line.

VOLTAGE REGULATION

Obtained Without External Equipment on Generators

UTILIZING a novel built-in circuit to keep voltage regulated without attention, a new Regulectric A.C. generator is claimed to provide the answer to voltage variations in small generator installations. One advantage is reported to be the elimination of separate accessory voltage-regulating equipment by a simple, compact, fool-proof method without moving parts. Sensitive to extremely small changes in generator voltage, the regulating circuit maintains normal voltage within 2 percent from no load to full load with normal engine-speed regulation. Operation is based on the series-resonant principle wherein an A. C.-voltage applied across a reactor and capacitor connected in series, achieves a reasonant condition. Intended for use where standby power is desirable, the Regulectric generator is manufactured in 5, 10, and 15 kilowatt sizes.

COILED-COTTON CLOTH

Stretches Like Rubber, Withstands Cleaning

AN ELASTIC fabric without rubber has been developed in which the elasticity is achieved by twisting cotton yarn into the shape of a coil spring. The new fabric is known as Strex and it can be made in various degrees of elongation, with a maximum of 100 percent. It will withstand repeated laundering or dry cleaning according to the makers, United States Rubber Company.

Uses so far developed include slip-covers, gloves, sweaters, and surgical bandages, but it is not intended for use in girdles, corsets, and other foundation garments. It has a lower degree of tension than materials deriving their elasticity from rubber.

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.)

METALLIC SOAPS. This 25-page booklet describes a number of individual soaps having industrial importance, and notes their physical and chemical characteristics. It also reviews some of their outstanding uses and gives hints and suggestions as to further applications. *Mallinckrodt Chemical Works, 72 Gold Street, New York 8, New York.—Gratis.*

DESIGN FOR ARC WELDED STRUCTURES. Produced by the colored cartoon technique, this 15 minute motion picture reviews the development of methods of fastening—from wooden pegs through nails, bolts, and rivets to modern arc welding. It then details, in simplified form, the advantages and possibilities of arc welding. *The Lincoln Electric Company, 12818 Coit Road, Cleveland 1, Ohio.—Available at no charge except for transportation.*

THE PROCEEDINGS OF THE MEXICAN-AMERICAN CONFERENCE ON INDUSTRIAL RESEARCH is a 176-page report that should prove of particular interest and service to research directors, consulting engineers, technical directors, and businessmen and manufacturers whose planning committees are considering means of intensified activity with all of our neighbors south of the border. *Mr. S. Charles Pappageorge, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois.—$2.50.*

THE OBSERVER'S HANDBOOK FOR 1947 contains data on the planets and other astronomical phenomena, month by month; also lists of double and multiple stars, variables, four star maps, an ephemeris of the Sun, and miscellaneous astronomical data. Most amateur astronomers obtain this booklet each year. *Royal Astronomical Society of Canada, 198 College Street, Toronto, Ontario, Canada.—25 cents.*

INDUSTRIAL SAFETY BRAKES. Described in this four-page bulletin are brakes that are said to have as much braking capacity as conventional brakes with but one tenth the operating pressure—thus eliminating the need for self-energizing action. These brakes range from 12 to 20 inches in diameter and are available in either self-contained or built-in types. Request Bulletin Number 460. *Linderman Devices Inc., Newburgh, New York.—Gratis.*

AIR TRANSPORTATION, by Helen R. Blank, is a six-page leaflet which evaluates air transportation as a career; discusses the nature of the work, qualifications, unions, preparation, entrance, advancement, earnings, and number and distribution of workers; and outlines its post-war prospects. With references for

additional reading, this leaflet is of interest to vocational counselors, students, and all air-minded men and women. *Occupational Index, Inc., New York University, New York 3, New York.—25 cents.*

TRANSLATING INVENTIONS INTO MARKETABLE PRODUCTS, by S. Bertrand Barnard, is a four-page reprint outlining this procedure. Emphasis is given to such factors as financing, development, research, production, and marketing. *S. Bertrand Barnard, M.E., 29-28 41st Avenue, Long Island City 1, New York. —Ten cents.*

MYCALEX. Presenting both technical and manufacturing data, this 24-page booklet on mycalex (a stone-like product of mica and special glass) gives its properties, available types, molded parts, fabricated parts, machining practice, and how and where to order the material. *General Electric Company, Chemical Department, Pittsfield, Massachusetts.—Gratis.*

FLUORESCENT SERVICE AND MAINTENANCE MANUAL is an 80-page book containing full details on fluorescent lamp operation and the various problems encountered in the maintenance of fluorescent systems. Written for electrical contractors, wholesalers, lighting engineers, and electricians, the book is pocket-sized for convenience and contains an index, helpful cross reference, and a glossary of fluorescent lighting terms. *Sylvania Electric Products, Inc., Department MA-3, 211 Derby Street, Salem, Massachusetts.—$1.00.*

XACTLINE STRAIGHT LINE TEMPERATURE CONTROL. This four-page bulletin presents a description of a temperature control regulator which gives accurate control at a minimum of cost when used in conjunction with conventional millivoltmeter and potentiometer type pyrometer controllers. *Claud S. Gordon Company, 3000 South Wallace Street, Chicago 16, Illinois.—Gratis.*

A QUICK PICTURE OF THE EATON PERMANENT MOLD PROCESS FOR PRODUCING GRAY IRON CASTINGS. This 17-page booklet traces the story of the permanent mold process from the drawing board to the finished mold. *Eaton Manufacturing Company, Foundry Division, 9771 French Road, Detroit 13, Michigan.—Gratis.*

HARDENING. In this four-page folder is given an outline of hardening practices in Surface Combustion standard rated furnaces. Request Bulletin Number SC-131. *Surface Combustion Corporation, Toledo 1, Ohio.—Gratis.*

THE PERFORMANCE-PROVED PROTECTIVE COATING. This is an 11-page illustrated booklet based on the story of Prufcoat—what it does and how it does it. Case histories and full directions are included for the use of the coating on concrete, structural steel, floors, pipes, tanks, machinery, and other equipment. *Prufcoat Laboratories, Inc., 63 Main Street, Cambridge 42, Massachusetts.—Gratis.*

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.

TO MAKE CERTAIN that books ordered by or for men in the Army, located in the United States, or men in the Navy, Marines, or Coast Guard, located anywhere, will be delivered, insurance fees should be sent with orders, as follows: To $5 in value, 3¢ additional; from $5 to $25, 10¢; from $25 to $50, 15¢.

DAWN OVER ZERO—THE STORY OF THE ATOMIC BOMB

By William L. Laurence

NO ONE has had a better opportunity than Mr. Laurence to learn about atomic energy and the tremendous effort of the world's scientists and American industry which fashioned from it a fantastically destructive weapon. "Dawn over Zero" tells the whole story of atomic energy from the experiments of Fermi, Meitner, and others through the entire span of the development, eleven years, to the utter destruction of the city of Nagasaki by a single bomb. The author also peers into the future of this new marvel and suggests some of the things that may come of it. We are assured that all the story that can be given out is here told. It is an eye witness account, for the author was the official, and only, reporter for the War Department on this entire project. As such, he had an unparalleled opportunity to learn the whole story, to visit all the plants and laboratories engaged in it, and to witness the effects of the explosions at Alamogordo and at Nagasaki. His account is primarily interesting and informative; every thinking American can and should read it for the guidance it will afford his thinking on the pressing problem of controlling atomic weapons for the peace of the world. (290 pages, 6 by 9 inches, illustrated.)—$3.10 postpaid.—*D.H.K.*

THE METALLURGY OF QUALITY STEELS

By Charles M. Parker

THE TECHNOLOGY of steel can be described in words so simple that almost anybody can understand them. If he has even a slight knowledge of chemistry and of industrial practices and of mathematics beyond the arithmetic stage a reader can be given a clear picture of how steels are made, how they are tested, and how they should be selected. Charles M. Parker has proved this by the lucid but economical writing style which he has used in this book, which gives the facts that every engineer and other executive ought to be able to use when selecting steels. Further, it gives the facts behind those facts, and the theories behind all the facts. It is an invaluable book for the engineer. But it can do still more for the purchasing agent and those other executives who so often wonder what the engineer is talking about. The author is Secretary, General Technical Committee, American Iron and Steel Institute. (248 pages, 6 by 9 inches, over 200 illustrations.)—$6.10 postpaid.—*E.L.C.*

Because of increased production costs of books, publishers' retail prices today are subject to constant change. It may be necessary, therefore, for our Book Department to advise book purchasers of increased costs, even when orders sent are based on current quotations.

The Editor

THERE IS NO MYSTERY ABOUT PATENTS

By William R. Ballard

A POTENT antidote against the ever-recurring works of those who use complex-association logic, involved quasi-social arguments, and plain misinformation in attempts to overthrow or emasculate the patent system, this small book achieves its worthy purpose by the weight of simple, understandable, and basic facts presented in a straightforward manner. On the solid foundation that the patent right for a limited time is the fair price paid by the public to an inventor for his efforts and the disclosure of his results for all time, the writer builds a structure of answers to the critics that penetrates cleanly the veil of clouds so often hanging over this much berated and little-understood system. Legal training or cognizance of "law" terms are entirely unnecessary for the reading of this book. An appendix offers the Constitutional and statutory provisions upon which the patent system is based. A second appendix provides a revealing

insight into the reactions of typical "small" business men queried during an investigation of a congressional bill that would have materially altered the present system. This book should be required reading for all legislators. (120 pages, 5 by 6 inches.)—$2.10 postpaid. —*E.F.L.*

FLUORESCENT LIGHTING

By A. D. S. Atkinson

A QUICK VIEW of the whole developing field of fluorescent lighting is given in this book which may roughly be divided into two parts. A discussion of fluorescent lamps and how they operate and a broad view of practical applications, largely to industrial plants and offices, with a few pages devoted to the still relatively small field of domestic lighting. Since this book was originally published in England, and the present volume is a facsimile reproduction, much of the terminology will have to be "translated" into words and phrases in general use in the United States. (144 pages, 5½ by 8½ inches, 67 illustrations.)—$3.60 postpaid.—*A.P.P.*

THE AIRCRAFT MANUFACTURING INDUSTRY—PRESENT AND FUTURE PROSPECTS

By Colonel George Bryant Woods

WRITTEN by a fighter pilot of World War I, who was Chief of Analysis Division, Air Technical Service Command in World War II, and has made the study of aircraft securities his professional career, this book is directed mainly to those interested in aircraft stocks as a medium of investment. But indirectly it provides an accurate, impartial, and far-sighted view of the whole industry—airplane manufacture and transportation, present and future. The discussion of advanced developments in jet propulsion and the helicopter is striking. (119 pages.)—$5.10 postpaid.—*A.K.*

MODERN CHEMISTRY

By A. J. Berry

THE SUB-TITLE, "Some Sketches of its Historical Development," indicates that this book is a history, but unlike most histories of chemistry and the other sciences, it deals only with modern chemistry. No alchemists and no mystics slink through its pages; Paracelsus, Roger Bacon, Albertus Magnus, and even Scheele and Priestley are absent from this history book for the first time in this reviewer's recollection. Even the great Lavoisier appears only once in the copious name index. To replace these ancients appear many of the present generation of builders of chemical theory: Adams, Bancroft, Brickwedde, Debye, von Grosse, Hevesy, Pauling, and many others. The basic idea of the book is to explain modern chemical theory by following its development historically. For convenient treatment, the subject matter is divided into chapters corresponding to the several important fields of current chemical thought: Classical Atomic Theory, Electrochemistry, Stereochem-

istry, Radioactivity, and so on. The author leads the reader through the steps of development in each of these fields to a complete exposition of the modern concepts of the science. The book is beyond the interest of the general reader but will prove invaluable to advanced students of science as well as those scientists whose student days are so far behind them that they are in danger of obsolescence. (240 pages, 5½ by 9 inches, unillustrated.)—$2.60 postpaid.—*D.H.K.*

CIRCUIT ANALYSIS BY LABORATORY METHODS

By Carl E. Skroder and M. Stanley Helm

PRINCIPALLY designed for use by electrical engineering students or practising electrical engineers, this text covers the whole field from circuit protection and rheostats through the fundamental laws of electricity to series circuits, parallel circuits, polyphase circuits, the measurement of reactive volt-amperes, and many others. (288 pages, 6 by 9 inches, well illustrated with drawings.)—$5.45 postpaid.—*A.P.P.*

FINISHING METAL PRODUCTS

By Herbert R. Simonds and Adolph Bregman

A SECOND edition of an earlier text on this subject, this book has been revised to include the metal-finishing methods that have developed with startling rapidity during the past few years. Stress is directed towards the commercial aspects of product finishing from the standpoint of sales, costs, and product function. All processes are treated from a production standpoint and the book offers considerable specific guidance to those faced with selecting finishing methods, materials, and equipment. Greatest emphasis is placed on cleaning and preparing surfaces; polishing and buffing; plating and metal-spray coating; and novelty finishes. Very little material is found on lacquer and enamel finishing. (352 pages, 5½ by 8½ inches, 134 illustrations, index.)—$4.10 postpaid.—*E.F.L.*

CREATIVE CRAFTS IN WOOD

By Michael C. Dank

LIGHT woodworking, largely for decorative purposes, which can be done with a jig or coping saw, is here dealt with in considerable detail. Specific instructions are given for handling the simple tools, and a large number of specific plans are presented for such projects as wall shelves, ornamental boxes, lapel pins, book ends, and many others. Wood-stippling and chipping are also offered for their further decorative possibilities. (200 pages, 7 by 10 inches, 102 illustrations.)—$3.10 postpaid.—*A.P.P.*

AIRCRAFT CARBURETION

By Robert H. Thorner

PRESUPPOSING a basic aircraft-engine knowledge, the author of this volume has handled a difficult and complex subject well and understandably without becoming involved in either mathematical ramblings or cartooning. The theory and principles of aviation carburetors as explained herein are essential knowledge for all pilots, flight engineers, development engineers, and mechanics who aspire to specialization. The usual resume of manufacturer's overhaul instructions has been refreshingly omitted and genuinely valuable material has been provided on the subject of carburetion as related to overall engine control. The subject matter is largely confined (although not in basic principle) to the larger diaphragm-type carburetors common to airline and military equipment. Flight operation, carburetor testing, and instrumentation are thoroughly discussed. (393 pages, 6 by 8½ inches, 188 illustrations, index.)—$3.60 postpaid.—*E.F.L.*

THEORY AND PRACTICE OF FILTRATION

By George D. Dickey and Charles L. Bryden

VIRTUALLY an encyclopedic treatment of the science and art of the vital process of filtration as it is practiced today. Production problems of every kind that can be solved by filtration and the types of equipment, both principal and auxiliary, available for such purposes are described in considerable and satisfactory detail. The treatment is primarily practical and is not encumbered by the kind of detail that one should normally seek from the makers of the equipment in question. The book is one greatly needed in the field. (346 pages, 6 by 9 inches, illustrated.)—$6.10 postpaid.—*D.H.K.*

SUN, MOON AND STARS

By Skilling and Richardson

OF THE several existing textbooks of astronomy many think the "Astronomy" by these authors is the most direct, simple, homespun approach to the science for the average adult. The same authors have now written this book covering, sufficiently for the purpose, the same general ground for youths in their teens, but not so felicitously. One such youth, 16 and not precocious, sensed that its style was condescending (written down). Perhaps best, therefore, for early teens. (274 pages, 6 by 9 inches, 99 illustrations.)—$2.60 postpaid.—*A.G.I.*

STATISTICAL THERMODYNAMICS

By Erwin Schrödinger

THIS little book is made up of a series of lectures given by the author at the School of Theoretical Physics of the Dublin Institute for Advanced Studies. The objective is to supply the advanced student of thermodynamics with a generally unified method of dealing with all phases of the subject and with all types of problems that may arise. The treatment is highly concentrated and presupposes thorough familiarity with both facts and theories of thermodynamics. (88 pages, 5 by 7½ inches.)—$1.60 postpaid.—*D.H.K.*

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"

ZEISS telescopes, large ones, made pre-war, are, or were, to be found in many observatories, not alone in the lands of the late German-Italian-Japanese Axis (now the declination axis) but in many others. None are known to exist in the United States. They have a distinctive appearance shown even in the smaller, tripod size not unknown in this country—white, clean enamel, neat finish, sound mechanics, and in the large instruments a complex mechanism (Figure 1, the 49″ Neubabelsberg, reflector near Berlin).

For this complex appearance a peculiar Zeiss design principle is largely responsible, the unique stress-relieving system. Probably few in this country have had opportunity to see a mounting embodying this system and, now that an amateur has built one (Figure 2), it may be time to add the type to our TN repertoire—it is not patented. An attempt to explain this Zeiss principle will follow the description of the telescope shown.

Dr. K. Hermann-Otavský, 335 Dolní Mokropsy, Praha, Czechoslovakia, writes, "I long ago read 'A.T.M.' and 'A.T.M.A.' with great interest and since the reopening of the national borders I am again following your column in Scientific American. I consider 'A.T.M.' and 'A.T.M.A.' best of all of their kind, especially as friends of astronomy from beginners to first-class experts tell in it their experiences gained by their own work and not merely from literature."

Dr. Hermann-Otavský's telescope is a neat 400-pound semi-portable type mounted on three little roller trucks so that it may be taken indoors. It is towed out by means of a folding stub tongue which steers the front truck, is spotted over hollows in three plates fixed permanently in the roof deck, and three vertical screws in the base are run rapidly down to their adjusted stopnuts with a detachable crank like a carpenter's brace. Two to four minutes suffice to complete these preparations.

The knee-shaped trunk of the mounting is a tube of sheet iron with 1.3 mm walls, reinforced inside at the knee with a welded-in plate. The knob—motor car gear lever—at this point is simply a handle for pushing the telescope. The base and diagonal brace are also of welded iron tubing. Rigidity, high. The mounting was built in a repair garage and at home, partly by the owner.

The 2″ polar axis turns in Timken conical bearings and carries an hour circle of the slip-ring type. The R.A. driving worm is of tool steel and runs in oil on ball bearings and is pressed against the 9″ soft iron driving wheel by a strong spring, eliminating play. The two were ground in with emery paste and they run smoothly. The slow motion controls at the eyepiece end work on a push-pull principle, eliminating play here also. In addition to the slow motions in R.A. and Decl. the transmission shaft of the hour circle has a reversing differential gearing, by means of which it is possible to make infinitesimal corrections with a flexible cable. This has proved simple and convenient, and long-exposure photographs have been successfully taken at the focus of the main tube, using a marginal guide star, although the errors

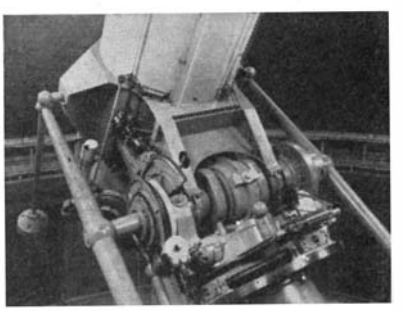


Figure 1: Typical Zeiss mounting

of guiding must not here exceed four seconds of arc.

By means of A.C. transformed to 6 volts all lenses may be mildly warmed. The same voltage lights the circles and so on. The drive is a gramophone electromotor combined with a hand-wound spring motor.

To the main tube two heavy plates are attached, with numerous holes permitting attachment of various instruments, since the mounting permits considerable overloading. When the photograph (Figure 2) was taken the mounting carried (left to right) a Zeiss C refractor 3⅛″ which rates as an RFT; a Zeiss 5⅛″ E refractor (*f*/15) and 2″ finder (hidden); a camera with 3″ Petzval lens; a monocular field glass (hidden). The optics were obtained from Zeiss and from Srb and Stys, Praha.

The main refractor has a Zeiss binocular eyepiece. Two removable achromatic Shapley lenses, the opposite of the Barlow lens, may be used for shortening the main tube focus.

Other auxiliaries include micrometers, a magnification meter, a planetary prism reflex camera with controlling ocular made by the owner, a focal camera with a side-aiming ocular, an accommodation for narrow-film cinematographic camera with mirror reflex control, and a focus-control microscope.

"Literally," Hermann-Otavský says, "there is no declination axis in the usual sense," and then mentions the standard Zeiss mountings described by Chief Engineer Franz Meyer of Carl Zeiss, in "Zeitschrift für Instrumentenkunde," Vol. 50 (1930). With the help of this and an article in "Product Engineering," New York, 1931, July, pages 290-94, and the pre-war Zeiss catalog of astronomical instruments, your scribe has tried to study out the principle of the mysterious Zeiss stress-relieving system.

In conventional mountings, precision—that is, freedom from flexure in all positions—is sought by making the axes stiff. This makes them heavy. This, in turn, increases friction in the drive. So Zeiss claims. More than 40 years ago Engineer Meyer therefore swung to almost the opposite extreme. If you can't entirely eliminate bending—and theoretically you can't—then "let 'er bend" and then neutralize it. This you can do entirely. It calls for some added mechanism.

Figures 3 and 4, from the "Product Engineering" article, exhibit the principle. Each of the two axes consists of an inner part which carries the weight—all of it—and around it *but nowhere touching it* an outer part which maintains the alinement and moves the telescope.

The inner, weight-bearing parts, shown only by theoretical lines in Figure 3, are sizable shafts, not by any means flimsy but not designed to prevent all bending.

The entire weight of the tube, its two pairs of spherical counterweights *H*,*H*, declination axis shaft *D*, and polar axis shaft itself including big weight *K* (below floor level on large telescopes), is delicately balanced on a single ball bearing pivoted horizontally on rockers on ledges in the pedestal (*A*, Figure 4).

Rotating with this weight-carrying polar axis shaft is the assembly consisting of the forked yoke (*F*, Figure 3); its lower straight extension (but not the surrounding casting that clasps the pedestal head) with R.A. worm; also tubular part *Do* (concentric with declination axis shaft); and bridge *S* connecting with and moving the main tube. These parts move as a unit in R.A.

Now, you inquire, you have given us two systems—somewhere they must connect. Yes and no. A light contact—just a kiss—occurs at *O* in Figure 3

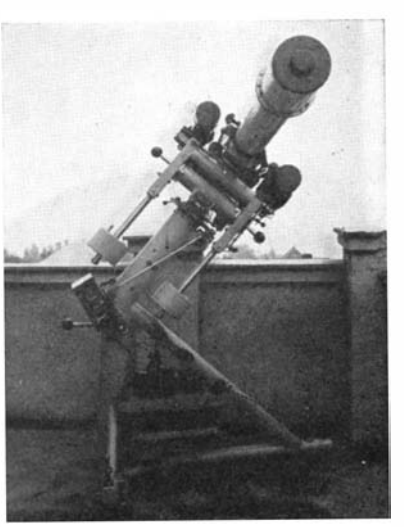
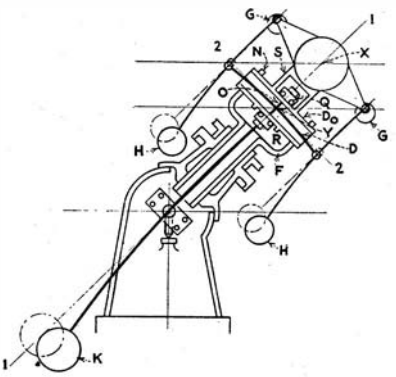


Figure 2: Hermann-Otavsky telescope

where a cross disk is diagrammatically indicated at the middle of the declination axis (is in line with the top of the polar axis). Actually, Figure 5 is that disk and there you see how it works: Bulge *O* on declination axis shaft *Di*; ball bearing *Q*; spherical surface in spherical seat (not lettered); and enough looseness at *R* to prevent cramping when the polar axis shaft bends. Because this ball bearing keeps



Courtesy "Product Engineering"
Figure 3: Weight-carrying system

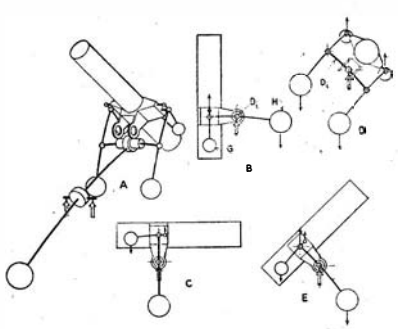
the two systems apart, yet transmits the desired drive, the claim can truthfully be made that the two systems do not touch each other at any point. Let's not quibble over this since, while the actual parts do touch through an intermediary, the *stresses*, which are what matter, don't.

Figure 1 shows an annular space between the hollow tubular element and the weight-bearing declination axis. The same space similarly exists in Figure 2 but does not there show.

Figure 4, *A*, was drawn to show that if the bridge part between the tubular element and telescope tube were purposely to be disengaged, as a demonstration stunt, it and the tube still would stay put wherever put; which shows that this assembly puts no stress on the driving element.

In the same figure, sketches *B,C,D,E* show how the counterweight arms isolate the stresses; there is no hidden composition of forces. It is claimed that freedom from cramping and increased precision are thus obtained.

This, then, is a scientific design. Just why it never made headway in this country your scribe knows not. Perhaps some reader does. Yet the fact that, over several pre-war decades, Zeiss made and sold many like it to large observatories seems to say that it



Courtesy "Product Engineering"
Figure 4: Balancing the weights

must have points. Amateurs desiring to experiment with it may borrow photographs of the Hermann-Otavský telescope, and of other Zeiss telescopes, not here reproduced. They should also study the two elevations in the German article cited above, these being on "Tafel 3" near page 74 (in case a photostat is sought from some library).

In the pre-war Zeiss catalog, today scarce if not rare, is the following summary of the Zeiss stress-relieving system and telescopes.

"The movable parts of the equatorial mounting are divided up into two distinct equatorial components, viz.—

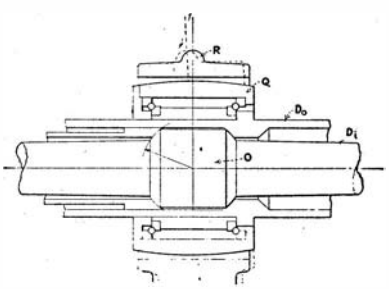
1) an equatorial directing system comprising the optical parts and enabling the telescope to be directed upon astronomical objects in terms of the coordinates (hour angle and declination);

2) an equatorial system of carriers for taking up any stresses in the directing system.

The catalog continues: "The equatorial telescope mountings with stress-relieving system fulfill the following requirements:

1) They obviate flexure in the telescope and in the polar and declination axes, and ensure easy movement of the axes by reason of all stresses being completely relieved in the carrying system.

2) Several telescopes may be assembled side by side on one mounting and any mutual tendency to deformation compensated by the stress relieving system.



Courtesy "Product Engineering"
Figure 5: The stealthy go-between

3) The tubes are freely movable through all ranges of the hour and declination angles without encountering obstruction by any part of the mounting or stand.

4) The tubes are so mounted as to continue the movements of the eye within a very small range, the eye being applied at a point near the intersection of the polar and declination axis.

5) The design affords easy access from the observer's position at the eye end to all attachments."

Close study of Figure 2 reveals that the telescope described does not embody all the standard details of the Zeiss mounting. For example, the counter weight *K* of Figure 3 is absent. This telescope was too small to justify a Chinese copy of the original. But the main feature is embodied; note the two knobs in Figure 2. These correspond to 2,2 of Figure 3 and emerge like wrists through loose cuffs which do not touch them, just as in Figure 1.

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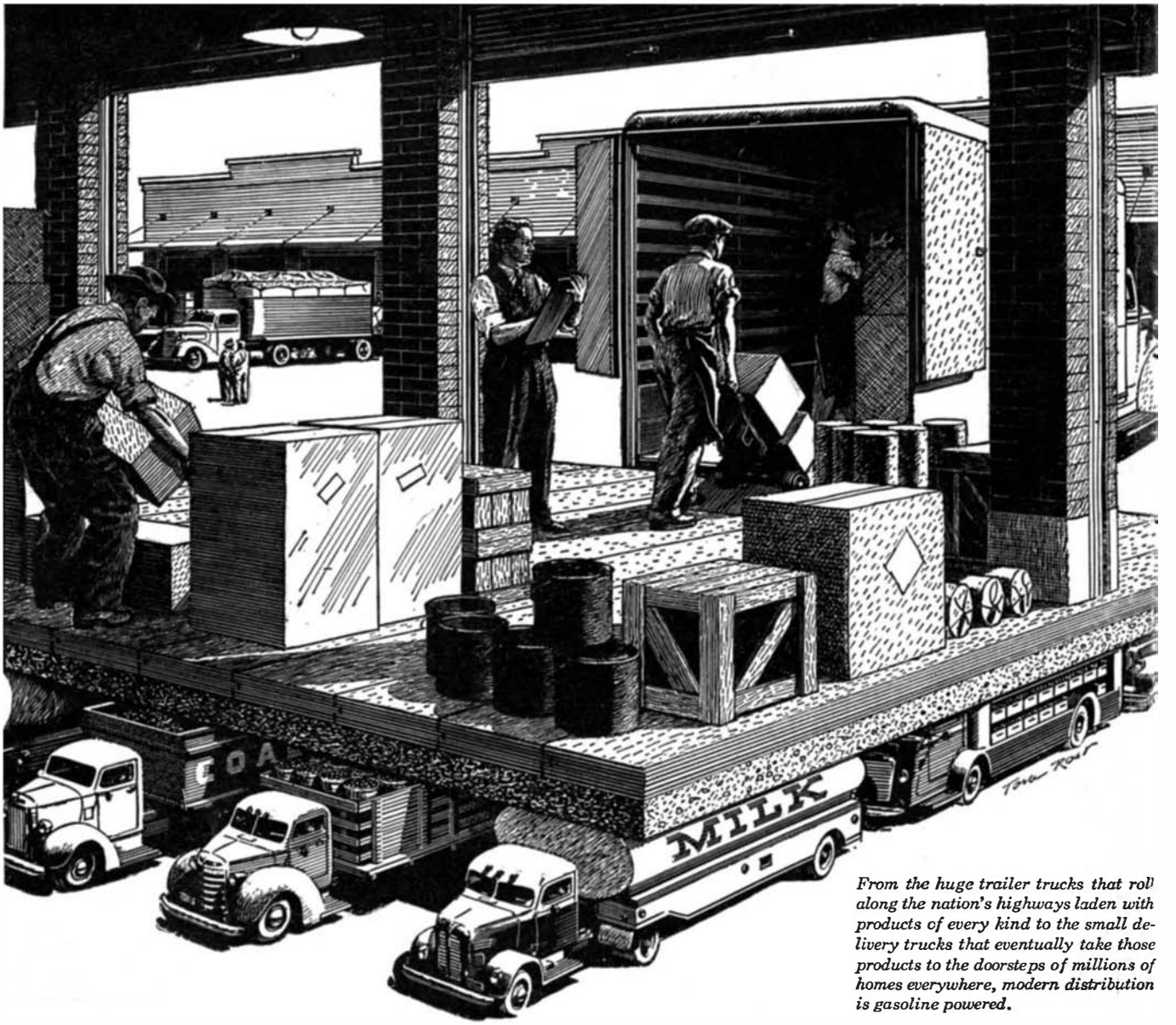

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